

## A TAXONOMIC REVISION OF THE GENUS *LECANOPTERIS* (POLYPODIACEAE) IN SULAWESI, INDONESIA

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### SUMMARY

The species of *Lecanopteris* s.l. native to Sulawesi, Indonesia, are revised; eight species are recognized, of which *L. celebica* Hennipman and *L. holttumii* Hennipman are new.

### INTRODUCTION

In the progress of our studies on the ant-ferns of the genus *Lecanopteris*, new collections became available which further illustrate the surprising diversification of the genus in Sulawesi. The present paper includes the description of two new species, a key to all species of the genus (taken in a broad sense, i.e. including *Myrmecopteris*) occurring in Sulawesi as well as diagnostic descriptions of these species. Of the 8 species native to Sulawesi, 6 are endemic. The exact delimitation of the species not occurring in Sulawesi is not yet clear; these will be revised in a separate paper. The Directors of the herbaria of the British Museum (Natural History), London (BM), the Royal Botanic Gardens, Kew (K), the Rijksherbarium, Leiden (L), the Muséum National d'Histoire Naturelle, Paris (P), kindly put their collections at our disposal. We are especially grateful to Mr. A.C. Jermy, London, and Dr. P. Hovenkamp, Rijksherbarium, Leiden, for invaluable help in various ways. A significant part of the material studied was collected by the Rijksherbarium-LIPI expedition to Sulawesi (1979), financed by the Dutch Organisation for Scientific Research in the Tropics (WOTRO).

### LECANOPTERIS

*Lecanopteris* Reinw., Flora, Beil. 3 (1825) 48; Hennipman, Kew Bull. 41 (1986) 781. – *Onychium* Reinw., Syll. Plant. 2 (1824) 2, nom. illeg., non Kaulfuss (1820). – Type species: *Lecanopteris carnosa* (Reinw.) Blume.

*Myrmecophila* (Christ) Nakai, Bot. Mag. Tokyo 43 (1929) 6, nom. illeg., non Rolfe (1917). – *Polypodium* sect. *Myrmecophila* Christ, Farnkr. (1897) 12. – *Myrmecopteris* Pichi Serm., Webbia 31 (1977) 239. – Lectotype species: *Lecanopteris sinuosa* (Hook.) Copel.

Epiphytic, rarely (*L. holttumii*) epilithic, small to medium-sized ferns with a creeping, usually hollow, ant-inhabited, much-branched stem, apparently naked, or

distinctly scaly; scales peltate, rounded, centrally clathrate, marginally hyaline; naked stems usually sparsely to densely set with usually rigid, sometimes hollow spines. *Fronds* remote, articulate to a usually distinct, short phyllopodium which is sometimes situated on flask-like swellings of the stem, monomorphic; petiole variously long, glabrous; lamina herbaceous to subcoriaceous, glabrous, entire, lobed, or deeply pinnatifid, leaving a narrow wing on either side of the primary vein; lobes entire, apex usually broadly rounded, sometimes acute; veins anastomosing, forming a complex network with excurrent or recurrent, included free veins. *Sori* all over the lamina or in its upper part only, rounded, situated on the lamina blade, on the margin, or on semi-circular or elongate extramarginal projections which bear a deeply immersed, acropically exposed sorus. *Spores* usually 64, in one species (*L. sarcopus*) 16 per sporangium, hyaline or yellowish, smooth, perispore usually indistinct.

**Distribution.** Malesia. Represented by c. 12 species which are easily accommodated in two distinct groups, the *Lecanopteris* group proper including 8 species with scaleless stem, and the *Myrmecopteris* group with 4 species with densely scaly stem.

**Habitat.** Epiphytes in rainforest; 0–c. 2400 m.

**Note.** *Lecanopteris curtisii* Baker (*Lecanopteris* group) may be expected to occur in Sulawesi as well, as it is widespread in Malesia. It is characterized by the rhizome remaining glaucous to maturity instead of being nigrescent, the large phyllopodia and the small sori.

#### KEY TO THE SPECIES

- 1 a. Rhizome without scales or almost so (*Lecanopteris* group) ..... 2
- b. Rhizome densely set with scales (*Myrmecopteris* group)..... 7
- 2 a. Rhizome set with 1–3 cm long, coralloid excrescences ..... **2. *L. carnosa***
- b. Rhizome naked, or set with up to 1 cm long spines or conical excrescences.... 3
- 3 a. Rhizome naked or sparsely set with short rigid spines, or with hollow conical spines homologous to fronds ..... 4
- b. Rhizome densely set with up to 1 cm long rigid spines ..... 5
- 4 a. Rhizome set with hollow, conical spines ..... **1. *L. balgooyi***
- b. Rhizome almost naked, or with few short rigid spines ..... **3. *L. celebica***
- 5 a. Fronds entire or lobed to 1/3 to the rachis; sori medially on fronds  
**6. *L. spinosa***
- b. Fronds deeply pinnatifid; sori marginally or on stalked projections ..... 6
- 6 a. Sori ± sessile, soral lobes not reflexed, veins manifestly sclerified  
**4. *L. darnaedii***
- b. Sori on stalked projections, soral lobes reflexed, veins slightly sclerified  
**5. *L. holttumii***
- 7 a. Fronds (deeply) pinnatifid ..... **7. *L. sarcopus***
- b. Fronds simple, entire ..... **8. *L. sinuosa***

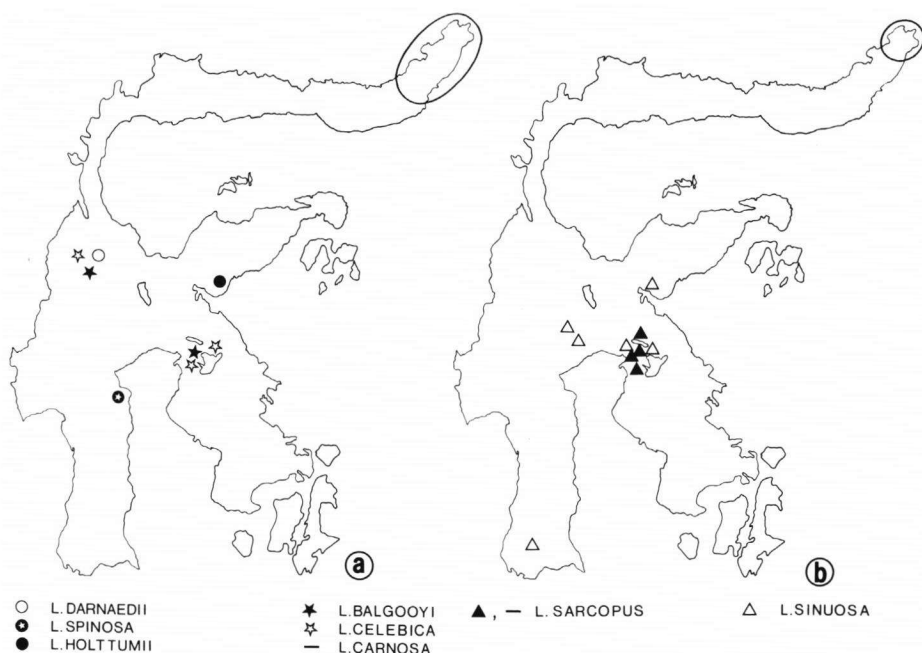


Fig. 1. Distribution of *Lecanopteris* in Sulawesi. – a. The *Lecanopteris* group (all endemic); b. the *Myrmecopteris* group. – Locality records in the Minahassa could not be traced.

### 1. *Lecanopteris balgooyi* Hennipman

*Lecanopteris balgooyi* Hennipman, Kew Bull. 41 (1986) 783. – Type: *Hennipman 5650*, Sulawesi, Central, Sopu Valley (L; iso in BO, K, U).

Rhizome much-branched, forming compact ‘balls’ up to 15 cm across, enclosing branches of trees, or spirally encircling branches, laterally with two rows of hollow conical spines, 6–9 by 2–4 mm, situated on flask-like swellings. *Fronde*s 25–45 cm long, entire to pinnatifid; lamina index 4.5–8(–11), 15–40 by 2–7 cm. *Sori* in one row along the rachis or submarginally to marginally in pinnatifid fronds, 2–3 mm in diam. Sporangia c. 900 µm long, capsule c. 400 by 320 µm. *Spores* bi- to planoconvex, index L/P 1.4–1.8, 50–65 by 35–40 µm. Receptacular paraphyses: 2–4-celled unbranched glandular hairs, with an elongated glandular cell up to 150 µm long.

Distribution. Central Sulawesi (fig. 1a).

SULAWESI. Central: Sopu Valley, *Hennipman 5650* (type). – South: Mt Wawonseru, SW. of Soroako, *Hennipman 6059* (BO, K, KYO, L, U).

Habitat. High epiphyte in upper montane rainforest; c. 1000–1200 m.

## 2. *Lecanopteris carnosa* (Reinw.) Blume

*Lecanopteris carnosa* (Reinw.) Blume, Enum. Pl. Jav. (1828) 120; Fl. Jav. Fil. (1829) pl. 94A; Becc., Malesia 2 (1886) 244, p. min. p.; C. Chr., Ind. Fil., Suppl. 1, Forr. (1913) 117, p.p., excl. *L. pumila*. — *Onychium carnosum* Reinw., Syll. Plant. 2 (1824) 3. — *Polypodium lecanopteris* Mett., Ann. Mus. Bot. Lugd.-Bat. 2 (1866) 244, nom. nov. — *Pleopeltis carnosa* Alderw., Bull. Dépt. Agric. Ind. Néerl. 27 (1909) 3. — *Polypodium carnosum* Christ, Verh. Nat. Ges. Basel 11 (1895) 26, nom. illeg. [non *P. carnosum* Mett. (1857) = *Pyrrosia lanceolata*; non *P. carnosum* Kellogg (1861) = *P. scouleri*]; Yapp, Ann. Bot. 16 (1902) 188. — Type: Reinwardt s.n., s.d., Sulawesi, Minahassa (L; iso in BM; K, coll. Hulton, Veitch 7/84; L, P).

Rhizome much-branched, forming a compact clump up to 1 m in diam., enclosing branches of trees, with 1–3 cm long coralloid excrescences homologous to fronds which are situated in two rows on flask-like swellings, the living parts densely set with many branched brown glandular hairs. *Fronde*s deeply pinnatifid, 25–90 cm long. Lamina index 3–7, 17–70 by 5–14 cm; sterile lobes index 2–5, 3–7 by 1.2–2 cm, fertile lobes index 4–7, 4–10 by 1–1.5 cm, apex acute. *Sori* on extramarginal reflexed lobes, 12–16 to a lobe, 3–5 mm in diam. Sporangia c. 1250 µm long, capsule c. 500 by 300 µm. *Spores* planoconvex, index 1.5–1.8, 70–80 by 40–50 µm. Receptacular paraphyses: (2- or) 3-celled unbranched glandular hairs.

Distribution. N. & NE. Sulawesi (fig. 1a).

SULAWESI. North: Bolaang Mongondow: *de Vogel & Vermeulen 7141* (L). — Northeast: Minahassa, *Alston 15637, 16274* (BM); *Hose s.n.*, -ii-1895 (BM); *Koorders 17011b, 17099b* (L); *Teijsmann 1554* (L), *s.n.*, s.d. (L 908.283-400); *Sarasin & Sarasin 707* (P); *de Vriese & Teijsmann 16* (K, L).

Habitat. Epiphytic on trees in lower montane rainforest up to 1000 m.

## 3. *Lecanopteris celebica* Hennipman, *spec. nov.*

Planta myrmecophila epiphytica. Rhizoma ventricosum, ramis brevibus lateralibus, initio subviride pruinose, demum nigrum coriaceum, spinis paucis, 1–3 mm. Frondes stipitatae, bifariae, 35–100 x 6–18 cm; rhachis flavovirens, lamina frondium fertilium pinnatifida lobata, apicibus loborum obtusus; venae anastomosantes, areolae venulis liberis clavatis includentibus. *Sori* in extensionibus exmarginalibus, reflexi, 1.5–3 mm diametro. Sporae monoletes, biconvexae 55–70 x 25–35 µm (L x P) luteolae, laeves. — Typus: *Hennipman 5665*, Sulawesi Central, Sopa Valley, 1000–1250 m (L; iso in BM, BO, U).

Rhizome much-branched, forming a compact clump up to 50 cm across, enclosing branches of trees, with few short rigid spines, situated in two rows on flask-like swellings, covered with many branched, brown, glandular hairs. *Fronde*s deeply pinnatifid, 35–100 cm long; lamina index 1.5–14, 30–85 by 6–18 cm; sterile lobes index 1.5–10, 3–10 by 1–2 cm, fertile lobes index 4–18, 5–14 by 0.6–1.2 cm, apex rounded, veins slightly sclerified. *Sori* on extramarginal reflexed lobes, 10–30 to a lobe, 1.5–3 mm in diam. Sporangia c. 1000 µm long, capsule c. 430 by 280 µm. *Spores* planoconvex, index L/P 1.6–2.8, 55–70 by 25–35 µm. Receptacular paraphyses: 2- or 3-celled unbranched glandular hairs.

Distribution. Central & S. Sulawesi (fig. 1a).

SULAWESI. Central: near Biromaru, *Hennipman 5007* (BO, L, U). Sopa Valley: *Hennipman 5665* (type). – South: Wawonseru Mt, *Hennipman 5993* (BO, L, U).

Habitat. High epiphyte in higher montane rainforest, around 1000 m; common.

#### 4. *Lecanopteris darnaedii* Hennipman

*Lecanopteris darnaedii* Hennipman, Kew Bull. 41 (1986) 785. – Type: *Hennipman 5322*, Sulawesi, Central, Mt Roroka Timbu, 2425 m (L; iso in BO, K, U).

Rhizome much-branched, creeping straight to somewhat spirally up trees, densely set with rigid spines, ventrally with gall-like swellings between lateral branches. *Fronde*s deeply pinnatifid, 40–60 cm long; lamina index 5–10, 30–55 by 4.5–7 cm, sterile lobes index 2.5–3.5, 2.5–5 by 0.8–1.6 cm, apex broadly rounded, fertile lobes index 2.5–4, 2–5 by 0.8–1.5 cm, veins strongly sclerified. *Sori* 5–12 to a lobe completely covering circular marginal extensions, c. 3 mm in diam., not reflexed. Sporangia c. 900 µm long, capsule c. 320 by 400 µm. *Spores* biconvex, index L/P 1.3–1.8, 55–65 by 35–45 µm. Receptacular paraphyses: 2–4-celled unbranched glandular hairs.

Distribution. Central Sulawesi (fig. 1a).

SULAWESI. Central: Mt Roroka Timbu, *Darnaedi 1564* (BO, K, L); *Hennipman 5322* (type).

Habitat. Epiphytic in the crowns of trees in upper montane rainforest on ridges; from c. 2300 m upwards.

#### 5. *Lecanopteris holttumii* Hennipman, *spec. nov.*

Planta myrmecophila epiphytica. Rhizoma glabrum, ventricosum, nigrum coriaceum, spinis 2–8 mm conicis attenuatis. *Fronde*s stipitatae, bifariae, 20–80 × 3–5 cm, rhachis flavovirens, lamina frondium fertileum pinnatifida lobata, apicibus loborum obtusus; venae anastomosantes, areolae venulis liberis clavatis includentibus. *Sori* in extensionibus marginalibus, reflexi, 1–2 mm diametro. *Sporae* monoletes, biconvexae, 60–70 × 37–43 µm (L×P), luteolae, laeves. –Type: *Lack & Grimes 1743*, Sulawesi, East Central, Morowali Prov., Mt Tambusisi (K).

Rhizome creeping, swollen, densely set with rigid spines, otherwise unknown. *Fronde*s deeply pinnatifid, 20–80 cm long; lamina index 4–25, 15–75 by 3–5 cm; sterile lobes index 1.5–60, 1.5–30 by 1–1.5 cm, fertile lobes index 2–8, 1.5–30 by 0.4–0.8 cm. *Sori* on reflexed marginal lobes, 1–2 mm in diam. Sporangia 1000 µm long, capsule 500 by 300 µm. *Spores* biconvex, index L/P 1.3–1.9, 60–70 by 37–43 µm. Receptacular paraphyses: 2–4-celled unbranched glandular hairs.

Distribution. E. Central Sulawesi (fig. 1a).

SULAWESI. East Central: Morowali Prov., Mt Tambusisi: *Lack & Grimes 1743* (type), 1744 (K).

Habitat. Epiphytic on trees and on rocks on mountain ridge, around 2000 m; common.

Collector's note. (Rhizome clump) 0.5 m across.

## 6. *Lecanopteris spinosa* Jermy & Walker

*Lecanopteris spinosa* Jermy & Walker, Fern Gaz. 11 (1975) 167, f. 1–26. — Type: *Jermy 7609*, Sulawesi, Latimojong Mts, 1950 m (BM; iso in BO, GH, L).

Rhizome long-creeping with many short and only few long lateral branches, forming clusters up to 25 cm in diam., densely set with rigid spines. *Fronde* entire (sterile) to lobed 1/3 to the rachis (fertile), 24–40 cm long; lamina index 8–10, 24–40 by 3–4 cm. *Sori* situated in the upper 2/3 of the frond, in one row along the rachis. Sporangia c. 800 µm long, capsule 300 by 380 µm. *Spores* planoconvex, index L/P 1.6–2.1, 66–72 by 35–41 µm. Receptacular paraphyses absent, with a multitude of sporangiasters, up to 1600 µm long, with an apical part of 80 by 60 µm, consisting of 6–9 thick-walled brown cells.

Distribution. S. Sulawesi (fig. 1a).

SULAWESI. South: Gunung Rantimario, Latimojong Mts, *Jermy 7609* (type); *Walker T 12179* (in herb. Walker).

Habitat. High epiphyte in mixed open oak-podocarp forest (upper montane forest); c. 1950 m (type).

## 7. *Lecanopteris sarcopus* (Teijsm. & Binnend.) Copel.

*Lecanopteris sarcopus* (Teijsm. & Binnend.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 123. — *Polypodium sarcopus* Teijsm. & Binnend., Natuurk. Tijdschr. Ned. Ind. 29 (1867) 241. — *Pleopeltis sarcopus* Alderw., Bull. Dépt. Agric. Ind. Néerl. 27 (1909) 3. — *Myrmecophila sarcopus* Ching, Sunyatsenia 5 (1940) 259. — *Myrmecopteris sarcopus* Pichi Serm., Webbia 31 (1977) 240. — Type: *Teijsmann & de Vriese 75*, Sulawesi, Minahassa, Manado, 'ad arbores' (iso in BM, fragm.; K, L).

*Drynaria lomarioides* J. Smith, Hook. J. Bot. 3 (1841) 397. — *Polypodium lomarioides* Kunze, Abh. Senckenb. Naturf. Gew. 2 (1856) 102, pl. 2: 18, 19; Burck, Ann. Jard. Bot. Buitenz. 4 (1884) 96. — *Pleopeltis lomarioides* Moore, Ind. Fil. (1857) 78; Alderw., Bull. Dépt. Agric. Ind. Néerl. 27 (1909) 3. — *Lecanopteris lomarioides* Copel., Univ. Calif. Publ. Bot. 16 (1929) 123. — *Myrmecopteris lomarioides* Pichi Serm., Webbia 31 (1977) 240. — Type: *Cuming 242*, Philippines, Luzon, Prov. Nueva Vizcaya (K; iso in BM, L, P, US).

*Polypodium savinierrii* ('*Sauvinierrii*') Baker, Ann. Bot. (1891) 480. — Type: *de la Savinière 382*, Sulawesi, Minahassa, 'route de Sukur à Sawāan, sur un tronc d'arbre', 5 Jan. 1877 (K).

Rhizome creeping, forming many lateral branches, which are often branched as well, forming compact 'crusts' up to 25 cm in diam., densely set with adpressed, peltate, clathrate, circular scales, 0.5–2 mm in diam. *Fronde* deeply pinnatifid, 25–120 cm long, situated on rod-like phyllopodia, 0.3–1 cm long; lamina index 3–5.5, 20–100 by 9–20 cm; sterile lobes index 4–6, 5–13 by 1–2.2 cm, fertile lobes index 5–17, 5–13 by 0.5–1.7 cm, veins not sclerified. *Sori* 30–60 to a lobe, in one row halfway between the midrib and the margin, 1–1.5 mm in diam. Sporangia c. 500 µm long, capsule 230 by 110 µm. *Spores* biconvex, index L/P 1.3–1.7, 45–50 by 30–35 µm. Receptacular paraphyses: 2-celled glandular hairs.

Distribution. NE. & S. Sulawesi (fig. 1b), Philippines (Luzon).

SULAWESI. Northeast: Minahassa, *Alston 15640, 16111* (BM); *Forsten 138* (L); *Koorders 17044b* (L, P), *17155b* (L); *Kurz 5274* (HRM); *de la Savinière 382* (P); *Teijsmann s.n., s.d.* (P); *de Vriese 14* (L); *de Vriese & Teijsmann 75* (BM, fragm.; K, L), *s.n., 1859/1860* (L, US). – South: around lake Matano, E. of Nahu, *de Joncheere 1418, 1428* (L); Soroako region, *Hennipman 6074* (L); near Wasoponda, *Hennipman 6019* (L); NW. of lake Towuti, *van Balgooy 3825* (L); *Kjellberg 2158* (S).

Habitat. Epiphytic on trees in lower montane rainforest; from 0–1000 m.

### 8. *Lecanopteris sinuosa* (Wall. ex Hook.) Copel.

*Lecanopteris sinuosa* (Wall. ex Hook.) Copel., Univ. Calif. Publ. Bot. 16 (1929) 123. – *Polypodium sinuosum* Wall. ex Hook., Spec. Fil. 5 (1864) 62, pl. 284. – *Polypodium sinuosum* [Wall., Cat. (1829) no. 2231, nom. nud.] Baker in Hook. & Baker, Syn. Fil. (1868) 355; Yapp, Ann. Bot. 16 (1902) 207. – *Pleopeltis sinuosa* Bedd., Ferns Br. Ind. (1865) pl. 8, c. descr.; Alderw., Bull. Dépt. Agric. Ind. Néerl. 27 (1909) 2. – *Phymatodes sinuosum* J. Smith, Ferns Br. and For. ed. 2 (1877) 296. – *Myrmecophila sinuosa* Nakai ex Ito, J. Jap. Bot. 11 (1935) 98. – *Myrmecopteris sinuosa* Pichi Serm., Webbia 31 (1977) 240. – Type: *Wallich 2231*, in Herb. Finlaysonianum, Malacca (K).

Rhizome creeping, forming on either side few lateral branches, 1–8 cm long, dorsally with two rows of conical projections, sometimes bearing fronds, densely set with adpressed, peltate, clathrate, circular scales 0.5–2 mm in diam. *Fronds* entire to sinuate, 7–45 cm long; lamina index 5–16, 7–38 by 1–35 cm. *Sori* in one row half-way between the primary vein and the margin, 2–5 mm in diam. Sporangia c. 300 µm long, capsule 250 by 250 µm. *Spores* biconvex, index L/P 1.2–1.5, 42–48 by 32–38 µm. Receptacular paraphyses: 2–6-celled unbranched glandular hairs.

Distribution. Central, S. & SW. Sulawesi (fig. 1b) and throughout the Malesian lowlands.

SULAWESI. Central: *Rachmat 845* (Exp. van Vuuren) (L); *Eyma 1537* (L). – East Central: Morowali Prov., *Grimes 1087* (K). – South: around Matano, *Darnaedi 1851, 1923, G 2309* (all in BO, K, L). – Southwest: SW. Malino, *Bünnemeijer 10917* (L).

Habitat. Epiphytic on trees in lowland rainforest; 0–500 m.