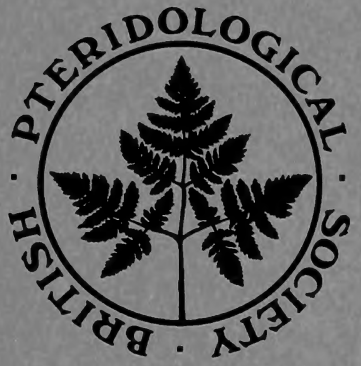

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NEW PTERIDOPHYTE RECORDS FROM GABON, WEST AFRICA, WITH A PRELIMINARY SPECIES LIST FOR HAUT-OGOOUÉ PROVINCE

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Key words: *Cheilanthes,* Gabon, new records, pteridophytes.

ABSTRACT

Seven new pteridophyte species records for Gabon are reported. A preliminary list of pteridophyte species of Haut-Ogooué province is also presented.

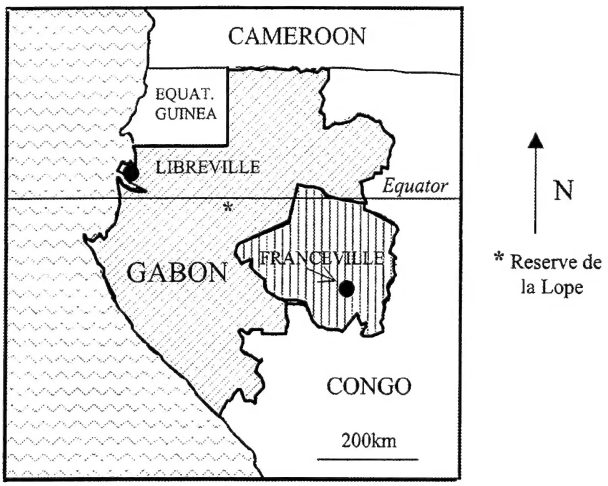
INTRODUCTION

The pteridophytes of central eastern Gabon have received little attention up to the present time. The only flora of Gabonese pteridophytes (Tardieu-Blot, 1964b) contains few references to collecting sites in the eastern portion of the country, and most of the more recent work has been confined to the north-eastern region (Hallé & Le Thomas, 1970; Hladik & Hallé, 1973; Florence & Hladik, 1980) and the centre of the country (Tutin *et al.*, 1994). However, the central eastern region, including Haut-Ogooué province and adjacent parts of Ogooué-Lolo province, has diverse habitats, including some which are absent from the remainder of the country (Caballé, 1983). In addition, recent systematic advances, notably in the genus *Triplophyllum* (Holttum, 1986; Pichi Sermolli, 1991), necessitate a reappraisal of pteridophyte distributions across Africa, a task which has only just begun.

Here I report the results of collecting trips made during a 20 month stay (November 1990-June 1992) at the Centre International de Recherche Médicale (CIRM), Franceville (FCV), the capital of Haut-Ogooué province, Gabon. Six new records and one new species were recorded for Gabon. Two additional species which were recently recorded for the first time in Gabon, from the Réserve de la Lopé in the centre of the country (Moyen-Ogooué Province) (Tutin *et al.*, 1994), were also found in the area covered in the present study.

SITES STUDIED

Floristically, the whole of Gabon lies within the Guinea-Congolian centre of endemism (White, 1983). The vegetation in the central eastern region under study varies from closed canopy moist forest in the north and west to a mosaic of savanna, gallery forest and moist forest in the centre and southwest to large expanses of savannah (the plateaux Batéké) with associated gallery forest in the southeast. Characteristic trees in these forests are members of the Caesalpiniaceae, including Okoumé, *Aucoumea klaineana*, an important economic species, in the western half



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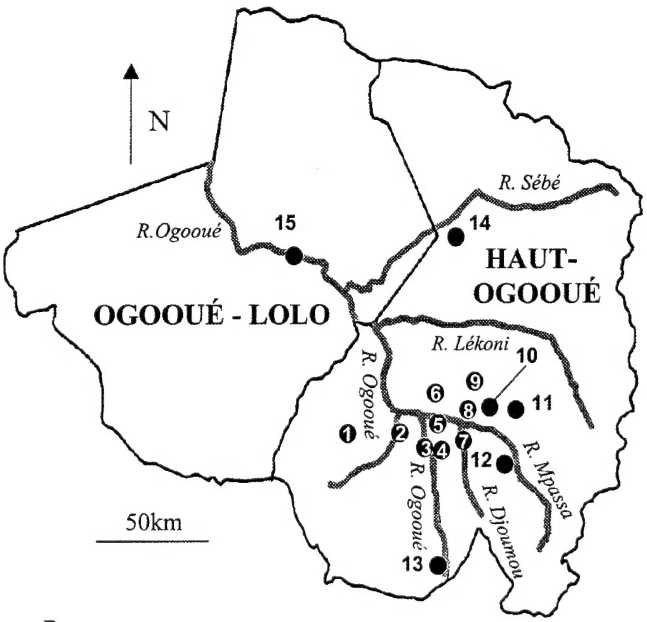

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Map 1a. Map of Gabon. Vertically hatched region is enlarged below.
1b. Collecting sites in Haut-Ogooué and Ogooué-Lolo provinces (Table 1). Franceville is site number 5. Moanda is just north of site 1, and Mounana is 10km SW of site 1.

of this area (Caballé, 1983; Wilks, 1990). In closed canopy forest, the majority of species of pteridophytes were found along watercourses. Microhabitats yielding interesting pteridophytes included waterfalls, rock outcrops and entrances to caves. The taxonomic treatment follows Johns (1991). Voucher specimens have been deposited at Royal Botanic Gardens, Kew (K; *Triplophyllum*, *Tectaria*, *Lastreopsis*) and the Natural History Museum, London (BM; all other genera). Habitat descriptions are followed by the numbers of collecting sites and representative collections made by the author.

Collecting localities are given in Map 1 and Table 1. The altitude of all collecting sites varies from 500m – 700m. All previously published pteridophyte records for Haut-Ogooué province are from Tardieu-Blot (1964b), and these are mentioned in the text.

Information on type specimens from literature has been included; the types have not been examined. Herbarium acronyms follow Holmgren *at al.* (1990).

Table 1. Collecting sites

No.	LOCALITY	PROVINCE	LONG	LAT	HABITAT
1	2 km S of Moanda	Haut-Ogooué	13° 3'E	1° 15'S	Rock outcrop
2	Monts Miyama, 3 km S of Mvengué	Haut-Ogooué	13° 26'E	1° 46'S	Gallery forest
3	Poubara falls 15 km S of Franceville	Haut-Ogooué	13° 33'E	1° 46'S	Gallery forest with waterfalls
4	4 km E of Poubara falls	Haut-Ogooué	13° 35'E	1° 46'S	Gallery forest
5	CIRM, Franceville	Haut-Ogooué	13° 35'E	1° 37'S	Secondary forest
6	6 km NW of Franceville	Haut-Ogooué	13° 34'E	1° 33'S	Secondary forest
7	Djoumou falls, 8 km SE of Franceville	Haut-Ogooué	13° 39'E	1° 42'S	Gallery forest with waterfalls
8	Near Kelle, 15 km E of Franceville	Haut-Ogooué	13° 44'E	1° 37'S	Forest
9	Near Okoumbi, 30 km NE of Franceville	Haut-Ogooué	13°42'E	1° 25'S	Forest

Table 1 continued. Collecting sites.

No.	LOCALITY	PROVINCE	LONG	LAT	HABITAT
11	11 km E of Bongoville	13° 57'E			Rock outcrops in savannah
12	Near Ndoumou, 10 km SE of Bangoué-ville	Haut-Ogooué	13° 51'E	1° 47'S	Gallery forest
13	Near Boumango	Haut-Ogooué	13° 34'E	2° 00'S	Gallery forest
14	Near Okondja	Haut-Ogooué	13° 51'E	1° 47'S	Forest
15	Near Kessipougou, 20 km SE of Lastoursville	Ogooué-Lolo	12° 57'E	0° 41'S	Forest with caves

NEW SPECIES RECORDS FOR GABON

1. **Cheilanthes similis** F.Ballard, Kew Bull. 1957: 47. 1957.

Bare earth on steep exposed slopes underneath cliffs (sites 1; 2: *Mundy 196*; 11). The dimorphic fronds of this species, with sterile fronds appressed to the substrate and erect fertile fronds, are characteristic (Fig. 1). This is the first *Cheilanthes* recorded from Gabon, and represents a northern and western extension of the known range of this species, which has previously been recorded from Congo, Zaire and Zambia (Ballard, 1957).

2. **Pteris commutata** Kuhn in Ascherson *et al.*, Bot. Ost. Afrika 3(3):20. 1879.

Found in two habitats - sloping ground in forest, and rotting tree trunks beneath bamboo (sites 10: *Mundy 331*; 13: *Mundy 306*, respectively). This species shares the simple upper pinnae of some specimens of *P. burtoni* Baker, but differs from the latter in the presence of irregularly anastomosing veins near the margins of the pinnae. Previously described from Sudan, Congo and Uganda (Schelpe, 1969).

3. **Asplenium gemmascens** Alston, Bol. Soc. Brot. ser. 2 30:10. 1956.

Terrestrial in forest (site 13: *Mundy 308, 309*). This species differs from the sympatric *A. hemitomum* Hieron. in the presence of a creeping rhizome, terminal buds on the rachis, and in the more obvious veins. It has previously been recorded from Nigeria, Cameroon, Zaire and Uganda (Tardieu-Blot, 1964a; Johns, 1991).

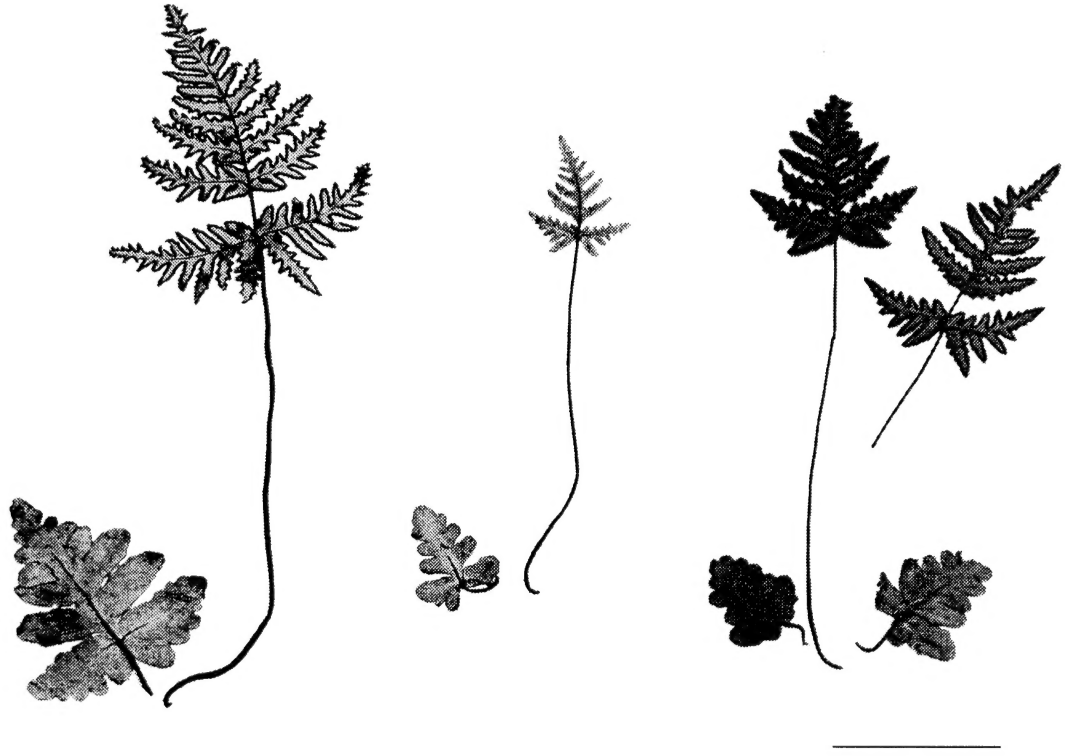

Figure 1. Specimens of *Cheilanthes similis* F.Ballard, showing short-stiped sterile fronds and long-stiped fertile fronds. From left to right, specimens are *Mundy 249, 250* and *196*. Scale bar = 5cm.

4. **A. unilaterale** Lam., Encycl. 2: 305. 1786.

Growing on rocks at the entrance to a cave in forest (site 15: *Mundy 267 - 269*). This species is identified by the combination of a long-creeping rhizome, absence of terminal buds, and the midvein of the pinna following the inferior pinna margin for the proximal 50% of the pinna. Widely recorded from Tropical Africa and Asia (e.g. Tardieu-Blot, 1964a).

5. **Sphaerostephanos arbuscula** (Willd.) Holttum ssp. **africanus** Holttum, J. S. African Bot. 40:164. 1974.
Aspidium arbusculum Willd., Sp. pl. 5:233. 1810.

Terrestrial in forest, associated with *Asplenium emarginatum* P. Beauv. in an unusual microhabitat, where a gentle flow of surface water allowed limited accumulation of organic material over the rocky substrate (site 4: *Mundy 126*). This species is easily separated from the three other members of the *Cyclosorus* group in the area on the basis of the erect rhizome, rounded segments, venation pattern, and the less deeply cut pinnae than *Christella dentata* (Forssk.) Brownsey & Jermy. It has previously been reported from Kenya and Tanzania (Johns, 1991).

6. **Tectaria magnifica** (Bonap.) C.Chr., Dansk Bot. Ark. 7: 21. 1932.
Aspidium magnificum Bonap., Notes Ptérid. 16: 183. 1925.

Terrestrial on banks or on rocks in forest (site 15: *Mundy 270, 271*). Easily distinguished from other members of the genus in Gabon by its large size (laminae up to 100cm long x 60-70cm wide); also, by lack of buds in contrast to *T. fernandensis* (Baker) C.Chr. Previously recorded from Cameroon and Tanzania (Tardieu-Blot, 1964a; Johns, 1991).

7. **Triplophyllum** sp.

The single specimen from the current area was terrestrial on a slope in forest (site 15: *Mundy 278*). This species has frond dissection similar to *T. jenseniae* (C.Chr.) Holttum, but extensive anastomosis of veins, as in *T. buchholzii* (Kuhn) Holttum (Mundy & Edwards, in prep). It was also collected at a single site in Moyen-Ogooué Province (4km from Ndjole on road to Bifoun, 10° 50'E 0° S: *Mundy 356*).

PRELIMINARY SPECIES LIST FOR HAUT-OGOOUÉ PROVINCE

LYCOPODIACEAE

Lycopodiella affinis (Bory) Pic.Serm., Webbia 23: 165. 1968.
Lycopodium affine Bory, Voy. Îles Afrique 2:204. 1804. Holotype: Île Mascareigne, *Bory s.n.* (P).

Found at a single site, an exposed marshy area at the base of a cliff (site 2: *Mundy 193-195*).

L. cernua (L.) Pic.Serm., Webbia 23: 166. 1968.
Lycopodium cernuum L., Sp. pl. 1103. 1753. Lectotype: Linnaean Herb. 1257.13 (LINN).

Abundant in disturbed habitats, especially roadsides (sites 1 - 3, 5 - 8, 11).

SELAGINELLACEAE

Selaginella cathedrifolia Spring, Mém. Acad. Roy. Sci. Belg. 24:112. 1850. Type: Principe, *Curror 3* (K).

Damp areas in forest, often near waterfalls (sites 1; 3: *Mundy 70-72*; 4; 5; 7; 8; 12).

S. molliceps Spring, Mém. Acad. Roy. Sci. Belg. 24:257. 1850. Type: Principe, *Curror s.n.* (K).

Damp areas in forest, often associated with the previous species (sites 1; 3: *Mundy 69*; 5: *Mundy 93*; 7 - 9).

S. myosorus (Sw.) Alston, J. Bot. 72:64. 1932.
Lycopodium myosorus Sw., J. Bot. (Schrader) 1800(2):118. 1801. Type: Sierra Leone, *Afzelius s.n.* (BM).

Common at savannah/forest boundaries and in secondary growth. This species appears to be a good marker for old logging roads, the only place where it was found in closed canopy forest (sites 1; 2; 3: *Mundy 64*; 4-9; 12-14).

S. tenerrima A.Braun ex Kuhn, Filic. afr. 193. 1868. Type: Angola, Golungo Alto, *Welwitsch 45* (?).

Rock crevices (site 2: *Mundy 191,192*).

S. versicolor Spring, Bull. Acad. Brux. 10:143. 1843. Type: French Guinea, Senegambia, *Huedelot s.n.* (?).

Marshy areas, including the splash zone of waterfalls (sites 3: *Mundy 65*; 5: *Mundy 90*).

S. vogelii Spring, Mém. Acad. Roy. Sci. Belg. 24:179. 1850. Type: Fernando Po, *Vogel s.n.* (K).

Streambank in forest (site 8: *Mundy 185, 186*).

MARATTIACEAE

Marattia fraxinea J.Sm. ex J.F.Gmel in L., Syst. nat. ed. 13(bis), 2:1294. 1791. Holotype: Île de France, Herb. Thouin 91, Herb. Smith 16442 (LINN).

Common along forest streambanks (sites 4 – 7; 8: *Mundy 98, 117*; 9).

SCHIZAEACEAE

Lygodium microphyllum (Cav.) R.Br., Prodr. 162. 1810
Ugena microphylla Cav., Icon. 6:76, t. 595 f. 2. 1801. Holotype: Philippines, Luzon, *Nee s.n.* (MA).

Moist areas at savannah/forest boundaries (sites 2: *Mundy 197*; 13).

L. smithianum C.Presl ex Kuhn, Filic. afr. 169. 1868. *sensu* Alston in J. Bot. Suppl. 72:8. 1934. Type: Congo, *C.Smith s.n.* (?).

Common in disturbed habitats (3; 4; 5: *Mundy 11*; 6 – 9; 12).

PARKERIACEAE

Ceratopteris thalictroides (L.) Brongn. var. **cornuta** (Beauv.) Schelpe, Contr. Bolus Herb. 1:46. 1969.

Pteris cornuta Beauv. Fl. Oware 1:63, t.37, f.2. 1809. Type: W. Africa, Oware, 'dans eaux salée, non loin des bords de la mer', *Palisot de Beauvois s.n.* (?).

Marshy area adjacent to a large river (site 13).

ADIANTACEAE

Afropteris repens (C.Chr.) Alston, Bol. Soc. Brot. Ser 2 30: 5. 1956.
Pteris repens C.Chr., Index Filic. 606. 1906. Type: W. Africa, Gaboon River, *Mann 1047* (?K).

Terrestrial on sloping ground in forest (sites 7: *Mundy 36, 37*; 8).

Cheilanthes similis F.Ballard, Kew Bull. 1957: 47. 1957. Type: Zambia, Mwinilunga District, Luakera Falls N of Mwinilunga, *Milne-Redhead 4351* (holo K, iso BM).

See notes under new species records (sites 1; 2: *Mundy 196*; 11).

Pellaea doniana J.Sm. in Hook., Sp. fil. 2:137, t. 125A. 1858. Type: Sao Tomé, *G.Don s.n.* (BM).

Terrestrial on moist rocky ground near a stream (site 4: *Mundy 127*). This species was recently reported for the first time in Gabon at the Réserve de la Lopé (Map 1b) in the centre of the country (Tutin *et al.*, 1994). It is easily distinguished from the two other Gabonese species of *Pellaea*, *P. goudotii* (Kunze) C.Chr. and *P. holstii* (Hieron.), by its large size and broad pinnae, and it is terrestrial whilst the other species are largely confined to rock crevices. It has been reported from widely scattered sites in Africa, e.g. Guinea, Cameroon, Congo, Uganda, Tanzania, Kenya (Tardieu-Blot, 1964a; Johns, 1991).

P. pectiniformis Baker in Hook. & Baker, Syn. fil. ed. 2:147. 1874. Type: Angola, Serra de Oiahoia, *Welwitsch 191* (lecto K, BM, LISU).

Exposed rock crevices and ledges in open habitats (site 11: *Mundy 252, 253*).

Pityrogramma calomelanos (L.) Link var. **calomelanos**, Handbuch 3: 20. 1833.
Acrostichum calomelanos L., Sp. pl. 2:1072. 1753. Type: Tropical America, Herb. Linn. 1245 (LINN).

Disturbed habitats, usually near streams (sites 3 - 5, 7, 8).

Adiantum vogelii Mett. ex Kuhn, Filic. afr. 66. 1868; Keys., in Mém. Acad. Imp. Sci. Saint Pétersbourg ser. 7. 22(2):8, 31. 1875. Type: Fernando Po, *Vogel s.n.* (B, iso K).

Streambanks (sites 5: *Mundy 85*; 13).

VITTARIACEAE

Vittaria guineensis Desv., Bot. Jahrb. Syst. 53:423. 1915. Holotype: Herb. Desvaux (P).

Epiphytic, often on oil palms (sites 3: Mundy 74, 75; 5; 8).

V. owariensis Fée, Mém. foug. 3:21 t. 3 f. 2. 1851-2. Type: W. Africa, 'Oware', *Palisot de Beauvois* in Herb. Willdenow no. 20027/2 (B) and in Herb. Bory (P).

Epiphytic or in rock crevices (sites 5, 11: *Mundy 298, 299*).

PTERIDACEAE

Pteris atrovirens Willd., Sp. pl. 5:385. 1810. Type: W. Africa, 'Oware et Benin', *Flugge s.n.*, in Herb. Willd. no. 19495 (B).

Terrestrial in forest (sites 3, 4, 5: *Mundy 77*).

P. burtoni Baker, Ann. Bot. 5:218. 1891. Holotype: Ghana, *Burton & Cameron s.n.* (K).

Terrestrial in forest . This species is very similar to *P. atrovirens* Willd., and may have been overlooked at other sites (site 5: *Mundy 215*).

P. commutata Kuhn in Ascherson *et al.*, Bot. Ost. Afrika 3(3):20. 1879. Type: Sudan, Niam-niam, *Schweinfurth 3318* (B).

See notes under new species records (sites 10: *Mundy 331*; 13: *Mundy 306*).

P. hamulosa Christ, Ann. Mus. Congo Belge, sér. 5, 3:30. 1909. Syntypes: Congo, Bena Dibele, *Flamigni 61* (P); Congo, Kidiata, *van Tilborg s.n.* (P).

Terrestrial in forest (site 3: *Mundy 327*; 5: *Mundy 350*).

P. mildbreadii Hieron., Bot. Jahrb. Syst. 53:415. 1915. Type: Cameroons, 58 km E of Kribi, *Mildbraed 5986* (B).

Terrestrial in forest (site 9: *Mundy 332*).

P. similis Kuhn in Ascherson *et al.*, Bot. Ost. Afrika 3(3): 21. 1879. Type: ?Sudan, Assika, *Schweinfurth 3311* (BM).

Marshy areas (sites 3; 5: *Mundy 78*; 12; 13).

HYMENOPHYLLACEAE

Cephalomanes crispiforme (Alston) G.Kunkel, Nova Hedwigia 6:215. 1963.
Trichomanes crispiforme Alston in Exell, Cat. Vasc. Pl. S. Tomé 57. 1944. Type: W. Africa, *Barter s.n.* Exped. Niger (K).

Streambank or streamside epiphyte (site 3: *Mundy 73*; 5; 7; 8).

Microgonium ballardianum (Alston) Pic.Serm., Webbia 23:181. 1968
Trichomanes ballardianum Alston, Bol. Soc. Brot. ser. 2 30:26. 1956. Type: Nigeria, *Richards 3438* (BM).

Epiphytic, terrestrial or in rock crevices, always in humid areas (sites 4; 5: *Mundy 81*; 7; 8; 13).

Selenodesmium cupressoides (Desv.) Copel., Philipp. Journ. Sci. 67:81. 1938.
Trichomanes cupressoides Desv., Prodr. 330. 1827. Type: Seychelles, Herb. Desv. (P).

Streambank, sometimes among rocks (sites 3 - 6; 7: *Mundy 45, 46*; 8).

S. guineense (Afzel. ex Sw.) Pic.Serm., Webbia 23: 190. 1968.
Trichomanes guineense Afzel. ex Sw., J. Bot. (Schrader) 1800. 96. 1801. Holotype: Sierra Leone, *Afzelius s.n.* (S-PA).

Streambanks or other damp banks (sites 5: *Mundy 87*; 6; 7: *Mundy 47*; 8; 12; 14).

Trichomanes mannii Hook., Syn. fil. 75. 1867. Type: Fernando Po, *G. Mann s.n.* (?K).

Streamside epiphyte (5: *Mundy 248*).

Vandenboschia africana (Christ) Kunkel, Nova Hedwigia 6:213. 1963.
Trichomanes africanum Christ., J. Bot. 22:21. 1909. Type: Ivory Coast, Malamalasso, *Chevalier 17527* (P).

Streamside epiphyte (sites 4; 7: *Mundy 44*; 12).

GLEICHENIACEAE

Dicranopteris linearis (Burm.f.) Underw., Bull. Torrey Bot. Club 34:250. 1907.
Polypodium linearis, Burm.f., Fl. indica 235. t. 67. f. 2. 1768. Holotype: Java, *Santen s.n.*, Herb. Delessert (G).

Abundant in exposed disturbed areas, often forming large patches on hillsides excluding other vegetation, like other members of the family in the tropics (sites 1 - 9, 13, 14).

POLYPODIACEAE

Drynaria laurentii (Christ) Hieron. in Engl., Veg. Erde 9:57 f. 54. 1908.
Polypodium propinquum Wallich ex Mett. var. *laurentii* Christ ex de Wild & Durand, Ann. Mus. Congo Belge, Bot. ser. 2, 1:70. 1899; ser. 5 1:6, t.2. 1903. Lectotype: Zaire, *Laurent s.n.* (BR).

Forest epiphyte, always seen growing above 10m (sites 4: *Mundy 237*; 8; 9; 13: *Mundy 316*).

Platycerium stemaria (Beauv.) Desv., Prodr. 213. 1827.
Acrostichum stemarium Beauv., Fl. Oware 1:2. t. 2. 1804. Type: Nigeria, *Palisot de Beauvois s.n.*, Herb. Juss. 1008 (P-JUS).

Epiphyte usually growing near water (sites 3, 8, 9, 12).

Microsorum punctatum (L.) Copel., Univ. Calif. Publ. Bot. 16:111. 1929.
Acrostichum punctatum L., Sp. pl. ed. 2. 2: 1524. 1763. Type: China, *Fothergill s.n.* (?, not found in LINN teste Bosman, 1991, Leiden Bot. Series 14:97).

Common epiphyte of streamsides and marshy areas in forest (sites 3 - 5, 7 - 9, 13).

Phymatosorus scolopendria (Burm.f.) Pic.Serm., Webbia 28: 460. 1973.

Polypodium scolopendria Burm.f., Fl. indica 232. 1768. Type: Ceylon, Herb. Hermann (?).

Common epiphyte of streamsides and marshy areas in forest (sites 3; 4; 5: *Mundy 23*; 6 – 9; 12; 13).

Microgramma owariensis (Desv.) Alston, Bol. Soc. Brot. ser. 2. 30:20. 1956.
Polypodium owariense Desv., Mag. Freunde Naturl. 5:314. 1811. Type: *Palisot de Beauvois s.n.* (?).

Common epiphyte of streamsides and marshy areas in forest, frequently associated with the previous two species (sites 3 - 5; 7: *Mundy 43*; 8; 9; 13).

CYATHEACEAE

Alsophila camerooniana (Hook.) R.M.Tryon, Contr. Gray Herb. 200:30. 1970.
Cyathea camerooniana Hook., Syn. fil. 21. 1865. Type: Cameroon Mountains, *G. Mann s.n.* (K).

Common along stream and river banks in forest (sites 3; 4; 6; 7; 8: *Mundy 99*; 9, 12).

A. manniana (Hook.) R.M.Tryon, Contr. Gray Herb. 200:30. 1970
Cyathea manniana Hook., Syn. fil. 21. 1865. Type: Fernando Po and Cameroon Mountains, *G. Mann s.n.* (?K).

Streambanks in forest, less common and less abundant than *A. camerooniana* (Hook.) R. M. Tryon (sites 4, 7, 8: *Mundy 147*).

DENNSTAEDTIACEAE

Microlepia speluncae (L.) T.Moore, Index fil. 93. 1857.
Polypodium speluncae L., Sp. pl. 2:1093. 1753. Lectotype: Herb. Hermann 3:41 (BM).

Marshy areas (sites 4: *Mundy 129*; 8; 9; 13).

Pteridium aquilinum (L.) Kuhn subsp. **aquilinum** in Ascherson *et al.*, Bot. Ost. Afrika 3(3): 11. 1879.
Pteris aquilinum L., Sp. pl. 2: 1075. 1753. Lectotype: Europe, Herb. Clifford 473, Pteris 6 (BM).

Common in moist savannah and savannah/forest edges (sites 1 - 9, 12, 13).

Histiopteris incisa (Thunb.) J.Sm., Hist. fil. 295. 1875.
Pteris incisa Thunb., Prodr. fl. cap. 171. 1800. Holotype: S. Africa, *Thunberg s.n.* (UPS).

Marshy ground in a waterfall splash zone (site 3).

Blotiella currori (Hook.) R.M.Tryon, Contr. Gray Herb. 191:99. 1962.
Pteris currori Hook., Sp. fil. 2: 232 t. 140. 1858. Type: W. Africa, *Curror s.n.* (?K).

Marshy ground in open areas in forest (site 3: *Mundy 291*; 7- 9).

Blotiella cf. **reducta** (C.Chr.) R.M.Tryon, Contr. Gray Herb. 191:100. 1962.
Lonchitis reducta C.Chr., Feddes Repert. 9:370. 1911. Type: French Guinea, *Pobéguin 28*, Herb. R. Bonaparte (?LY, P).

This plant was abundant at the transition between open marshy ground and forest in a waterfall splash zone (site 3: *Mundy 68, 382*). Its taxonomic status is uncertain, as it bears overall similarity to *Blotiella reducta*, but has abundant long hairs on the rachis, stipe and both surfaces of the lamina.

DAVALLIACEAE

Davallia chaerophylloides (Poir.) Steud., Nom. encl. bot. 2:146. 1824.
Trichomanes chaerophylloides Poir. in Lam., Enc. 8:80. 1808. Syntypes: Madagascar, Herb. de Candolle (G), Herb. Thouars (P).

Epiphyte, often on oil palms (sites 3, 8, 9, 13).

NEPHROLEPIDACEAE

Nephrolepis biserrata (Sw.) Schott, Gen. fil. ad t. 3. 1834.
Aspidium biserratum Sw., Schrad. Journ. 1800:32. 1801. Holotype: Mauritius, *Gröndal s.n.* (S).

Abundant in disturbed habitats; terrestrial or epiphytic (sites 1, 3-9, 12, 13).

N. undulata (Afzel. ex Sw.) J.Sm., Bot. Mag. 72, Companion:37. 1846.
Aspidium undulatum, Afzel. ex Sw. J. Bot. (Schrad). 1800(2):32. 1801. Type: Sierra Leone, *Afzel s.n.* (iso BM).

Common in moist savannah (sites 1; 3; 4: *Mundy 130, 131*; 6; 9; 12).

OLEANDRACEAE

Oleandra distenta Kunze, Bot. Zeitung (Berlin) 1851: 347. Types: S. Africa, *Zeyher s.n.* Herb Kunze (holo † LZ), *Zeyher 1869* (BM).

Epiphyte (sites 9; 10: *Mundy 334*; 13: *Mundy 315*). This species was growing over 8m above the ground in the two sites where it was seen, and could easily have been overlooked elsewhere.

ASPLENIACEAE

Asplenium africanum Desv., Mag. Freunde Naturl. 5:322. 1811. Type S. Nigeria, *Palisot de Baeuvois s.n.* (P).

Common epiphyte (sites 3; 4; 5: *Mundy 17, 21*; 7 – 9; 12; 13).

A. dregeanum Kunze, Linnaea 10:517. 1836. Type: S. Africa, *Drège 158* (holo †LZ, lecto BM).

Epiphyte in marshy area (site 13: *Mundy 310, 311, 312*).

A. emarginatum P.Beauv., Fl. Oware 2:6 t. 61. 1807. Type: Île du Prince, *Palisot de Beauvois s.n.* (?).

Terrestrial in forest, near rocks in moist situations (sites 3, 4: Mundy 123, 124). First recorded from Gabon by Florence & Hladik (1970). It is identified by the emarginate pinnae with buds. Widely recorded from Tropical Africa, from Guinea to Tanzania and south to Angola (Tardieu-Blot, 1964a; Johns, 1991).

A. gemmascens Alston, Bol. Soc. Brot. sér. 2. 30:10. 1956. Type: Nigeria, *Savory & Keay FHI 25201* (BM).

See notes under new species records (site 13: *Mundy 308, 309*).

A. hemitomum Hieron., Bot. Jahrb. Syst. 46:365. 1911. Type: Fernando Po, *(Elais), Barter s.n.* Niger Expedition (?K).
A. dimidiatum Sw. in Hook. Sp. fil. 3:157. 1860. p.p., Hook. & Baker, Syn. Fil. 209. 1868. p.p.

Epiphyte or occasionally terrestrial near water courses (site 3: *Mundy* 66; 4; 5; 7; 8).

A. laurentii J.Bommer, Bull. Herb. Boissier 4:663. 1896. Type: W. Africa, Vungo, Bas Congo, Novembre 1893, *Laurent s.n.* (?).

Forest epiphyte (site 8: *Mundy 118*; 13).

A. variabile Hook. var. **variabile**, Sp. fil. 3:93 t. 185. 1860. Type: Fernando Po, *Barter s.n.* Baikie's 2nd Niger Expedition (?K).

Epiphytic or terrestrial in banks in marshy areas in forest (sites 4; 5: *Mundy 21, 82*; 13).

THELYPTERIDACEAE

Christella dentata (Forssk.) Brownsey & Jermy, Brit. Fern Gaz. 10:338. 1973.
Polypodium dentatum Forssk., Fl. aegypt.-arab. 185. 1775. Type: Arabia, *Forsskal s.n.* (C).

Terrestrial in forest (sites 3; 5: Mundy 243; 9; 13).

Cyclosorus striatus (Schumach.) Ching, Bull. Fan Mem. Inst. Biol. Bot. 10:249. 1941.
Aspidium striatum Schumach., Kongel. Danske Vidensk Selsk. Naturvidensk. Math. Afh. ser. 4. 4:230. 1827. Type: Guinea, in damp places at Whyde and Aquapim. ?Thonning (C).

Marshy ground (sites 3; 4; 5: *Mundy 13*; 13).

Pneumatopteris afra (Christ) Holttum, Blumea 21:306, 1973.
Dryopteris afra Christ, Bull. Soc. Bot. Fr. 55. Mém 8b:107. 1908. Lectotype: Congo, Haut-Oubangi, *Chevalier 5799* (P, K).

Marshy ground, in more exposed conditions than *Cyclosorus striatus* (sites 4: *Mundy 128*; 5; 7; 8). Mounana, HO (Tardieu-Blot, 1964b).

Sphaerostephanos arbuscula (Willd.) Holttum ssp. **africanus** Holttum, J. S. African Bot. 40:164. 1974. Type: Kenya, Kwale District, Shimba Hills 300m *Drummond & Hemsley 1203* (K).
Aspidium arbusculum Willd., Sp. pl. 5:233. 1810.

See notes under new species records (site 4: *Mundy 126*).

WOODSIACEAE

Diplazium sammatii (Kuhn) C. Chr., Index Filic. 238. 1905.
Asplenium sammatii Kuhn in Ascherson *et al.*, Bot. Ost. Afrika 3(3): 34. 1879. Types: West Africa, in Wäldern bei Majombe, Loango, *Soyaux 134* (?); Central Africa, im Niam-Niamlande am Chor Diagbe bei Uando's Dorf, *Schweinfurth 3117* (?); am Bach bei Bongua's Dorf, *Schweinfurth 3588* (?); im Lande der Monbuttu am Mbulabache nördlich vom Kibaliflusse, *Schweinfurth s.n.* (?).

Marshy areas in forest (sites 5: *Mundy 3*; 7; 13; 14). Mounana, HO (Tardieu-Blot, 1964b).

D. welwitschii (Hook.) Diels in Engl., Nat. Pflanzenfam. 1:226. 1899.
Asplenium welwitschii Hook., Syn. fil. 235. 1867. Type: Angola, *Welwitsch 100* (?K).

Common along streambanks in forest (sites 4; 7; 8: *Mundy 150 – 152*; 9; 12; 13).

LOMARIOPSIDACEAE

Lomariopsis congoensis Holttum, Kew Bull. 1939:622 f.8-9. 1940. Type: Angola (Cabinda), Mayumbe, R. Lufo, *Grossweiler 8219* (BM).

Forest climber (sites 5; 8; 9; 11: *Mundy 256, 301*; 13). The first Gabonese record for this species from the Réserve de la Lopé was recently published (Tutin *et al.*, 1994). Distinguished from other pinnate species by the characteristic dark, shiny rhizome scales; previously reported from Congo and Angola (Holttum, 1939) and Uganda (Johns 1991).

L. guineensis (Underw.) Alston, J. Bot. 72 (Suppl.):5. 1934.
Stenochlaena guineensis Underw., Bull. Torrey Bot. Club 33:46 f3. 1906. Type: Fernando Po, *Mann 139* (K).

Forest climber (sites 3: *Mundy 324*; 4: *Mundy 238*).

L. palustris (Hook.) Mett. ex Kuhn, Filic. afr. 53. 1868.
Acrostichum palustre Hook., Sp. fil. 5:214. 1864. Lectotype: S. Nigeria, Onitsha, *Barter 1452* (K).

Climber along streamsides and marshy areas (sites 4; 5: *Mundy 28*; 7; 8; 13).

L. rossii Holttum, Kew Bull. 1939:625 f.11-12. 1940. Type: S. Nigeria, *Ross 22* (BM).

Forest climber (site 8: *Mundy 376*).

Bolbitis acrostichoides (Afzel. ex Sw.) Ching, in C.Chr. Index filic. Suppl. 3:47. 1934.
Hemionitis acrostichoides Afzel. ex Sw. J. Bot. (Schrader) 1800:17. 1801. Lectotype: Sierra Leone, *Afzelius s.n. p.p.* (S-PA).

Streamside rocks (sites 3, 4: *Mundy 227, 265*).

Although three species of *Bolbitis*, *B. acrostichoides*, *B. auriculata* (L.) Alston and *B. salicina* (Hook.) Ching, occur in the same general habitat, and they were sometimes found in different streams at the same site, no more than one species was ever found in the same stream.

B. auriculata (Lam.) Alston, J. Bot. 1934. Suppl. 3. 1934.
Acrostichum auriculatum Lam., Enc. 1:36. 1783. Type: Mascerenes, Réunion, *Sonnerat per Thouin s.n.* (iso in Herb. Vahl C, Herb. Swartz S-PA).

Streamside rocks (sites 3; 4: *Mundy 119*; 7; 8: *Mundy 103*).

B. gaboonensis (Hook.) Alston, Kew Bull. 1934. Suppl. 3. 1934.
Acrostichum gaboonensis Hook., Sp. fil. 5:270. 1864. Type: Guinea, *Mann 1049* (K).

Terrestrial in forest (sites 3; 4; 5: *Mundy 86*; 6; 7:*Mundy 42*; 8; 9;12).

B. gemmifera (Hieron.) C.Chr., Index filic. Suppl. 3:48. 1934.
Leptochilus gemmifer Hieron., Bot. Jahrb. Syst. 46:345. 1911. Lectotype: Angola, Cuanza norte, Golungo Alto, *Welwitsch 157b* (B).

Common terrestrial species in forest (sites 3: *Mundy 60*; 4: *Mundy 120*; 7 – 9; 12; 15). First recorded from Gabon by Florence and Hladik (1970). It is easily identified in this area by the pinnate fronds and the presence of buds on the terminal segments of the fronds. Reported from a large area of tropical Africa, from Guinea to Tanzania and south to Angola.

B. heudelotii (Bory ex Fée) Alston, J. Bot. 72 Suppl. 2:3: 1934.
Gymnopteris heudelotii Bory ex Fée, Hist. Acrost. 84, t.45. 1845. Type: Guinea, Fouta-Djallon, ('Senégambie, Foula-Dhiallon'), *Heudelot 805 ('s.n.')* (P, iso B, some sterile and fertile pinnae K, L; teste Hennipman, 1977, Leiden Bot. Series 2:236)

On rocks in streams, usually submerged (site 4: *Mundy 230, 260*).

B. salicina (Hook.) Ching, in C.Chr. Index filic. Suppl. 3:50. 1934.
Acrostichum salicinus Hook., Sp. Fil. 5:265. 1864. Type: Sierra Leone, *Barter s.n.* Niger Expedition (K).

Streamside rocks (site 7: *Mundy 134, 170*).

DRYOPTERIDACEAE

Triplophyllum buchholzii (Kuhn) Holttum, Kew Bull. 41:251. 1986.
Aspidium buchholzii Kuhn in Ascherson *et al.* Bot. Ost Afrika 3(3):47. 1879. Type: Cameroon, Mungo, April 1874, *Bucholz s.n.* (B).

Terrestrial along streambanks (sites 7: *Mundy 133*; 8).

T. gabonense Holttum, Kew Bull. 41:245. 1986. Type: Gabon, Metzic, *C.Jeffrey 71* (holotype K).

Terrestrial on forest banks (sites 3: *Mundy 321*; 5).

T. jenseniae (C.Chr.) Holttum, Kew Bull. 41:253. 1986.
Dryopteris jenseniae C.Chr., Dansk Bot. Ark. 9(3):63. 1937. Type: Zaire, Dibele Terr., by river, *J.M.Jensen 65* (BM).

Terrestrial on banks in marshy areas (sites 4, 5, 13, 14: *Mundy 289,290*).

T. pilosissimum (T.Moore) Holttum, Kew Bull. 41(2):246. 1986.
Lastrea pilosissima T.Moore, Gard. Chron. 1855. 677. 1855. Type: cult. Chelsea Physic Garden in 1853, origin Sierra Leone, *Whitfield* (K).

Terrestrial along streambanks (sites 7; 8: *Mundy 189*; 12). Moanda, HO (Tardieu-Blot, 1964b).

T. protensum (Sw.) Holttum, Kew Bull. 41(2):247. 1986.
Aspidium protensum Afzel. ex Sw., J. Bot. (Schrader) 1800:36. 1801. Type: Sierra Leone, *Afzel s.n.* (S).

Common terrestrial species in almost any situation in forest (sites 3; 5; 6: *Mundy 303*; 7; 9; 12; 13). This taxon was recently split into three (Pichi Sermolli, 1991) viz*: T. heudelotii* Pic.Serm., *T. subquinquefidum* (P. Beauv.) Pic.Serm. and *T.* x *protensum* (Afzel. ex. Sw.) Holttum (pro sp.). Specimens potentially referable to all three of these taxa were found in Haut-Ogooué, but as much more work on these specimens remains to be done, I have chosen to retain the earlier taxonomic arrangement for current purposes.

T. securidiforme (Hook) Holttum, Kew Bull 41(2):242. 1986.
Nephrodium subquinquefidum P.Beauv. var *securidiforme* Hook., Sp. fil. 4:130. 1862. Lectotype: Fernando Po, *Barter 2042* (K).

On rocks in or near streams (site 7: *Mundy 218*).

T. troupinii (Pic.Serm.) Holttum, Kew Bull. 41(2):243. 1986.
Ctenitis troupinii Pic.Serm., Webbia 39:23. 1985. Type: Zaire, near Yangambi, *Pichi Sermolli 5286* (Herb. Pic. Serm.).

Terrestrial along streambanks (sites 4: *Mundy 231*; 8; 12).

T. varians (T.Moore) Holttum, Kew Bull. 41(2):249. 1986.
Dictyopteris varians T.Moore, Gard. Chron. 1863. 1108. Type: cult. Hort. Edinb. 1863, origin Calabar (K).

Terrestrial in forest, not usually closely associated with streams (sites 5; 6; 8: *Mundy 161, 379*; 9; 12).

T. vogelii (Hook.) Holttum, Kew Bull. 41(2):249. 1986.
Aspidium vogelii Hook., Icon. pl. 10:t. 921. 1854. Type: Fernando Po, 'ad rivuli litt. sax.', *Vogel 250*, (K).

Terrestrial in forest (sites 4; 5; 8: *Mundy 187*; 9: *Mundy 338*). Moanda, HO (Tardieu-Blot, 1964b).

Tectaria fernandensis (Baker) C.Chr., Index filic. Suppl. 3:179. 1934.
Polypodium fernandense Baker, Ann. Bot. (König & Sims) 5:462. 1891. Type: Fernando Po, *Henderson s.n.* (?K).

Terrestrial along streambank (site 7: *Mundy 164, 165*). Moanda, HO (Tardieu-Blot, 1964b).

Lastreopsis currori (Mett. ex Kuhn) Tindale ssp. **currori**, Victoria Naturalist 73:184. 1957.
Aspidium currori Mett. ex Kuhn, Filic. afr. 130. 1868. Type: W. Africa, *Curror s.n.*(K holo, B iso).

Terrestrial along streambanks (sites 3, 7).

SALVINIACEAE

Salvinia nymphellula Desv., Prodr. 177. 1827. Type: W. Africa, *Palisot de Beauvois* in Herb. Desvaux (P).

Exposed swamp adjacent to Franceville town centre.

DISCUSSION

The new species records bring the total number of pteridophyte species recorded from Gabon to about 140. The addition of nine of these species within the last six years suggests that much systematic work remains to be accomplished in the country as a whole. Very few pteridophytes had been previously recorded from Haut-Ogooué (Tardieu-Blot, 1964b), and all of these were also found in the present study. The species list presented here for Haut-Ogooué province is still only preliminary as the sites visited are concentrated near Franceville, and more time was spent at sites nearer to Franceville than ones at a greater distance.

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REFERENCES

BALLARD, F. 1957. New african ferns. Kew Bull. 1957: 10.

CABALLÉ, G. 1983. Végétation. In: Géographie et cartographie du Gabon. Edicef, Paris. Pp 34-37.

FLORENCE, J. & HLADIK, A. 1980. Catalogue des phanérogames et des ptéridophytes du N.-E. du Gabon (Sixième liste). Adansonia, ser.2, 20: 235-253.

HALLÉ, N. & LE THOMAS, A. 1970. Quatrième liste de phanérogames et ptéridophytes du nord-est du Gabon (Bassin de l'Ivindo). Biol. Gabon. 6: 131-138.

HLADIK, A. & HALLÉ, N. 1973. Catalogue des phanérogames de N.-E. du Gabon (5e liste). Adansonia, ser.2, 13: 527-544.

HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. (eds) 1990. Index Herbariorum. Part I: The Herbaria of the World. 8th ed. New York Botanical Garden, New York.

HOLTTUM, R.E. 1939 (1940) New species of *Lomariopsis*. Kew Bull. 10: 613-628.

HOLTTUM, R.E. 1986. Studies in the fern-genera allied to *Tectaria* V: *Triplophyllum*, a new genus of Africa and America. Kew Bull. 41: 237-260.

JOHNS, R.J. 1991. Pteridophytes of tropical East Africa. A preliminary check-list of the species. Royal Botanic Gardens, Kew.

PICHI SERMOLLI, R.E.G. 1991. On the taxonomy and nomenclature of some species from tropical Africa of the genus *Triplophyllum* Holttum (Dryopteridaceae). Webbia 45: 117-135.

SCHELPE, E.A.C.L.E. 1969. Reviews of tropical African Pteridophyta 1. Contr. Bolus Herb. 1:1-132.

TARDIEU-BLOT, M.L. 1964a. Ptéridophytes. In: Aubréville, A. (ed.), Flore du Cameroun :3. Muséum National d'Histoire Naturelle, Paris, pp.1-372.

TARDIEU-BLOT, M.L. 1964b. Ptéridophytes. In: Aubréville, A. (ed.), Flore du Gabon : 8. Muséum National d'Histoire Naturelle, Paris, pp.1-128.

TINDALE, M.D. 1965. A monograph of the genus *Lastreopsis* Ching. Contr. New South Wales Natl. Herb. 3:265-310.

TUTIN, C. E. G. , WHITE, L. J. T., WILLIAMSON, E. A., FERNANDEZ, M. & MCPHERSON, G. 1994. List of plant species identified in the northern part of the Lopé Reserve, Gabon. Tropics 3: 249-276.

WHITE, F. 1983. The vegetation of Africa: a descriptive memoir to accompany the UNESCO-AETFAT-UNSO vegetation map of Africa. UNESCO. Paris.

WILKS, C. 1990. La conservation des ecosystèmes forestiers du Gabon. IUCN, Cambridge, UK.

EQUISETUM X *FONT-QUERI* Rothm. (*E. PALUSTRE* L. X *E. TELMATEIA* Ehrh.) (EQUISETACEAE: PTERIDOPHYTA) IN IRELAND

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Key words: *Equisetum* x *font-queri*, Benbulben, Ireland, distribution, Europe

ABSTRACT

Equisetum x *font-queri*, the hybrid between *Equisetum palustre* and *Equisetum telmateia* could be discovered in County Sligo, Ireland. Together with its parents it grows vigorously at three separated localities. This presumably first record for Ireland is not surprising, because up to now this hybrid is known to exist at several stations in the British Isles. Outside Britain *Equisetum* x *font-queri* has been known only from Spain (solely from the type locality) and France. Recently it was discovered in Germany. It is also a member of the North American flora (Canada). The Sligo plants show a remarkable vegetative spreading, which seems to be a general feature of this horsetail hybrid.

INTRODUCTION

During a visit to the Benbulben massif north of Sligo (Co. Sligo, Ireland) in May 1999 three independent populations of *Equisetum* x *font-queri* Rothm., the hybrid between the Marsh Horsetail, *Equisetum palustre* L., and the Great Horsetail, *Equisetum telmateia* Ehrh., were observed.

At one locality, which is by far the most extensive of the three, the hybrid occupies at least 1.5 kilometers of a roadside bank (Horseshoe Road, southeastern part, between Truskmore and Benwiskin, G/746.477 - 737.472). A small population grows also beside Horseshoe Road at its northwestern exit near Benwiskin (G/739.498), and another one was discovered on a road embankment between Horseshoe Road and Moneylahan (G/719.501). At the latter place *E.* x *font-queri* is associated with *E.* x *litorale* Kühlew. ex Rupr., the hybrid between *E. arvense* L. and *E. fluviatile* L.

E. palustre, one of the parent species, is well represented at all of the three localities and *E. telmateia* was found growing along the western part of Horseshoe Road.

Although this is, as far as it is known, the first record of *E.* x *font-queri* for Ireland, the occurrence of this hybrid horsetail in the western part of Europe and here especially near the western atlantic coast is not surprising. After first being recognized as a British plant in the 1960s on the Isle of Skye, Scotland (Page, 1973), several records of *E.* x *font-queri* for Britain followed (Roberts & Page, 1979; Page & Busby, 1985; Page, 1997). This is one of the reasons why Page & Barker (1985) suggested a connection between the high number of hybrid horsetails in the British Isles generally and the highly oceanic climate characterizing this extreme atlantic periphery of Europe (see also Page, 1990). In this sense the discovery of *E.* x *font-queri* in Ireland was to be expected.

EUROPEAN DISTRIBUTION

E. x *font-queri* is probably the second most common hybrid in *Equisetum* subgenus *Equisetum* after *E.* x *litorale* (Page, 1997). Outside the British Isles, it is reported from Spain (type locality, Rothmaler, 1951; Duckett & Page, 1975), France (Hauke, 1966; Duckett & Page, 1975; Badré & Prelli, 1980) and Germany (Lubienski, Jessen, Levermann & Bennert, in prep.). Further European records for Italy and Portugal (Derrick, Jermy & Paul, 1987) do not seem to be authenticated (Page, 1990). In North America *E.* x *font-queri* originates from *E. palustre* and *E. telmateia* subsp. *braunii* (Milde) Hauke. It is reported for British Columbia, Canada (Hauke, 1978, 1993).

DISCUSSION

The presence of the hybrid near the Benbulben massif at three independent localities which are connected by a single road suggests that they have grown vegetatively from perhaps one clone. Breaking of the rhizome to pieces and transport by roadworks could be a possible explanation. The vigour with which *E.* x *font-queri* spreads at the Truskmore habitat seems to be a general feature of this hybrid and is reported from several other localities (Page, 1973; Badré & Prelli, 1980; Roberts & Page, 1979).

Specimens of *E.* x *font-queri* from Benbulben have been deposited at DBN, Eire (Holmgren et al., 1990).

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REFERENCES

BADRÉ, F. & PRELLI, R. 1980. New records of *Asplenium* and *Equisetum* hybrids in France. Fern Gaz. 12:115-117.

DERRICK, L.N., JERMY, A.C. & PAUL, A.M. 1987. Checklist of European Pteridophytes. Sommerfeltia 6:1-94.

DUCKETT, J.G. & PAGE. C.N. 1975. *Equisetum.* In: Stace, C.A. (ed.) Hybridization and the flora of the British Isles, pp. 9-103. Academic Press, London/New York/San Francisco.

HAUKE, R.L. 1966. A systematic study of *Equisetum arvense*. Nova Hedwigia 13:81-109.

HAUKE, R.L. 1978. A taxonomic monograph of *Equisetum* subgenus *Equisetum*. Nova Hedwigia 30:385-455.

HAUKE, R.L. 1993. *Equisetaceae* Michaux ex DeCandolle - Horsetail family. In: Flora of north america editorial committee (ed.) Flora of North America. North of Mexico. Volume 2. Pteridophytes and Gymnosperms, pp. 76-84. Oxford University Press, New York/Oxford.

HOLMGREN, P.K., HOLMGREN, N.H. & BARNETT, L.C. (eds) 1990. Index Herbariorum. Part I: The Herbaria of the World. 8th ed. New York Botanical Garden, New York.

PAGE, C.N. 1973. Two hybrids in *Equisetum* new to the British flora. Watsonia 9: 229-237.

PAGE, C. 1990. Hybrids in the genus *Equisetum* in Europe: an updated annotation. In: Rita, J. (ed.) Taxonomia, Biogeografia y conservacion de Pteridofitos, pp. 151-156. Impresrapit de Mallorca.c/Baron Santa Maria del Sepulcro, Palma de Mallorca.

PAGE, C.N. 1997. The ferns of Britain and Ireland. 2nd ed. Cambridge University Press, Cambridge.

PAGE, C.N. & BARKER, M. 1985. Ecology and geography of hybridization in British and Irish horsetails. Proc. Roy. Soc. Edinburgh, B. 86:265-272.

PAGE, C.N. & BUSBY, A.R. 1985. *Equisetum* x *font-queri* in Shropshire. Pteridologist 1:72.

ROBERTS, R.H. & PAGE, C.N. 1979. A second British record for *Equisetum* x *font-queri*, and its addition to the English flora. Fern Gaz. 12:61-62.

ROTHMALER, W. 1951. Pteridophyten-Studien I. Feddes Repert. 54:55-82.

BOOK REVIEW

THE PLANTFINDER'S GUIDE TO GARDEN FERNS. M.Rickard. 2000. 192pp. David & Charles, Newton Abbot. Price £19.99. ISBN 0 7153 0806 8. Hardback.

For a group of plants enjoying such a horticultural rediscovery and rekindling of interest, the would be fern grower has had precious little in the way of guidance on what is potentially available, what they look like and where they will best grow. Martin Rickard has set out to address this in this the latest of David and Charles' *Plantfinder Guides* to particular garden plants. The book is unequally divided into three sections; an initial introduction to ferns, followed by the bulk of the work – a descriptive A-Z of species and cultivars, rounded off by an account of propagation and plant care. The first section gives a very brief introduction to the history of fern growing and fern hunting before considering ferns and the decorative arts and fern literature. Here we see some of Martin's abiding interests, although I think the inclusion of the decorative arts, while fascinating, has less of a place in a horticultural guide. I also think that a section titled "The Botany and History of Ferns" might have had a little more botany without alienating the casual enthusiast and straying into the scientific ground which the author rightly comments in his introduction is already better served. Admittedly some of this botanical information – such as the lifecycle, is dealt with later under propagation.

Within the first section we then are introduced to "Choosing and Using Ferns" where the author's considerable experience is used to good effect, indeed this whole section could have been longer. I would have liked to have heard more anecdotes of triumphs and failures and to have seen more of the consistently good photographs of ferns in garden settings which can give such inspiration to those coming to these plants anew. Far too many people still equate ferns with moisture and shade only!

Three special cases are then treated: Tree ferns, Desert ferns and Filmy ferns, although it is the first of these, which judging from the numbers currently on sale, will be of most interest and where again Martin's expertise helpfully shines through. Perhaps now a greater proportion will survive as a result! The account of environmental impact and sustainability of the considerable Australian tree-fern harvesting programme currently going on provides a balm for those of us whose conscience is pricked when buying these marvellous plants but I can't help but feel the issue is a little more complex and less rosey than the author would have us believe. I would love to be proved wrong!

The bulk of the book, though, is the descriptive section which aims to give a comprehensive coverage of those species and cultivars which would be hardy at least in some parts of the British Isles – helpfully mapped with the appropriate plant hardiness zones. Many of these are illustrated by a range of beautiful photographs, some of the more helpful presenting different cultivars of the same taxon on ...

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FERN SPORE RAIN COLLECTED AT TWO DIFFERENT HEIGHTS AT MOJI GUAÇU (SÃO PAULO, BRAZIL)

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Key words: *cerrado*, fern spore rain, gallery forest, marsh, pollen rain, Brazil

ABSTRACT

This paper presents an analysis of pteridophyte spore rain collected at two different heights at the Reserva Biológica e Estação Experimental de Moji Guaçu (São Paulo state), Brazil. This is a contribution on the methodology of collecting spores in the spore rain in Brazil dealing with the height at which the collectors should be placed. Spore rain was collected monthly in four localities: open cerrado, cerrado, gallery forest and marsh and at two heights: 0.5 m and 1.5 m above the ground. The study was carried out from April 1995 to July 1996. A total of 40 species of pteridophyte occur in the area but spores of only 16 species were present in the spore rain from the 0.5 m collector and 19 from the 1.5 m collector. Spores of some species were present in both collectors, but some species were specific to one collector only. In all localities and at the two heights the highest percentage of spores was observed in the summer-autumn months (November-April). The two collector heights provide a list for each site which is longer than the lists for each collector individually. From the present results we now know that in future studies of spore rain there is the need to use more than one collector at each site and to combine the results in order to obtain at least a reasonably complete qualitative assessment of the fern spore rain.

INTRODUCTION

The analysis of pollen rain is, in general, concerned with pollen grains and has been used in several regions with very different objectives. In urban areas it is used mainly because of problems relating to allergy and the number and variety of the pollen grains may be high in sites with parks and gardens (Singh & Devi, 1991). In Brazil, because of medical studies about allergy, analyses of pollen rain were carried out in different localities (Oliveira-Lima *et al.* 1945, 1946; Oliveira-Lima & Guimarães, 1958, Salgado-Labouriau, 1973; Barth, 1975; Melhem & Makino, 1978). Fern spore rain was never studied in these investigations and this was the reason for the study carried out by Simabukuro *et al.* (1998a). For all these analyses, the pollen and fern spore grains were collected either in slides covered with gelatin or collectors

containing glycerin placed at different heights according to the site in which the work was carried out.

Ferns can be epiphytes, and tree ferns can be very tall but the majority of pteridophytes are small with spores being produced and released close to the ground. In the investigation by Simabukuro *et al.* (1998a), also at Moji Guaçu, collectors using glycerin were used and they were placed at 1.5 m above ground. The results showed spores of very few pteridophyte species in the spore rain in relation to the number of species occurring in the studied area. In a work carried out in Itirapina, São Paulo state (southeast Brazil), together with studies on the presence of a fern spore bank (Simabukuro *et al.*, 1999), a very preliminary study of spore rain was carried out. At the time there was neither a check list of the pteridophyta species of the area nor a morphological study of the fern spores. The aerial collectors were placed at two different heights, 1.5 m (as in Simabukuro *et al.*, 1998a) and at 0.5 m above ground. This preliminary study showed that the data from these two collectors complemented each other (Simabukuro *et al.*, 1998b).

The objective of the present investigation was to compare the efficiency of collectors filled with glycerin placed at 0.5 m and 1.5 m above soil level when studying pteridophyte spore rain. The height of 1.5 m was selected as it is recommended by Melhem & Makino (1978) whereas the height of 0.5 m was arbitrarily chosen by us as some species are around 50 cm high. The data from this and the earlier study in the same reserve at Moji Guaçu (Simabukuro *et al.*, 1998a) will assist in developing techniques for the use in future studies of spore rain in Brazil.

MATERIAL AND METHODS

Study area

The Reserva Biológica e Estação Experimental de Moji Guaçu (from now on called The Reserve), is located in Moji Guaçu, State of São Paulo, Brazil (22°18'S and 47°11'W). The Reserve (total area of 470,046 ha) includes gallery forest (situated along the Cortado and Fundão streams), marsh (very near these streams), cerrado *sensu stricto* and open cerrado and is surrounded by *Pinus* sp. plantation (Mantovani & Martins, 1993). According to Eiten (1972), the natural cover of about 25% of the land area of Brazil was savannah vegetation given the name of cerrado *sensu lato*; cerrado vegetation is floristically and physiognomically diverse. When the cerrado *sensu lato* presents scattered trees and shrubs to give a canopy cover of less than 2% it is called open cerrado; when presenting a canopy cover less than 50% (but higher than the open cerrado) it is called cerrado *sensu stricto* (in this paper always called cerrado). Much of the cerrado is subject to prolonged and often severe winter drought lasting for up to four months of the year (Eiten, 1972). According to Esteves & Felippe (1985) and Simabukuro *et al.* (1994), forty species of pteridophyte occur in the Reserve (Table 1). The morphology of the spores of the 40 species of pteridophyte of the Reserve has been studied (Esteves & Melhem 1992; Simabukuro *et al.*, 1998a).

Table 1. Pteridophyta collected as sporophytes growing in The Reserve. (From Esteves & Felippe 1985, Simabukuro *et al.* 1994)

species		
Asplenium serra Langsd. & Fisch.	(Aspleniaceae)	g.f.
Blechnum brasiliense Desv.	(Blechnaceae)	g.f.
B. glandulosum Link		g.f.
B. raddianum Rosenst.		g.f.
B.serrulatum Rich.		g.f.
Salpichlaena volubilis (Kaulf.) Hook. *		g.f.
Cyathea delgadii Sternb.**	(Cyatheaceae)	g.f.
C. phalerata Mart.**		g.f.
Lindsaea lancea (L.) Bedd.	(Dennstaedtiaceae)	g.f.
L. quadrangularis Raddi		g.f.
Pteridum aquilinum (L.) Kuhn var. *arachnoideum* (Kaulf.) Kuhn		g.f.
Cyclodium meniscioides (Willd.) C.Presl var. *meniscioides*	(Dryopteridaceae)	g.f.
Dicranopteris flexuosa (Schrad.) Underw.	(Gleicheniaceae)	g.f.
Trichomanes cristatum Kaulf.	(Hymenophyllaceae)	g.f.
T. emarginatum C.Presl		g.f.
Lycopodiella cernua (L.) Pichi-Serm.	(Lycopodiaceae)	m.
Osmunda cinnamomea L.	(Osmundaceae)	g.f.
O. regalis L.		g.f.
Campyloneurum phyllitidis (L.) C.Presl.	(Polypodiaceae)	g.f.
Microgramma squamulosa (Kaulf.) de la Sota ***		g.f., cer.
Pecluma ptilodon (Kuntze) M.G.Price ***		g.f.
Pleopeltis angusta Humb., Bonpl. ex Willd.***		g.f., cer.
Polypodium fraxinifolium Jacq.*		g.f.
Polypodium hirsutissumum Raddi ***		cer., o.cerr.
P. latipes Langsd. & Fisch.		g.f., cer., o.cerr.
P. polypodioides (L.) Watt. var. *minus* (Fée) Weath. ***		g.f., cer.
Adiantum fructuosum Spreng.	(Pteridaceae)	g.f.
A. serratodentatum Willd.		cer.
Doryopteris concolor Langsd. & Fisch.		cer.
Pityrogramma calomelanos (L.) Link		g.f., m.
P. trifoliata (L.) R.M.Tryon		m.
Anemia flexuosa (Sav.) Sw.	(Schizaeaceae)	cer., o.cerr.
A. raddiana Link		cer., o.cerr.
Thelypteris brevisora (H.Ross) Ponce	(Thelypteridaceae)	g.f.
T. dentata (Forssk.) E.P.St.John		g.f.
T. interrupta (Willd.) Barr.		g.f., m.
T. linkiana (C.Presl) R.M.Tryon		g.f.
T. longifolia (Desv.) R.M.Tryon		g.f.
T. rivularioides (Fée) Abbiatti		g.f.
T. serrata (Cav.) Alston		g.f., m.

Notes: * climber; ** arborescent, *** epiphytic species; all the others are terrestrial.
cer.: cerrado; o.cerr.: open cerrado; g.f.: gallery forest; m.: marsh

Spore rain analysis

This study was carried out monthly from April 1995 to July 1996. Aerial collectors filled with glycerin were used rather than slides covered with a layer of gelatin (Potter & Rowley, 1960) because the collectors remained in the field for a whole month and over such long exposures the gelatin loses its adhesion properties; also they are not reliable when exposed to precipitation, especially during the rainy season. The collectors (cylindrical with 9 cm diameter aperture and 2 litres capacity) containing 100 ml glycerin, covered with fine gauze to prevent entry of insects and debris, were placed together at 0.5 m (the 0.5 m collector) and 1.5 m (the 1.5 m collector) from the soil surface. In each case the 0.5 m collector was placed beside (1 m distance) the 1.5 m collector both facing the same direction. Preliminary tests carried out in our laboratory showed that no or very few pollen grains (or spores) remained attached to the gauze. The collectors were attached to the top of different poles and placed in the middle region of four different sites in the Reserve: gallery forest (collectors under the canopy), cerrado (collectors under the canopy), open cerrado and marsh (in the open, not under canopy; no trees were present in the case of the open cerrado). The distance from the ones in the open cerrado to the other sites was about 2 km. The collectors in the other three sites (gallery forest, marsh and cerrado) were located about 500 m from each other. The collectors were not placed very near adult fern plants. In the case of the gallery forest the nearest ferns were trees of *Cyathea delgadii*, some of them located about 2 m from the collectors. In the case of the cerrado and open cerrado, some plants of *Polypodium latipes* were circa 1-2 m from the collectors. No visible epiphyte mature ferns were present in the trees in the vicinity of the collectors. The collectors were removed monthly during the period of the experiment and the amount of liquid in each collector was measured. The temperature and rainfall of the Reserve in the period of the survey can be seen in Simabukuro *et al.* (1998c). The material from each collector was concentrated and treated by acetolysis (Erdtman, 1971). A total of 500 grains (pollen + spores) was always counted. According to Tejero-Diez *et al.* (1988), 500 grains are more than enough for the analysis of plant communities; Hansen & Wright Jr. (1987) use only 200 grains. The number of slides required to be able to reach 500 grains varied from three to fifteen. The spores were identified using the data of Esteves & Melhem (1992) and Simabukuro *et al.* (1998a) and their percentage in each sample was calculated. All the results relating to number of spores are thus presented as percentages and not absolute numbers. Thus a change in value for a certain species from month to month does not necessarily mean a change in the absolute numbers of spores of that species; it could be the result of changes in frequency of other species. This is a limitation of this method but no other available method for quantifying the spores would have been more useful.

RESULTS AND DISCUSSION

It was impossible to distinguish between the spores of some species of pteridophyte in the spore rain because their characteristics are very similar. Species in this study with indistinguishable spores include *Lindsaea lancea/L. quadrangularis, Campyloneurum phyllitidis/Pleopeltis angusta, Thelypteris* (perispore with large folds) and *Thelypteris/Asplenium* (reticulate perispore). This was also true for the study carried out in 1994 in The Reserve by Simabukuro *et al.* (1998a). Some spores

were not included in the descriptions presented in Esteves & Melhem (1992) and Simabukuro *et al.* (1998a) and are here referred to as types 1, 2 and 3 (type 1 is a trilete spore, convex in equatorial view, perispore with spiculae; type 2 is a large trilete spore with a granulate surface; type 3 is a trilete spore with concave sides and surface presenting large tubercles, verrucate). They are from species not collected in the study area at present (see Table 1) but may be from plants growing in the vicinity of the Reserve.

Figure 1 presents the percentage of pteridophyte spores of all species in relation to the total number of grains (500) in the spore rain of the collectors placed at 0.5 m and 1.5 m above soil level for the period April 1995 to July 1996. In relation to the 1.5 m collectors, the highest percentage of spores was found in the collector located in the marsh and the lowest in the cerrado. For the year 1994, Simabukuro *et al.* (1998a), also with the use of 1.5 m collectors, showed the same result for the marsh site but the lowest percentage of spores of pteridophyte was found in the open cerrado. The results for the 0.5 m collectors are similar. More spores were present in the rainy season (November to March), and especially in the Summer months (December-February) in all sites. In the gallery forest and in the marsh, spores were present in all months of the year (spore-releasing sporophytes of some species, for example *Cyathea delgadii*, can be found during the whole year in the gallery forest). In open cerrado and cerrado, spores were almost entirely restricted to the summer months: this is not surprising, as in the winter (dry season) the sporophytes are not present or in a very dry state (depending on the species: for example the sporophytes of *Polypodium latipes*, a very common species in the cerrado, disappear completely). The annual rainfall pattern was the same for all the sites studied (Simabukuro *et al.*, 1998c). The prolonged and often severe winter drought is due to the absence of ground water. There is a positive correlation between the higher percentages of spores of pteridophyte in the summer months and the peaks of precipitation as shown by the amount of water in the collectors during the period of the experiment shown in Figure 2. This indicates that most of the fern spores are brought out of the air by rainwater. The higher temperatures occur also over the same period (Simabukuro *et al.*, 1998c). This was also found during the study conducted in the Reserve in 1994 with 1.5 m collectors (Simabukuro *et al.*, 1998a). In a study carried out in India, the highest concentration of spores caught in collectors occurred in the period of higher humidity (Hanumantha *et al.*, 1991) but a negative correlation between rain and spores and a positive correlation with temperature and spores was found in Portugal (Silva, 1989).

The zero values on Figure 1 represent absence of spores of pteridophytes in these samples; grains (pollen and bryophytes spores) were present in every month of the year. A minimum of three microscope slides had to be examined in order to count a total of 500 grains. In general, more slides were required when spore rain from the open cerrado and cerrado was analysed. From this it can be said that both total grains and spores of pteridophyte were in smaller numbers over the winter months (June - September) for the four sites in 1995 and during the whole year for cerrado and open cerrado.

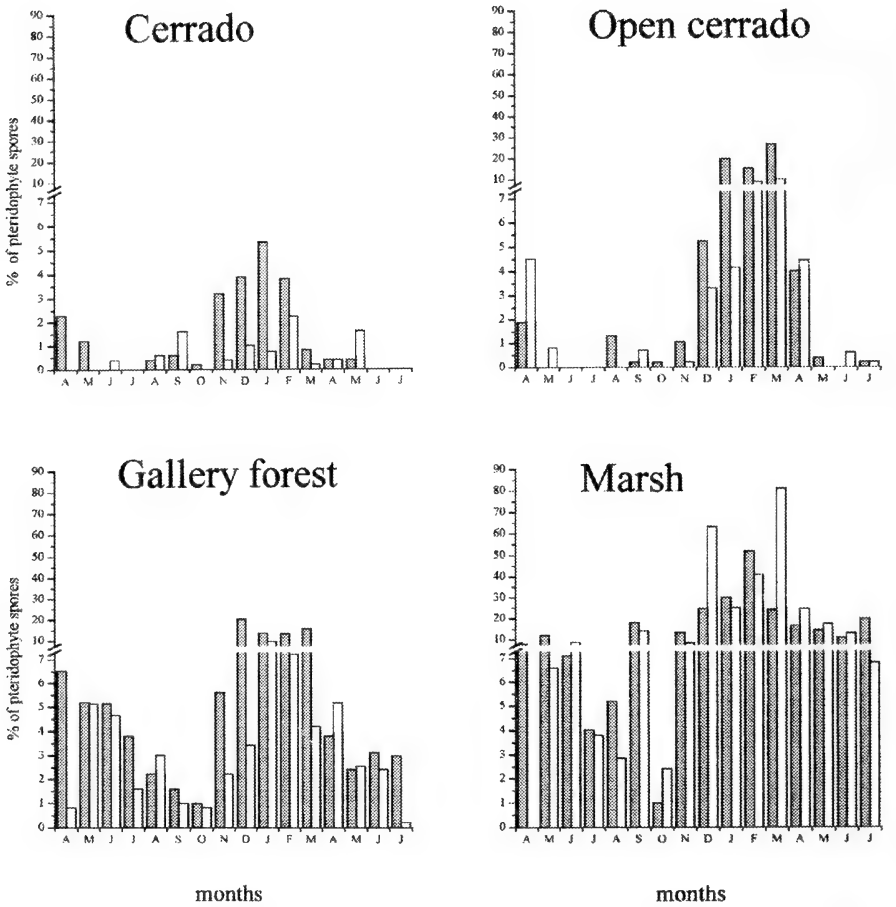

Figure 1. Percentage of spores of pteridophyta in relation to the total number of grains (pollen + spores) in the spore rain of The Reserve, between April 1995 and July 1996. Collector at 1.5 m (white areas) and 0.5 m (grey areas) above soil level.

The final volume of each collector was measured monthly and the results are shown in Figure 2. The final volume represents the effect of additions of precipitation (direct rain or indirect from the canopy) or less by evaporation (in the dry season). The initial volume was 100 ml. In some cases in July and August, the months with less rain, the final volume was similar to the original volume. In general the final volume was very similar in the collectors placed at 0.5 m and at 1.5 m above soil level in the four sites. There were differences sometimes, but they did not follow any pattern and we do not have any explanation to account for this. For example: in the case of the open cerrado site: in May 1995 a total of 110 ml was found in the collector placed at

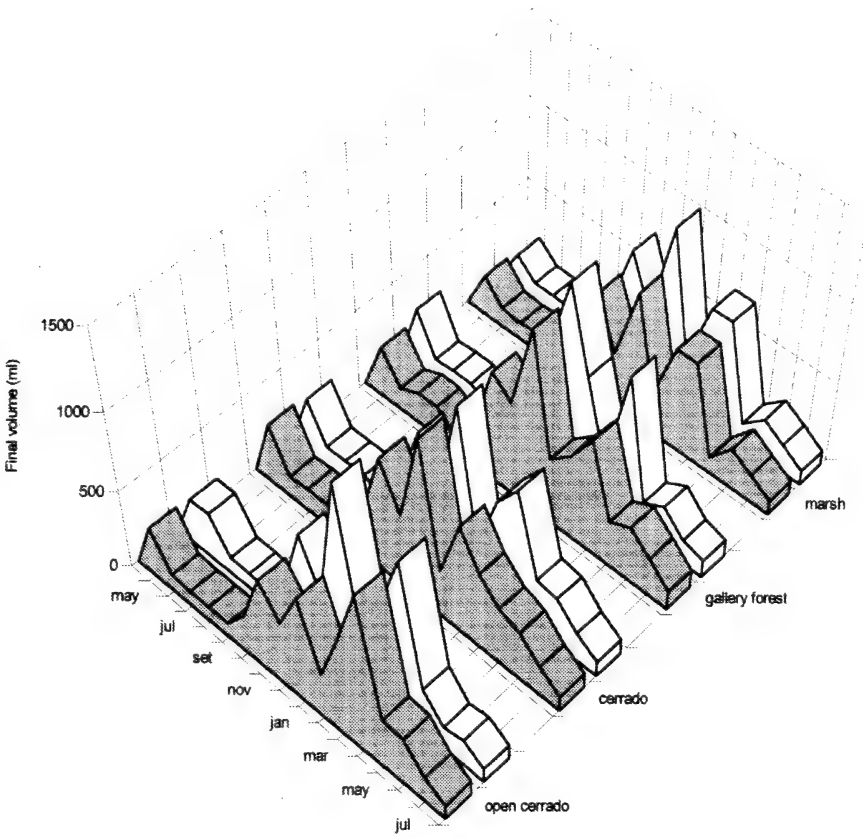

Figure 2. Final volume of water in the collectors placed at 0.5 m (grey areas) and 1.5 m (white areas) above soil level in the open cerrado, cerrado, gallery forest and marsh of The Reserve from April 1995 to July 1996 (initial volume = 100ml).

0.5 m and 305 ml at 1.5 m and in May 1996 a total of 320 ml was found in the collector placed at 0.5 m and 150 ml at 1.5 m above soil level.

The number of species or types of spores of pteridophytes collected at the four sites was higher in the 0.5 m collector in some months and in 1.5 m collectors in others (Figure 3). The diversity of species/types can be seen in Table 2 (compare with Table 1). It can be seen that during the whole period of the experiment 19 species/types were identified in the spore rain from the 1.5 m collectors and 16 when the rain from the 0.5 m collectors was analysed. Tables 3 and 4 show all the species collected in the spore rain. The tables show the distribution of spores over the period of the experiment and in all four sites studied. Most species were present in the spore rain types of collector (compare with Table 1). Some species of pteridophyte that

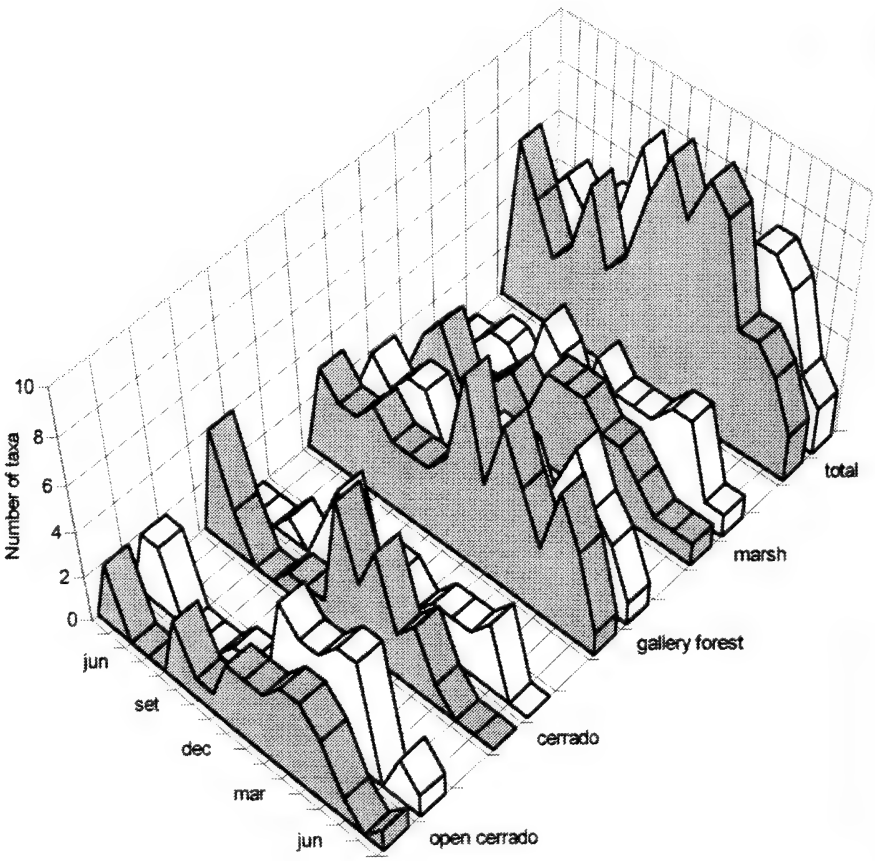

Figure 3. Number of species (or types of spores) per month in the spore rain samples collected at 0.5 m (grey areas) and 1.5 m (white areas) above soil level in the open cerrado, cerrado, gallery forest and marsh of The Reserve, from April 1995 to July 1996.

occur in the Reserve (Esteves & Felippe, 1985; Simabukuro *et al.*, 1994) were present in one type of collector only. Thus the species *Blechnum glandulosum, Lycopodiella cernua, Pityrogramma trifoliata* and species producing type 1 and type 2 were present only in spore rain from the 1.5 m collectors. The species *Osmunda regalis* and *Thelypteris chrisodioides* were present only in the spore rain from the 0.5 m collectors. Of the forty species that were collected in The Reserve (Esteves & Felippe, 1985; Simabukuro *et al.*, 1994) the following species were not found in the spore rain collected in the period studied here: *Adiantum serratodentatum*, *Adiantum fructuosum*, *Anemia flexuosa*, *Anemia raddiana*, *Blechnum raddianum*, *Blechnum serrulatum*, *Dicranopteris flexuosa*, *Doryopteris concolor*, *Microgramma squamulosa*, *Polypodium hirsutissimum*, *Polypodium polypodioides* var. *minus*,

Pteridium aquilinum var. *arachnoideum*, *Salpichlaena volubilis*, *Trichomanes cristatum* and *Trichomanes emarginatum*. These species produced spores during the time of the experiment. The most likely explanation is that in relation to the collectors, these species are outside the range of their spore dispersal i.e. the nearest ferns of the species in question are too far away for recoverable quantities of spores to reach the collectors.

In Table 1 it can be seen that nine species of pteridophyte occurred in the cerrado and open cerrado. Four of these also occur in the gallery forest: *Microgramma squamulosa*, *Pleopeltis angusta, Polypodium latipes* and *Polypodium polypodioides* var. *minus*. Spores of only two of these species were found in the spore rain: *Polypodium latipes* and *Pleopeltis angusta*. *P. latipes* was found from November to April in high percentages in the spore rain from the open cerrado and cerrado when the 0.5 m collector was used and in open cerrado, cerrado and gallery forest from November to January in the 1.5 m collector; the percentage of spores was lower in the 1.5 m than in the 0.5 m collector. *P. latipes,* a very frequent species in the cerrado in The Reserve does not produce spores over the winter season in The Reserve. This species is usually terrestrial and very rarely grows as an epiphyte; thus the higher percentage of spores in the 0.5 m collector is to be expected. *Pleopeltis angusta* is a very frequent epiphyte both in the cerrado and the gallery forest, and spores of the *Campyloneurum/Pleopeltis* type were collected in both types of collectors (higher percentages in the 1.5 m collector in the four sites studied). According to Table 1, *Lycopodiella cernua* was present only in the marsh and *Pityrogramma calomelanos* on the marsh and the gallery forest. Of these two, *Pityrogramma calomelanos* was found in the spore rain in the marsh in April only in the 0.5 m collector and in September only in the 1.5 m collector. *Lycopodiella cernua* was present in the spore rain only in the 1.5 m collector in the cerrado. *Cyathea delgadii*, a tree fern which is very frequent in The Reserve, produced spores throughout the year with a peak in January - March and the spores are present in the spore rain collected every month in both types of collectors. Spores of the climbing fern *Polypodium fraxinifolium* produced spores during two different periods of the year and spores were found in the two types of collector: from July to September (gallery forest and marsh) in the 1.5 m collector and more widely distributed from December to April (found in the four sites studied) in the 0.5 m collector. In view of the complications caused by spore percentages, discrepancies between the two collectors at a site, and absence of information about ferns near the collectors, the most significant feature of the results is the presence in a collector of spores of a species which does not grow in the habitat type in which the collector is sited. This means dispersal of spores over a considerable distance (about 2 km from the open cerrado site to the gallery forest site). *Cyathea delgadii* grows only in gallery forest (Table 1) but spores of this species were present in the spore rain of the four sites (Table 3). In the case of the open cerrado only four species grow (Table 1): *Anemia flexuosa, A. raddiana, Polypodium hirsutissimum* and *P. latipes*, but of these, only spores of *P. latipes* were present in the open cerrado collectors. However it can be

Table 2. Pteridophyte species (or types of spores) detected in spore rain samples collected at 0.5 m and 1.5 m above soil level in the open cerrado, cerrado, gallery forest and marsh of The Reserve, from April 1995 to July 1996. x = present.

Species / type of spores	0.5m			
	open cerrado	cerrado	gallery forest	marsh
Blechnum brasiliense Desv.	x	x	x	
Blechnum glandulosum Link				
Campyloneurum / Pleopeltis	x	x	x	x
Cyathea delgadii Sternb.	x	x	x	x
Cyathea phalerata Mart.		x	x	x
Cyclodium meniscioides (Willd) C.Presl	x			
Lindsaea	x	x	x	x
Lycopodiella cernua (L.) Pichi-Serm.				
Osmunda cinnamomea L.		x		x
Osmunda regalis L.				x
Pecluma ptilodon (Kunze) M.G.Price		x	x	
Pityrogramma calomelanos(L.) Link				x
Pityrogramma trifoliata (L.) R.M.Tryon				
Polypodium fraxinifolium Jacq.	x	x	x	x
Polypodium latipes Langsd. & Fisch.	x	x		
Thelypteris chrisodioides (Fée) Morton	x		x	
Thelypteris	x	x	x	x
Thelypteris / Asplenium	x		x	x
type 1				
type 2				
type 3	x	x	x	

Notes: Type *Campyloneurum / Pleopeltis=Campyloneurum phyllitidis* (L.) C.Presl / *Pleopeltis angusta Humb., Bonpl. ex Willd;* type. *Lindsaea* = *L. lancea* (L.) Bedd. and *L. quadrangularis* Raddi; type *Thelypteris* = perispore with large folds: *Thelypteris dentata* (Forssk.) E.P.St. John, *T. interrupta* (Willd.) Iwats., *T. longifolia* (Desv.) R.M.Tryon., *T. serrata* (Cav.) Alston,; *Thelypteris / Asplenium* = reticulate perispore: *Thelypteris dutrai* (C.Chr. ex Dutra) Ponce, *T. rivularioides* (Fée) Abbiatti, *Asplenium serra* Langsd. & Fisch.; type 1, type 2 and type 3: spores of species not found growing at the Reserve.

Table 2 cont. Pteridophyte species (or types of spores) detected in spore rain samples collected at 0.5 m and 1.5 m above soil level in the open cerrado, cerrado, gallery forest and marsh of The Reserve, from April 1995 to July 1996. x = present.

Species / type of spores	1.5m			
	Open Cerrado	cerrado	gallery forest	marsh
Blechnum brasiliense Desv.	x	x	x	x
Blechnum glandulosum Link	x			
Campyloneurum / Pleopeltis	x	x	x	x
Cyathea delgadii Sternb.	x	x	x	x
Cyathea phalerata Mart.		x	x	x
Cyclodium meniscioides (Willd.) C.Presl	x	x	x	
Lindsaea		x	x	
Lycopodiella cernua (L.) Pichi-Serm.		x		
Osmunda cinnamomea L.				x
Osmunda regalis L.				
Pecluma ptilodon (Kunze) M.G.Price	x		x	
Pityrogramma calomelanos(L.) Link				x
Pityrogramma trifoliata (L.) R.M.Tryon	x			
Polypodium fraxinifolium Jacq.			x	x
Polypodium latipes Langsd. & Fisch.	x	x	x	
Thelypteris chrisodioides (Fée) Morton				
Thelypteris	x	x	x	x
Thelypteris / Asplenium	x		x	x
type 1	x			
type 2				X
type 3	x			

Notes: Type *Campyloneurum / Pleopeltis* = *Campyloneurum phyllitidis* (L.) C.Presl / *Pleopeltis angusta* Humb., Bonpl. ex Willd; type. *Lindsaea* = *L. lancea* (L.) Bedd. and *L. quadrangularis* Raddi; type *Thelypteris* = perispore with large folds: *Thelypteris dentata* (Forssk.) E.P.St. John, *T. interrupta* (Willd.) Iwats., *T. longifolia* (Desv.) R.M.Tryon., *T. serrata* (Cav.) Alston,; *Thelypteris / Asplenium* = reticulate perispore: *Thelypteris dutrai* (C.Chr. ex Dutra) Ponce, *T. rivularioides* (Fée) Abbiatti, *Asplenium serra* Langsd. & Fisch.; type 1, type 2 and type 3: spores of species not found growing at the Reserve.

Table 3. Percentage of spores of each species in relation to the total number of pteridophyte spores per month in the spore rain in the collectors placed at 1.5 m above soil level in the open cerrado (o.c.), cerrado (ce.), gallery forest (g.f.) and marsh (m.) of The Reserve, from April 1995 to July 1996.

Species	site	1995								
		A	M	J	J	A	S	O	N	D
B. brasiliense	o.c.		25.0							
	ce.						12.5			
	g.f.		7.7				20.5			12.5
	m.									1.4
B. glandulosum	o.c	28.6								
Camp/Pl	o.c.									
	ce.									
	g.f.	33.3		11.1	12.5	6.7		25.0	27.3	
	m.									
C. delgadii	o.c.	42.9	25.0							6.2
	ce.					66.7	62.5			60.0
	g.f.	66.7	61.5	77.8	25.0	80.0	80.0		54.5	62.5
	m.	100.0	100.0	97.7	89.5	100.0	48.6	58.3	97.6	63.2
C. phalerata	ce.									
	g.f.				25.0	6. 7		75.0	27.3	
	m.						48.6	41. 7		31.9
C. meniscioides	o.c.		50.0							
	ce.					33.3				
	g.f.									
Lindsaea	ce.						12.5		50.0	
	g.f.									
L. cernua	ce.			100.0						
O. cinnamomea	m				10.5					
P. ptilodon	o.c.									
	g.f		3.8							
P. calomelanos	m						1.4			
P. trifoliata	o.c..									
P. fraxinifolium	g.f.				37.5	6. 7				
	m.						1.4			
P. latipes	o.c.	28.6								68.7
	ce.								50.0	40.0
	g.f.									6.2
Thelypteris	o.c.								100.0	12.5
	ce.						12.5			
	g.f.		26.9	11.1					9.1	18.7
	m			2.3						2.8
T./Asp	o.c.									
	g.f.									
	m.									
Type 1	o.c						100.0	2.3		6.2
Type 2	m.							16.1		
Type 3	o.c									6.2

Notes: *B. brasiliense*: *Blechnum brasiliense*; *B. glandulosum*: *Blechnum glandulosum*; *Camp/Pl*: *Campyloneurum/Pleopeltis*; *C.. delgadii*: *Cyathea delgadii*; *C. phalerata*: *Cyathea phalerata*; *C.. meniscioides*: *Cyclodium meniscioides*; *Lindsaea*: *Lindsaea*; *L. cernua*: *L.ycopodiella cernua*; *O. cinnamomea*: *Osmunda cinnamomea*; *P. ptilodon*: *Pecluma ptilodon*; *P. calomelanos*: *Pityrogramma calomelanos*; *P. trifoliata*: *Pityrogramma trifoliata*; *P. fraxinifolium*: *Polypodium fraxinifolium*; *P. latipes*: *Polypodium latipes*; *Thelypteris*: *Thelypteris*; *T/Asp*: *Thelypteris/ Asplenium*.

Table 3 cont. Percentage of spores of each species in relation to the total number of pteridophyte spores per month in the spore rain in the collectors placed at 1.5 m above soil level in the open cerrado (o.c.), cerrado (ce.), gallery forest (g.f.) and marsh (m.) of The Reserve, from April 1995 to July 1996.

Species	site	1996						
		J	F	M	A	M	J	J
B. brasiliense	o.c.	10.5		2.0	7.7		66. 7	
	ce.			100.0		25.0		
	g.f.			4.8	11.8	38.5	16.7	
	m.			0.7				
B. glandulosum	o.c							
Camp/Pl	o.c.	68.4	83.7	83.7				
	ce.		63.6					
	g.f.			4.8	17.6	23.1		
	m.	1.6	0.5			1.0		
C. delgadii	o.c.		7.0		38.5		33.3	
	ce.		36.4			62.5		
	g.f.	87.2	97.2	85.7	5.9	30.8	66. 7	
	m.	79.0	99.0	99.0	68.3	94.8	100.0	100.0
C. phalerata	ce.			2.0	19.2			
	g.f.				5.9			
	m.				26.0	3.1		
C. meniscioides	o.c.				7.7			
	ce.	50.0						
	g.f.	4.3			23.5			
Lindsaea	ce.							
	g.f.					7.7		
L. cernua	ce.							
O. cinnamomea	m							
P. ptilodon	o.c.		2.3					
	g.f							
P. calomelanos	m							
P. trifoliata	o.c..			8.2				
P. fraxinifolium	g.f.							
	m.							
P. latipes	o.c.	50.0						
	ce.							
	g.f.							
Thelypteris	o.c.	21.0		2.0	23.1			100.0
	ce.				100.0	12.5		
	g.f.	6.4	2.8	4.8	35.3		16.7	100.0
	m	16.1	0.5	0.2	2.4	1.0		
T./Asp	o.c.		2.3	2.0	3.8			
	g.f.	2.3						
	m.				0.8			
Type 1	o.c							
Type 2	m.							
Type 3	o.c							

Notes: see Table 3

Table 4. Percentage of spores of each species in relation to the total number of pteridophyte spores per month in the spore rain in the collectors placed at 0.5 m above soil level in the open cerrado (o.c.), cerrado (ce.), gallery forest (g.f.) and marsh (m.) of The Reserve from April 1995 to July 1996.

Species	site	1995								
		A	M	J	J	A	S	O	N	D
B. brasiliense	o.c.									7.7
	ce.	8.3							6.2	
	g.f.	18.2			5.3	40.0		20.0	3.6	9.9
Camp/Pl	o.c.					20.0	100.0			
	ce.		66.7						6.2	
	g.f.		3.8	7.7	10.5		25.0			1.0
	m.		1.7							
C. delgadii	o.c.	16.7							33.3	7.7
	ce.	66.7	33.3			100.0	100.0		31.2	50.0
	g.f.	40.9	46.1	53.8	78.9	90.9	50.0	60.0	57.1	40.6
	m.	94.9	96.7	100.0	100.0	80.8	64.4	80.0	43.9	72.4
C. phalerata	ce.	8.3								25.0
	g.f.	31.8					25.0		17.9	9.9
	m.	5.1					24.4	20.0	33.3	26.0
C. meniscioides	o.c.									
Lindsaea	o.c.	16.7						100.0		
	ce.	8.3								
	g.f.					9.1				
	m.									
O. cinnamomea	ce.								6.2	
	m.					11.5	11.1		4.5	
O. regalis	m.									
P. ptilodon	ce.	8.3								
	g.f.									1.0
P. calomelanos	m.									
P. fraxinifolium	o.c								33.3	
	ce.									
	g.f.	9.1								
	m.									0.8
P. latipes	o.c.	66.7							33.3	84.6
	ce.								12.5	25.0
T. chrisodioides	o.c.									
	g.f.									
Thelypteris	o.c.					20.0				
	ce.							100.0	37.5	
	g.f.		50.0	38.5	5.3			20.0	21.4	35.6
	m		1.7						1.5	0.8
T/Asp	o.c.					20.0				
	g.f.									1.0
	m.									
Type 3	o.c.									
	ce.									
	g.f.									1.0

Notes: *B. brasiliense*: *Blechnum brasiliense*; *Camp/Pl*: *Campyloneurum/Pleopeltis*; *C.. delgadii*: *Cyathea delgadii*; *C. phalerata*: *Cyathea phalerata*; *C.. meniscioides*: *Cyclodium meniscioides*; *Lindsaea*: *Lindsaea*; *O. cinnamomea*: *Osmunda cinnamomea*; *O. regalis*: *Osmunda regalis*; *P. ptilodon*: *Pecluma ptilodon*; *P. calomelanos*: *Pityrogramma calomelanos*; *P. fraxinifolium*: *Polypodium fraxinifolium*; *P. latipes*: *Polypodium latipes*; *T. chrisodioides*: *Thelypteris chrisodioides*; *Thelypteris*: *Thelypteris*; *T/Asp*: *Thelypteris/ Asplenium*.

Table 4 cont. Percentage of spores of each species in relation to the total number of pteridophyte spores per month in the spore rain in the collectors placed at 0.5 m above soil level in the open cerrado (o.c.), cerrado (ce.), gallery forest (g.f.) and marsh (m.) of The Reserve from April 1995 to July 1996.

Species	site	1996						
		J	F	M	A	M	J	J
B. brasiliense	o.c.							
	ce.							
	g.f.		10.4	7.7	5.3	33.3	13.3	
Camp/Pl	o.c.	20.0		3.7		100.0		
	ce.							
	g.f.			2.6		16.7	6.7	
	m.		31.6					
C. delgadii	o.c.			1.5	5.3			
	ce.	41.7		25.0	100.0			
	g.f.	23.2	6.0	56.4	63.16	25.0	66.7	100.0
	m.	96.7	96.1	95.6	97.56	100.0	100.0	100.0
C. phalerata	ce.	8.3						
	g.f.	47.8	67.2	15.4			13.3	
	m.		3.9					
C. meniscioides	o.c.							100.0
Lindsaea	o.c.							
	ce.							
	g.f.	11.6	4.5			8.3		
	m.	0. 7						
O. cinnamomea	ce.							
	m.							
O. regalis	m.			3.3				
P. ptilodon	ce.							
	g.f.							
P. calomelanos	m.				2.4			
P. fraxinifolium	o.c							
	ce.	8.3						
	g.f.		1.5			8.3		
	m.							
P. latipes	o.c.	70.0	93.4	86.6	90.0			
	ce.	25.0	36.8	50.0				
T. chrisodioides	o.c.		2.6					
	g.f.		1.5					
Thelypteris	o.c.	10.0	2.6		5.0			
	ce.	16.7	5.3					
	g.f.	17.4	8.9	17.9	31.6			
	m	1.3						
T/Asp	o.c.							
	g.f.					8.3		
	m.	1.3		0.8				
Type 3	o.c.		1.3	8.2				
	ce.			25.0				
	g.f.							

Notes: see Table 4

Table 5. Pteridophyte species (or types of spores) detected both in the in spore rain and soil spore bank (rain + bank), in spore rain only (rain only) and soil spore bank only (bank only) samples in the open cerrado, cerrado, gallery forest and marsh of The Reserve, from April 1995 to July 1996. The data quoted here for soil spore bank (in this case always dead spores because of the acetolysis method used) are from Simabukuro *et al.* (1998c). x = present.

	open cerrado			cerrado		
	bank + rain	rain only	bank only	bank + rain	rain only	bank only
Blechnum brasiliense	x				x	
Blechnum glandulosum		x				
Campyloneurum/Pleopeltis	x			x		
Cyathea delgadii	x			x		
Cyathea phalerata			x		x	
Cyclodium meniscioides		x			x	
Lindsaea	x			x		
Lycopodiella cernua			x	x		
Osmunda cinnamomea					x	
Osmunda regalis						
Pecluma ptilodon		x			x	
Pityrogramma calomelanos						
Pityrogramma trifoliata		x				
Polypodium fraxinifolium	x				x	
Polypodium latipes	x				x	
Thelypteris chrisodioides		x				
Thelypteris	x			x		
Thelypteris/ Asplenium.		x				
Type 1		x				
Type 2			x			
Type 3		x			x	

Notes: see notes in Table 2.

Table 5 cont. Pteridophyte species (or types of spores) detected both in the in spore rain and soil spore bank (rain + bank), in spore rain only (rain only) and soil spore bank only (bank only) samples in the open cerrado, cerrado, gallery forest and marsh of The Reserve, from April 1995 to July 1996. The data quoted here for soil spore bank (in this case always dead spores because of the acetolysis method used) are from Simabukuro *et al.* (1998c). x = present.

	gallery forest			marsh		
	bank + rain	rain only	Bank Only	bank + rain	rain only	bank only
Blechnum brasiliense	x			x		
Blechnum glandulosum						
Campyloneurum/Pleopeltis	x			x		
Cyathea delgadii	x			x		
Cyathea phalerata	x				x	
Cyclodium meniscioides		x				
Lindsaea	x			x		
Lycopodiella cernua			x			
Osmunda cinnamomea					x	
Osmunda regalis					x	
Pecluma ptilodon		x				x
Pityrogramma calomelanos	x				x	
Pityrogramma trifoliata						
Polypodium fraxinifolium	x				x	
Polypodium latipes		x				
Thelypteris chrisodioides		x				
Thelypteris		x		x		
Thelypteris/ Asplenium.		x			x	
Type 1						x
Type 2					x	
Type 3		x				

Notes: see notes in Table 2.

seen on Table 3 that in the spore rain of this site (open cerrado), spores of species occurring in the other sites (compare with Table 1) were collected. There are several cases more where species only occur in spore rain in other habitats and are not recorded from the habitat to which their growth is restricted, e.g. *Blechnum glandulosum, Lycopodiella cernua* and *Pityrogramma trifoliata*. Perhaps this could be explained by the restricted range of spore dispersal within their native habitat.

The species *Dicranopteris flexuosa* and *Salpichlaena volubilis* found in the spore rain of the Reserve in a survey carried out in 1994 with a 1.5 m collector (Simabukuro *et al.*, 1998a) were not found in the collectors of the two heights used in the present work. Thus these two species probably do not produce spores every year in the Reserve. The same can be said for the species *Cyclodium meniscioides* var. *meniscioides*, *Pityrogramma calomelanos, Pityrogramma trifoliata*, *Thelypteris chrisodioides* and species producing spores type 1, type 2 and type 3 which are represented in the period April 1995 to July 1996 and were not present in 1994. The 1.5 m collectors used by Simabukuro *et al.* (1998a) in the survey carried out in The Reserve in 1994 were placed in the same positions in the same sites as in the present survey. According to Chen & Chien (1986) both the quality and the quantity of grains in the air change from year to year in the same area because of the weather conditions and the phenological behaviour of the plants.

From the above investigations it is not possible to conclude that a collector placed at 0.5 m was more efficient at collecting spores for the study of spore rain than one placed at 1.5 m above soil level. The two collector heights provide a list for each site which is longer than the lists for each collector individually. This does not mean that the list of species is complete, as other spores might be not recorded in the spore rain of these two collectors. This confirms the preliminary results obtained in Itirapina for a much shorter period (Simabukuro *et al.*, 1998b). The present results do not unquestionably establish that two collectors are sufficient or that 0.5 m and 1.5 m are the best heights. One conclusion is that for future studies there is the need to use more than one collector (and at different heights) at each site and to combine the results in order to obtain at least a reasonably complete qualitative assessment of the fern spore rain. It is of interest to compare the spore flora trapped in the collectors in the present study with the species represented in the spore bank, as the soil acts in effect as a long-term spore trap for spore rain. A comparison of the species present in the spore rain in this work compared with the data for spores present in the spore bank at the same sites over the same period of time is presented in Table 5. The spore bank data are from Simabukuro *et al.* (1988c) in which the spores were treated with the acetolysis method. It can be seen that of all the species present in the spore rain only about half of them were present in the spore bank. In open cerrado 15 species were present in the spore rain and only seven were present in the bank; in cerrado, of the 13 species present in the rain only five were present in the bank; in gallery forest of 14 species in the rain only seven were in the bank and in marsh, of the 12 species present in the rain only five were also present in the bank. Few species appeared only in the spore bank: *Cyathea phalerata* (open cerrado site), *Lycopodiella cernua* (open cerrado and gallery forest sites), *Pecluma ptilodon* (marsh site), spores type 1 (marsh site) and type 2 (open cerrado site). With these few exceptions, all the other species

present in the soil bank were detected in the spore rain. It is difficult to think of a plausible biological explanation to cover all these cases. Rapid degradation might explain the absence of some species in the spore bank. Some species have short-lived spores and these will not be present in the bank. *Cyathea delgadii* is one of only two species that are in the rain and the bank at all four sites, and that is perhaps the species most consistently found, often at a high percentage, in the rain at different times, heights and sites. This species presents long-lived spores, it has been shown that the spores are still viable after been buried in cerrado soil for ten months (Guimarães & Felippe, 1999). It is of interest that also in the case of the soil spore bank, there are some species present in the soil bank of a certain site that were not recorded as growing in the same site (Table 1).

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REFERENCES

BARTH, O.M.1975. Principais tipos de esporos de pteridófitas encontrados em sedimentos do ar do Rio de Janeiro. Leandra 6:55-59.

CHEN, S. & CHIEN, M.1986. Two-year investigation of the airborne pollen at Nankang, Taipei (Taiwan). Taiwania 31:33-40.

EITEN, G. 1972. The cerrado vegetation of Brazil. Bot. Rev. Lancaster 38: 201-341.

ERDTMAN, G.1971. Handbook of palinology (morphology-taxonomy-ecology). An introduction to the study of pollen grains and spores. Munksgaard, Copenhagen.

ESTEVES, L.M. & FELIPPE, G.M.1985. Fotossensibilidade de esporos de pteridófitas dos cerrados. Revista Brasil. Bot. 8:219-222.

ESTEVES, L.M. & MELHEM, T.S. 1992. Morfologia de esporos de pteridófitas do cerrado da Reserva Biológica de Moji Guaçu (SP). Revista Brasil. Bot. 15:73-83.

GUIMARÃES, T.B. & FELIPPE, G.M. 1999. The survival and establishment potential of spores of *Cyathea delgadii* Sternb. in soils from Itirapina and Moji Guaçu (SP), Brazil. Revista Brasil. Bot. 22:385-390.

HANSEN, M.V. & WRIGHT JR., H.E. 1987. The modern pollen rain of North Dakota, USA. Pollen & Spores 29:167-184.

HANUMANTHA, B.T., KANNAN, N., DAIVSIKAMANI, S. & GOVINDARAJAN, T.S. 1991. Air-spores of a coffee plantation in Chikamagalur region of Karnataka. J. Coffee Res. 21:20-31.

MANTOVANI, W. & MARTINS, F.R. 1993. Florística do cerrado na Reserva Biológica de Moji Guaçu, SP. Acta Bot. brasil. 7:33-60.

MELHEM, T.S. & MAKINO, H. 1978. Precipitação polínica na cidade de São Paulo (Brasil). Hoehnea 7:1-10.

OLIVEIRA-LIMA, A. & GUIMARÃES, O.1958. Contagens de pólens na atmosfera da cidade de São Paulo. Hospital (Rio de Janeiro) 54:153-162.

OLIVEIRA-LIMA, A., COSTA, P.D. DA & GALENO, R.1946. Contagem de pólens aéreos na cidade de Porto Alegre (Rio Grande do Sul). Hospital (Rio de Janeiro) 30:513-515.

OLIVEIRA-LIMA, A., COSTA, P.D. DA, GALENO, R. & SANTOS, P.P. DOS 1945. Contagem de pólen aéreo na cidade de Florianópolis (Santa Catarina), durante 10 meses consecutivos. Hospital (Rio de Janeiro). 28:197-199.

POTTER, L.D. & ROWLEY, J. 1960. Pollen rain and vegetation, San Ajugustin Plains, New Mexico. Bot. Gaz. 122:1-25.

SALGADO-LABOURIAU, M.L. 1973. Contribuição à palinologia do cerrado. Academia Brasileira de Ciências, Rio de Janeiro, 293p.

SILVA, Q.G.P. 1989. Análise polínica do ar no Observatório da Serra do Pilar (Instituto Geofísico da Universidade do Porto) durante os anos de 1969 e 1970. Bol. Soc. Brot. 62:263-288.

SIMABUKURO, E.A., ESTEVES, L.M. & FELIPPE, G.M. 1994. Lista de pteridófitas da mata ciliar da Reserva Biológica de Moji Guaçu, SP. Insula 23:91-98.

SIMABUKURO, E.A., ESTEVES, L.M. & FELIPPE, G.M. 1998a. Fern spore morphology and spore rain of a preserved cerrado region in south-east Brazil (Reserva Biológica de Moji Guaçu, São Paulo). Amer. Fern J. 88:114-137

SIMABUKURO, E.A., ESTEVES, L.M. & FELIPPE, G.M. 1998b. Fern spore rain at Itirapina (SP, Brazil): preliminary results. Insula 27 39-62.

SIMABUKURO, E.A., ESTEVES, L.M. & FELIPPE, G.M. 1998c. Analysis of a fern spore bank in Southeast Brazil. Hoehnea 25:45-57.

SIMABUKURO, E.A., BEGOVACZ, A., ESTEVES, L.M. & FELIPPE, G.M. 1999. Fern spore bank at Pedregulho (Itirapina, São Paulo, Brazil). Revista Brasil. Biol. 59: 131-139.

SINGH, J. & DEVI, S. 1991. Pteridophyte aerospora of Lucknow. Indian Fern J. 8:34-40.

TEJERO-DIEZ, J.D., REYES-SALA, M. & MARTINEZ-HERNANDEZ, E. 1988. Lluvia de polen moderno en un gradiente altitudinal com vegetacion templada en el municipio de Ocuilan, Edo. Mex. (Mex.). Palynol. PaleoBot. 1:61-80.

BOOK REVIEW

THE PLANTFINDER'S GUIDE TO GARDEN FERNS. M.Rickard. Continued from p. 146

... the same plate. For those taxa not illustrated I think the brief descriptions given may not always be adequate to create the necessary mental picture but helpful comments and inciteful discussion on the history of many of these now obscure cultivars is very valuable.

The question of fern cultivar names remains a thorny issue and one is left in no doubt as to where the author stands. No other group of plants is so endlessly mutable, with staggering variability in shape, stature and form – Victorian attempts to provide a descriptive system to accommodate this harked back to a pre-linnean polynomial past and must have been anachronistic even last century! Am I alone in getting these descriptive phrases muddled with cultivars? Too often they seem to be used interchangeably. Long hyphenated latin names do little to sell these plants, although I suspect most readers of this book will be purchasing their ferns at garden centres and will be lucky to get their plants correctly labelled even to species level!

So many of the species mentioned sadly will only ever be available through spore exchanges – indeed a constant frustration to me is the general unavailability of a wider range of taxa. It would have been nice to have flagged up which of the plants mentioned were generally available in the trade, information which could have been culled from past Plantfinders and nursery catalogues? But given that spores offer the only chance for many people to own treasures, raise their own cultivars and hybrids, or in this conservation aware world, responsibly collect from the wild, it would have been good to have a series of illustrations to back up the useful text on this method of propagation.

The book is fairly free of errors, although I would contest the statement on p.16 that no fern species has become extinct in Britain – what about *Dryopteris remota* or *Cystopteris alpina*? On p.57 the American *Asplenium scolopendrium* is incorrectly referred to as diploid, it is in fact the European plant which is diploid, the American tetraploid. The use of such terms in the text will probably baffle many of the readers of this book in spite of their definition in appendix 1 and would have benefitted perhaps from a more fulsome treatment in the introduction?

The suggestion that *Dryopteris submontana is "particularly common in the north of England"* is a little misleading. *Polypodium macaronesicum* is mis-spelt throughout and the diagnostic shape character given on p.140 does not work...it is also far from being Zone 8 hardy in my experience!

These however are minor quibbles about an attractive and informative book which manages to capture some of the enthusiasm that the author clearly feels for these plants. There is much here for anyone interested in ferns and their cultivation, nicely presented and at an affordable price. I'm sure it will become a natural first choice of information for many and will certainly encourage others to use and grow these plants. I therefore warmly recommend it.

F.J. Rumsey

INSTRUCTIONS FOR AUTHORS

Manuscripts on all subjects of pteridology are welcome and should be sent to the editor: Miss J.M. Camus, Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, UK; fax +44-(0)20-7942 5529; email j.camus@nhm.ac.uk.

PLEASE NOTE that papers should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Longer review articles will be considered. Short notes are acceptable e.g. new records. The senior author should supply fax and email numbers to facilitate correspondence.

MANUSCRIPTS should be written in English (British), double spaced, preferably on A4 paper. Three hard copies are required in the first instance; a version on disc will be required after revision (WORD 97 in WINDOWS 95, DOS). All manuscripts will be refereed. The title should reflect the content of the paper and be in **BOLD CAPITALS** 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 WILLD. (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: in BOLD CAPITALS and centrally aligned.

SUBSIDIARY HEADINGS: in italics and left aligned.

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

KEY WORDS: up to ten.

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

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HOOKER, W.J. 1864. Species Filicum, 5. Dulau & Co., London.

MORTON, C.V. 1947. The American species of *Hymenophyllum*, section *Sphaeroconium*. Contr. U.S. Natl. Herb. 29(3): 139-201.

STEVENSON, D.W. & LOCONTE, H. 1996. Ordinal and familial relationships of pteridophyte genera. In: CAMUS, J.M., GIBBY, M. & JOHNS, R.J. (Eds) Pteridology in perspective, pp. 435-467. Royal Botanic Gardens, Kew.

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