

LEPISORUS IN MALESIA

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SUMMARY

The genus *Lepisorus* J.Sm. is represented in Malesia with four species. One new species and one new combination are described here.

GENERIC DELIMITATION OF LEPISORUS

The polypodiaceous genus *Lepisorus* is represented in Malesia by four species. Two of these have formerly been separated as *Paragramma*, for reasons that have never been very clear. According to Holttum (1955), the presence of a specialised hypoderm was decisive for Copeland to distinguish *Paragramma*, but although Copeland (1947) mentions this hypoderm in his description, he does not explicitly use this as an argument to separate *Paragramma* from *Pleopeltis* (in his circumscription, i.e., including *Lepisorus*). Copeland's only argument seems to be the resemblance of the two species he includes in *Paragramma* to species of *Pyrrosia* [presumably *P. angustata* (Sw.) Ching]. This resemblance, however, is purely superficial.

The presence of a well-developed hypoderm in both the original species of *Paragramma* (*P. longifolia*, *P. balteiformis*) can here be confirmed; it may be particularly well developed in *P. longifolia*, sometimes consisting of 3 or 4 layers of cells. The distribution of a hypoderm in the continental species of *Lepisorus* is not known, but the presence of a hypoderm is highly variable in other genera of Polypodiaceae (e.g., *Pyrrosia*, *Selliguea*), and cannot be used as the basis of a generic separation of *Paragramma*. In other characters, *Paragramma* falls within the range encountered in *Lepisorus*, although the fronds may attain much larger sizes than is usual in *Lepisorus*.

Lepisorus in general is characterised by rhizomes with scattered sclerenchyma cells, clathrate scales, simple fronds, an included venation that is predominantly recurrent, and sori in a single row between midrib and margin, covered with peltate paraphyses at least when young. The delimitation of *Lepisorus* against *Belvisia* and *Lemmaphyllum* has been discussed by Hovenkamp & Franken (1993), and against the mainly Neotropical *Pleopeltis* by Zink (1993). The delimitation against *Microsorum*, however, is more troublesome. Peltate paraphyses occur in, among others, *Microsorum normale* (Nootboom, 1997: 341), and a single row of sori is characteristic for a number of species formerly included in *Phymatosorus*. It could be argued that *Lepisorus* and *Microsorum* are not sufficiently distinct to be kept separate. However, the full extent of the variability in *Lepisorus* is not known, and has not been investigated here. Moreover, to include *Lepisorus* in *Microsorum* would make it nearly

inevitable to include the lepisorioid genera *Belvisia* and *Lemmaphyllum* as well, a step I am not prepared to take. Being kept distinct, *Lepisorus* can be recognised by a unique combination of characters:

Scales clathrate, fronds simple, sori in a single row between midrib and margin, usually singly between each pair of veins (the exact disposition of sori with regard to the lateral veins in *L. longifolius* is not clear due to the marginal position), covered with peltate paraphyses at least when young.

LEPISORUS

Drynaria * *Lepisorus* J. Sm., Bot. Mag. 12 Comp. (1846) 13; Hist. Fil. (1875) 113, as section. — *Lepisorus* Ching, Bull. Fan Mem. Inst. Biol. 4 (1933) 47; Holttum, Revis. Fl. Malaya 2 (1955) 151. — Type species: *Lepisorus nudus* (Hook.) Ching.

Paragamma T. Moore, Index Filic. (1857) xxxii; Copel., Gen. Fil. (1947) 190; Fern Fl. Philipp. (1960) 465; Hennipman et al. in Kramer & Green, Fam. & Genera Vasc. Pl. 1 (1990) 217. — Type species: *Grammitis longifolia* Blume (= *Lepisorus longifolius*).

Pleopeltis auct. non Humboldt & Bonpland ex Willd.: Copel., Fern Fl. Philipp. (1960) 463.

KEY TO THE SPECIES

- 1a. Sori marginal **2. *L. longifolius***
- b. Sori costal to medial **2**
- 2a. Rhizome scales clathrate with thin-walled cells throughout, 2–4 mm wide **3**
- b. Rhizome scales with a central band of dark, thick-walled cells, 1–1.5 mm wide **4. *L. thunbergianus***
- 3a. Rhizome short-creeping, fronds close together, long, strap-shaped **1. *L. balteiformis***
- b. Rhizome long-creeping, fronds remote, narrowly ovate-lanceolate **3. *L. mamas***

1. *Lepisorus balteiformis* (Brause) Hovenkamp, comb. nov.

Polypodium balteiforme Brause, Bot. Jahrb. Syst. 56 (1920) 194. — *Paragamma balteiformis* Copel., Gen. Fil. (1947) 190. — Type: *Ledermann* 10979 (B; iso BM, fragment), Papua New Guinea, Hunsteinspitze.

Rhizome 4–8 mm thick, not glaucous, brownish when dry, shortly creeping, phyllospodia raised, 1.5–2 cm distant. Anatomy: vascular strands c. 12, without sclerified bundle sheaths, sclerenchyma strands absent, ground tissue not sclerified or with some erratic sclerification. Rhizome scales pseudopeltate, appressed, 6.5–8 × 2 mm, clathrate, margin regularly dentate, apex acute. Fronds not or very shortly stipitate, stipe to c. 0.7 cm; lamina to 150 × 1.5–3.3 cm, papyraceous, strap-shaped or widest at 1/3–1/2 its length, at base very gradually narrowed to a short truncate base, apex rounded to acute, margin flat or very slightly incurved; costa sparsely set with dark clathrate, dentate, elongate scales, similar but smaller scales sparsely scattered over the lower surface of the lamina. Venation usually quite visible, main veins indistinct, all veins forming a mesh of areoles. Free veinlets many, recurrent and excurrent. Anatomy: mesophyll weakly differentiated, with a hypoderm consisting of a single layer of enlarged cells; stomata superficial, polocytic. Hydathodes present, super-

ficial. *Sori* round or slightly elongated transversely, to 6×4 mm, impressed, densely covered with scales when young, in a single row close to or up to 2 mm from the costa. Sporangia long-stalked, capsules c. 0.4 mm high, with 14–15 indurated annulus cells. Soral scales of two types: dark, peltate, round, irregularly dentate clathrate scales to 0.5 mm diameter, deciduous or remaining as a dark ring around the ripe sorus; and brown, irregularly branched scale-like hairs remaining between the old sporangia. Spores hyaline, c. 70×50 μm , coarsely verrucate.

Distribution — New Guinea: Irian Jaya, Papua New Guinea (5 collections seen).

Habitat — Epiphytic, in forest, on *Pandanus* in gullies, crown epiphyte; altitude 1550–2200 m.

Collections studied. IRIAN JAYA. Bernhard Camp: Brass 12075 (BO, L). Wissel Lake region: Eyma 4431 (L). — PAPUA NEW GUINEA. Milne Bay: Brass 23099 (L), 23289, Mt Dayman. Morobe: Streimann & Kairo NGF 45470 (BO, L), Spreader Divide.

2. *Lepisorus longifolius* (Blume) Holttum

Lepisorus longifolius (Blume) Holttum, Revis. Fl. Malaya 2 (1955) 151; Tagawa & Iwats., Fl. Thailand 3, 4 (1989) 508. — *Grammitis longifolia* Blume, Enum. Pl. Javae (1828) 119. — *Pleopeltis longifolia* Blume, Enum. Pl. Javae (1828), Addenda et emendanda. — *Polypodium longifolium* Hook., Icon. Pl. (1854) 987; Mett., Farnigg. I. Polypodium (1856) 87, pl. 1, f. 46; Hook., Sp. Fil. 5 (1864) 60; Baker, Syn. Fil. (1867) 355. — *Paragamma longifolia* (Blume) T. Moore, Index Filic. (1857) xxxii; (1860) pl. 19b; Copel., Gen. Fil. (1947) 190; Fern Fl. Philipp. (1960) 465. — *Phymatodes longifolia* J. Sm., Cat. Cult. Ferns (1857) 9. — *Pleopeltis longifolia* Bedd., Ferns Brit. Ind. (1866) pl. 6; Handb. Ferns Brit. Ind. (1883) 349. — *Niphobolus longifolius* Keys., Polyp. Cyath. Herb. Bunge (1873) 38, non Sprengel (1827). — Type: *Blume s. n.* (L), ‘in arboribus Javae occidentalis’.

Grammitis decurrens Blume, Enum. Pl. Javae (1828) 119. — *Pleopeltis decurrens* Blume, Enum. Pl. Javae (1828), Addenda et emendanda. — *Polypodium decurrens* Kunze, Bot. Zeitung (Berlin) 4 (1846) 421, nom. illeg., non Raddi (1819). — *Paragamma decurrens* T. Moore, Index Filic. (1857) xxxii. — Type: *Blume s. n.* (L), ‘in montosis Javae supra arboreis’.

Polypodium contiguum Wall., Cat. 285, nom. nud. — *Drynaria revoluta* J. Sm., J. Bot. (Hooker) 3 (1841) 421, nom. nud. — *Polypodium contiguum* Hook., Icon. Pl. 10 (1854) pl. 987; Century of Ferns (1854) pl. 87; non Brackenridge (1854). — *Polypodium revolutum* C. Chr., Index Filic. (1906) 331, 559; Alderw., Malayan Ferns (1909) 638; Backer & Posth., Varenfl. Java (1939) 195. — *Pleopeltis revoluta* Alderw., Bull. Dép. Agric. Indes Néerl. 23 (1909) 5. — *Phymatodes revoluta* Tardieu & C. Chr., Fl. Indo-Chine 7 (1941) 468 (ascribed to Moore). — Syntypes: Wallich 285; Griffith, Mergui; Cuming 247; Low, Singapore; Fortune 21 (not seen).

Polypodium productum H. Christ, Philipp. J. Sci. 3, Bot. (1907) 178. — Type: Copeland 1585, San Ramon, Zamboanga, Mindanao (not seen).

Rhizome 3–4.5 mm thick, often slightly glaucous, ascending to short creeping, phyllopoidia raised, contiguous or very short-spaced. Anatomy: vascular strands to 18, without sclerified bundle sheaths, sclerenchyma strands many, scattered, smaller towards the periphery, ground tissue not sclerified. **Rhizome scales** appressed, 3.5–4 \times 1 mm, clathrate, often somewhat parenchymatous near the attachment, superficially set with long unicellular hairs, margin irregularly coarsely dentate, apex acute. **Fronds** stipitate; stipe to 8 cm long, not distinctly delimitated from the narrowed lamina base, lamina to 70×1 –4.5 cm, chartaceous, glabrous, strap-shaped or widest at 1/3–1/2 its length, base very gradually narrowed into the stipe, rounded to acute, margin often incurved. **Venation:** veins immersed in the lamina, main veins indistinct, all veins

forming a mesh of areoles. Free veinlets many, recurrent and excurrent. Anatomy: mesophyll clearly differentiated, hypoderm consisting of 1–3 layers of large cells, stomata superficial, polocytic. Hydathodes absent. *Sori* round or elongated longitudinally, to 10×2 mm, sunken, densely covered with scales when young, in a single row at 1–2 mm from the margin, margin often incurved over the sori. Sporangia long-stalked, capsules c. 0.3 mm high, with 13 or 14 indurated annulus cells. Soral scales of two types: dark, peltate, round, entire, clathrate scales to 0.3 mm diameter, deciduous or remaining as a dark ring around the ripe sorus; and brown, irregularly shaped, mostly basifixated scales with irregularly thickened cell walls, remaining between the old sporangia. *Spores* hyaline, $50–60 \times 35 \mu\text{m}$, verrucate.

Distribution — Sumatra, Malay Peninsula (extending to S Thailand), Java, Borneo, Philippines, Celebes. Outside Malesia: Mergui (several specimens in K), Himalayas (?; a single specimen in K: 'Dr. Jerdon, Kumaon', from Beddome's herbarium may have been mislaid!); Vietnam.

Habitat — Low to high epiphytic in various types of forest, rarely terrestrial, in humus; sea level to 800–1350 m altitude.

3. *Lepisorus mamas* Hovenkamp, spec. nov. — Fig. 1

Rhizoma repens, 6–7 mm crassum, paleis clathratis, adpressis, pseudopeltatis, lanceolatis, 7–8.5 mm longis, 2–4 mm latis, margine integro flabelliforme obtectum. Frondes monomorphae; stipes 1–3.5 cm longus; lamina ad 62 cm longa vel longior, 6.5 cm lata, angustevata, glabra vel sparsissima paleis clathratis parvis vestita, nervis inconspicuis, venulis liberis numerosis excurrentibus et recurrentibus. Sori ad 5 mm magni vel longiori, elongati, uniseriati ad 1,3 inter costam et marginem, juvenilis squamis peltatis rotundatis clathratis ad 0.7 mm magnis obtecti. Sporangia stipitata, capsulis ad 0.3 mm altis, sporis hyalinis, $58–62 \mu\text{m}$ longis, 40 μm latis, laeviter verrucatis. — Typus: de Wilde & de Wilde-Duyfjes 15812 (L), Sumatra, Gunung Mamas, 1850 m.

Rhizome 6–7 mm thick, not or slightly glaucous, blackish when dry, medium to long creeping, internodes 1.5–6 cm long, sometimes irregularly longer, branches arising approximately halfway on the internodia. **Anatomy:** vascular strands 16–19, without sclerified bundle sheaths, sclerenchyma strands 30–50, scattered, ground tissue not sclerified. *Rhizome scales* pseudopeltate, appressed, 7–8.5 \times 2–4 mm, widest slightly above the point of attachment, clathrate with a narrow flabelloid margin of non-clathrate cells, light-brown, dull to lightly iridescent, entire, apex obtuse to acute. **Fronds** monomorphic, stipitate; stipe 1–3.5 cm long, lamina to 62×6.5 cm or longer, widest at 1/3–1/2 of its length, base narrowly acuminate, apex acute to slightly acuminate, glabrous or with very few, scattered, small, round, clathrate scales. **Venation:** main veins not visible or indistinct, running to halfway to the margin or less, then splitting and disappearing in a mesh of areoles. Free veinlets many, recurrent and excurrent, ending in hydathodes. **Anatomy:** mesophyll poorly differentiated, mainly consisting of spongy parenchyma, hypoderm absent; stomata superficial, polocytic. Hydathodes present. *Sori* to 5 mm across, sometimes elongated longitudinally, in a single row at approximately 1/3 between midrib and margin, superficial, sometimes confluent across the primary veins, densely covered with scales when young. Sporangia stalked, capsules c. 0.3 mm high, with 13–16 indurated annulus cells. Soral scales round, peltate, clathrate, to 0.7 mm diameter. *Spores* hyaline, $58–62 \times$ c. 40 μm , finely verrucate.

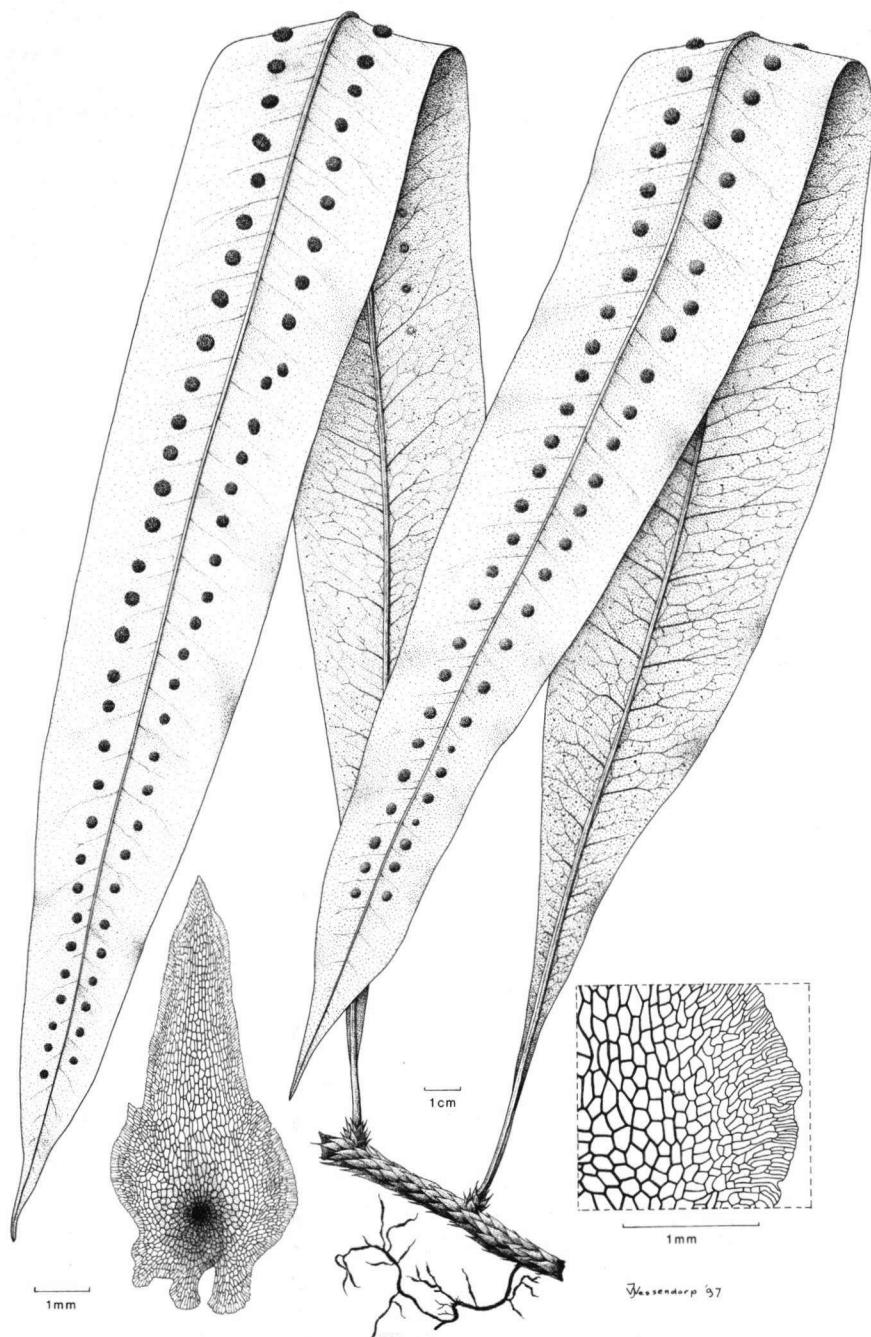


Fig. 1. *Lepisorus mamas* Hovenkamp. a. Habit; b. rhizome scale; c. detail of rhizome scale (a: de Wilde & de Wilde-Duyffes 15812; b & c: de Wilde & de Wilde-Duyffes 13050).

Distribution — North Sumatra.

Habitat — Open forest or cleared places, epiphytic on trunks or stumps, also terrestrial; altitude 1600–1950 m.

Note — *Lepisorus mamas* is more similar to some of the continental species of the genus, e.g., *L. khasyapii* (Mehra) Mehra, than the other Malesian representatives of *Lepisorus*. It can best be distinguished by the pseudopeltate, large, entire, nearly concolorous rhizome scales.

Collections studied. SUMATRA. G. Bandahara: *de Wilde & de Wilde-Duyffes* 13050 (BO, L), 13345 (L), 15004 (L); G. Mamas: *de Wilde & de Wilde-Duyffes* 15812, 16707 (L); Dairiweg: *Lörzing* 16295 (BO, L); *Otto-Surbeck* 276, 281, 365 (all L); Lae Pandom: *Surbeck* 73 (BO); Siboeatan-Zuid: *Surbeck* 644 (L).

4. *Lepisorus thunbergianus* (Kaulf.) Ching

Polypodium lineare Thunb. ex Murray, Syst. Veg. ed. 14 (1784) 934, nom. illeg., non N. L. Burman (1768). — *Pleopeltis thunbergiana* Kaulf., Wesen Farnkr. (1827) 113; Copel., Fern Fl. Philipp. (1960) 463. — *Polypodium thunbergianum* C.Chr., Ind. Fil. Suppl. 3 (1934) 160. — *Lepisorus thunbergianus* Ching, Bull. Fan. Mem. Inst. Biol. 4 (1933) 88; Tardieu & C.Chr., Fl. Indo-Chine 7 (1941) 458; De Vol & Kuo, Fl. Taiwan 1 [Pterid.] (1975) 188; W. C. Shieh et al., Fl. Taiwan 1, sec. ed. (1994) 493. — Type: *Kosido* (UPS, fide Zink, 1993), Japan, Herb. Thunberg.

Rhizome 1–1.5 mm thick, not glaucous, brownish when dry, short-creeping, phylloodia nearly contiguous (internodes rarely to 1 cm long in material from other locations). Anatomy: vascular strands c. 6, without sclerified bundle sheaths, sclerenchyma strands 5–15, scattered, ground tissue not sclerified. *Rhizome scales* peltate, slightly spreading, 1–1.5 × 2–3 mm, widest near the point of attachment, clathrate with a central band of dark thick-walled, opaque cells, margin irregularly dentate, apex acute. *Fronds* monomorphic, indistinctly stipitate; stipe to 1 cm long, lamina 5–13 × 0.5–1 cm (dry), widest at 1/3–1/2 its length, base very narrowly acuminate, apex acute to somewhat apiculate, glabrous or with few, small, deltoid, clathrate scales near the base of the costa on the lower surface. *Venation:* completely hidden. Anatomy: mesophyll differentiated, without hypoderm, stomata superficial, polocytic. *Hydathodes* present. *Sori* mostly slightly elongated longitudinally, to 4 × 2.5 mm, in a single row halfway between midrib and margin, sometimes protruding when old, superficial, densely covered with scales when young. Sporangia stalked, capsules c. 0.3 mm high, with 14–16 indurated annulus cells. Soral scales round, peltate, clathrate, to 0.5 mm diameter. *Spores* hyaline, 68–74 × 40–48 µm, coarsely verrucate.

Distribution — Probably widespread from the Himalayas throughout Southeast Asia to Japan and Hawaii (Zink, 1993: 96), but not critically studied over its entire range. In Malesia: Philippines (northern Luzon).

Habitat — On rocks in pine wood; 1800–2100 m altitude.

Collections studied: PHILIPPINES. Luzon, Benguet: *Copeland* 1941 (MICH), 7 Nov. 1905, Pauai, 6000 ft, dry rocks, pine mountains; *Mearns BS* 4527 (MICH), 2 Aug. 1907, "Heights in the oaks", 7000 ft.

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