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New records, names and combinations of scaly tree ferns (*Cyatheaceae*) in eastern Malesia

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Key words

Alsophila
Cyatheaceae
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Sulawesi
threatened

Abstract Several scaly tree ferns (*Cyatheaceae*) from eastern Malesia are transferred from *Cyathea* s.lat. to other genera: *Alsophila roroka* from Sulawesi; *Alsophila lamoureuxii* from New Guinea; *Alsophila binayana*, *A. bisquamata*, *A. mapahuwensis*, *A. murkelensis*, *A. ohaensis*, and *Sphaeropteris pukuana* from Seram. A new name is chosen for *Cyathea coriacea*, *Alsophila katoi*, which here is first reported for the Vogelkop Peninsula, New Guinea. *Alsophila commutata*, a tree fern with branched trunks, is first reported from the Philippines, expanding its original distribution from the Malay Peninsula, Sumatra, and Borneo. A detailed and revised diagnostic description of this species is provided and a second-step lectotype is chosen.

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INTRODUCTION

The scaly tree ferns (*Cyatheaceae*) comprise c. 600 species worldwide (Conant et al. 1995, Smith et al. 2006) and occur mainly in the wet tropics and southern temperate regions (Lehnert et al. 2013). The Malesian archipelago is considered the main centre of diversity of scaly tree ferns in the Asian region (Tryon & Gastony 1975), with many of the 250 species being single island endemics (Holttum 1963, 1964). The majority of species are found in mountain ecosystems at high elevations with high relative humidity (Coritico 2014). The complex taxonomy of the tree ferns, fragmentary collections, inadequate descriptions, and special descriptive vocabulary all contribute to the poor taxonomic knowledge of this group (Lehnert et al. 2013). As a result, many specimen identifications in herbaria are doubtful or erroneous. Adding to the confusion is the fact that for a long time, two rivalling systems of genera existed, in which many species have to bear different epithets. In the treatments covering the Neotropics, a system that formally recognized several genera was used (Tryon 1970, Lellinger 1987), whereas in treatments for the Paleotropics, all genera were united under *Cyathea* with several subgenera and sections (Holttum 1963, Janssen & Rakotondrainibe 2006, 2007). Phylogenetic studies (Conant et al. 1995, Korall et al. 2007, Janssen et al. 2008) retrieved most of Holttum's subdivisions as monophyletic groups, and confirmed Tryon's splitting of genera as untenable (Conant 1983, Lellinger 1987). The latest classification proposal (PPG 1 2016) favours the recognition of three morphologically definable, monophyletic genera (*Cyathea*, *Alsophila*, *Sphaeropteris*).

Relatively few new taxa have been described from Asia since Holttum's treatments (Holttum 1963, 1964). For one reason, Holttum already dealt with a high number of species described for the region and was able to disseminate his insights in concise descriptions. He also took into account the little understood morphological variability of the taxa, defining some species relatively loosely. This means that using Holttum's treatments, a name can be applied to a specimen in most cases. Only in areas with low tree fern diversity and when a species is morphologically unique (Lu 1998, Takeuchi 2007), taxonomists felt confident enough to describe species as new to science.

Another reason is the difference in accessibility of the mountains of the island archipelagos in the Malesian region compared to, for example, those of South America. In South America most people live in the mountains, thus exploration of this biodiversity hotspot can rely on relatively good infrastructure, allowing comparatively quick transportation on ever-improving roads between towns. In Indonesia and the Philippines, the settlements are concentrated near the shores of the islands and the mountains form the neglected hinterland. Getting from island to island, and from the shores to the mountains consumes much more time and resources, resulting in fewer field trips and few discoveries. As the rather sporadic explorations of the interior of Sulawesi, the Moluccas and New Guinea demonstrate (Hovenkamp & De Joncheere 1988, Kato 1990, Lehnert 2016), the Malesian region still harbours many undescribed species.

In the Philippines, there is a total of 40 accepted species of scaly tree ferns (Holttum 1963). Mindanao and Luzon Islands have the highest species richness with 20 species each (Coritico 2014) but there are areas that have remained unexplored until recently. Mount Kiamo is one of the remaining mountain ecosystems in the province of Bukidnon in Mindanao island (N08°15.301' E125°09.321') with the highest point of 1 760 m; Mt Limbawon is part of the central cordillera on the island of Mindanao together with the Pantaron range (Gronemeyer et al. 2014). It was here in June 2014 and July 2015, respectively, where FPC and VBA collected a species of scaly tree fern of a unique appearance previously not known among Philippine tree ferns. The plants, which had a highly branched stem and weakly but notably dimorphic fronds, were identified as *Cyathea recommutata* Copel. (1909) (*Alsophila commutata* Mett.), a species hitherto only known from the Malay Peninsula, Sumatra, and Borneo. Despite its relatively wide distribution, there is little information about its habit and ecology.

We take the new record for the Philippines as occasion to present a more detailed description of *Alsophila commutata*, con-

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solidate its typification and provide new combinations and names for species still kept under a broadly defined genus *Cyathea*.

TAXONOMIC TREATMENT

Alsophila binayana (M.Kato) Lehnert & Coritico, *comb. nov*.

Cyathea binayana M.Kato (1990) 371. — Type: *Kato et al. C-3841* (holo TI; iso BO, L), Indonesia, Central Seram, Manusela National Park, along trail between Wae Huhu and Owae Puku in Mt Binaya, 2800 m.

Distribution — Indonesia (Seram).

Alsophila bisquamata (M.Kato) Lehnert & Coritico, *comb. nov.*

Cyathea bisquamata M.Kato (1990) 376. — Type: *Kato et al. C-14123* (holo TI; iso BO, L), Indonesia, Central Seram, Manusela National Park, near Muselleinan Pass, in lower montane forest, 700 m.

Distribution — Indonesia (Seram).

Alsophila katoi Lehnert & Coritico, *nom. nov*.

Cyathea coriacea M.Kato (1990) 376, not *Cyathea coriacea* (Rosenst.) Domin (1929) 262 = *Alsophila coriacea* Rosenst. (1914) 50. — Type: *Kato et al. C-3505* (holo TI; iso BO, K, KYO, L, MO), Indonesia, Central Seram, Manusela National Park, along a trail between Wae Ansela and Wae Huhu, in middle montane forest, 1290–2000 m.

Distribution — Indonesia (Seram, Papua Barat).

Specimen examined. Indonesia, Papua Barat (West Papua) Province, Manokwari, Dist. Oransbari, Arfak region, Mt Iwom, S1°20.7' E134°07.6', 1730 m, primary mountain forest, with *Myrtaceae* and *Lithocarpus* sp., 12 Mar. 2011, *Lehnert 2489* (BOG, STU, Z).

Alsophila lamoureuxii (W.N.Takeuchi) Lehnert & Coritico, *comb. nov*.

Cyathea lamoureuxii W.N.Takeuchi (2007) 148, f. 2–3, map. — Type: *Takeuchi*, *Ama*, *Siga & Kavua 16190* (holo LAE; iso A, L), Papua New Guinea, Morobe Province, Siboma Bay, 50 m, 25 Apr. 2002.

Distribution — E Papua New Guinea.

Alsophila mapahuwensis (M.Kato) Lehnert & Coritico, *comb. nov.*

Cyathea mapahuwensis M.Kato (1990) 373. — Type: *Kato et al. C-11697* (holo TI; iso BO, L, MO), Indonesia, Central Seram, Manusela National Park, along trail from Wae Nua to Gunung (Mt) Mapahawe, near Saunulu, in mossy forest on mountain ridge, 880–1010 m.

Distribution — Indonesia (Seram).

Alsophila murkelensis (M.Kato) Lehnert & Coritico, *comb. nov*.

Cyathea murkelensis M.Kato (1990) 373. — Type: *Kato et al. C-12807* (holo TI; iso BO, L), Indonesia, Central Seram, Manusela National Park, along trail (Jalan Pipileina) from Gunung Sinaunia to Marraina in the Murkele mountain range, on steep slope in deep shade in montane forest, 2000–2190 m.

Distribution — Indonesia (Seram).

Alsophila ohaensis (M.Kato) Lehnert & Coritico, *comb. nov*.

Cyathea ohaensis M.Kato (1990) 378. — Type: *Kato M et al. C-11773* (holo TI; iso BO, K, KYO, L, MO), Indonesia, Central Seram, Manusela National Park, along trail (Jalan Lelesiru) to Gunung (Mt) Ohae, in light shade in *Cyathea*-mixed sparse forest, 400–990 m.

Distribution — Indonesia (Seram).

Alsophila roroka (Hovenkamp) Lehnert & Coritico, *comb. nov*.

Cyathea roroka Hovenkamp in Hovenkamp & De Joncheere (1988) 397. — Type: *Hennipman E 5286* (holo L 3 sheets (L0051390, L0051391, L0051392); iso K (K000721210) , U (U0007312), US (US00604360)), Indonesia, Sulawesi Tengah, Roroka Timbu, Mountain Forest, 2000 m, 11 May 1979.

Distribution — Indonesia (Sulawesi).

Sphaeropteris pukuana (M.Kato) Lehnert & Coritico, *comb. nov*.

Cyathea pukuana M.Kato (1990) 381. — Type: *Kato M. et al. C-1530* (holo TI; iso BO, L), Indonesia, Central Seram, Manusela National Park, along a trail between Owae Huhu and the summit of Gunung (Mt) Owae Puku, northeast of G. Binaya, 2800 m.

Distribution — Indonesia (Seram).

Alsophila commutata Mett. — Fig. 1; Map 1

Alsophila commutata Mett. (1863) 53. — *Cyathea recommutata* Copel. (1909) 36, nom. nov. for *Alsophila commutata* Mett., not *Cyathea commutata* Spreng. (1804) 146, t. 3, f. 32. — *Gymnosphaera recommutata* (Copel.) Copel. (1947) 98, nom. superfl. — Type: *Cuming 396* (lecto K, first step, selected by Holttum (1963) 118, second step (K000636428), selected here; isolecto BM 3 sheets (BM001048020, BM001048021, BM001048022), K 2 sheets (K00636429, K000636430 p.p.), P (P00631684)), Malaysia, Malacca, 1841.

Alsophila heteromorpha Alderw. (1914) 1; (1917) 56; (1920) 129. — *Cyathea heteromorpha* (Alderw.) Domin (1929) 262. — Type: *Matthew 688* (K (K000698822, K000698823, K000698824)), Indonesia, Sumatra, Gunong Sago, 29 Jan. 1913.

Alsophila heteromorpha var. *decomposita* Alderw. (1920) 129. — Type: *Bünnemeijer 3047* (holo L (L0051387); iso K (K000698827), L (L0051386)), Indonesia, Sumatra, Mangani, Sumatra Bi Tinggi bij Mangani, 1100 m, 15 June 1918.

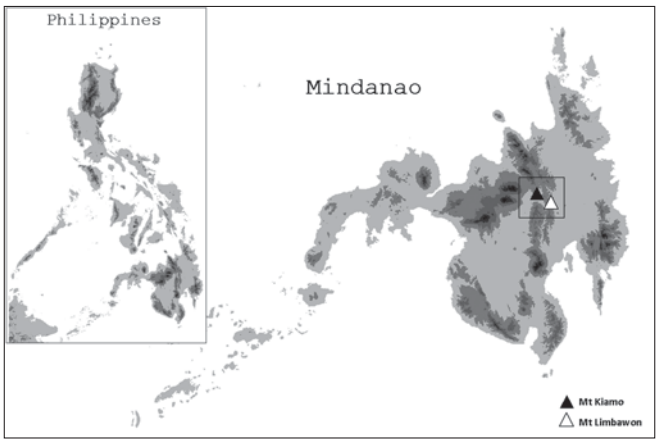
Cyathea hewittii Copel. (1911) 134. — *Alsophila hewittii* Alderw. (1917) 55; C.Chr. (in Christensen & Holttum 1934) 221. — Type: *Brooks & Hewitt 21* (holo MICH (MICH1190233)), Malaysia, Sarawak, Bongo Mountain.

Cyathea toppingii Copel. (1917) 51; C.Chr. (in Christensen & Holttum 1934) 220. — Type: *Topping 1824* (holo PNH destroyed; iso GH-00020915, NY-00127883, S (S-P-3433), MO (MO255790), US (US00134805), MICH (MICH1190283)), Malaysia, Gurulau Spur, Mount Kinabalu, 21 Nov. 1915.

Alsophila subulata Alderw. (1918) 1. — *Cyathea subulata* (Alderw.) Domin (1930) 164. — Type: *Brooks 300.S* (holo not located; iso BM 4 sheets (BM001048023, BM001048024, BM001048025, BM001048026)), Indonesia, Sumatra, Lebong Simpang, Benkoelen, Aug. 1917.

Gymnosphaera squamulata auct. non Blume (1828) 243, J.Sm. (1841) 419. — *Alsophila squamulata* auct. non (Blume) Hook. (1844) 51, Hook. & Baker (1867) 235.

Tree fern. *Trunks* erect to decumbent, to 3 m tall, 10–16 cm diam, smooth to muricate, with old petiole bases; frond scars not observed, trunk apices not visible, covered with crowded petioles; adventitious buds present, sprouting up to 8 branches.



Map 1 Distribution of *Alsophila commutata* Mett. in the Philippines.

Fronds to 210 cm long, ascending, crown funnel shaped. *Petioles* covered with reddish brown scales from stipe up to rachis and costa 4–6 cm long, smooth, dark purple to black abaxially and adaxially, on each side with a line of discontinuous small narrowly elliptic dark brown pneumatodes; coarsely dissected aphlebiae at base of petiole 4–10 pairs, reflexed to 5 cm long, evanescent with age, the strong costae remaining as blunt spines, aphlebiae either separated by gap from rest of the normal pinnae (Sumatra to Borneo) or transient with them (Sumatra, Philippines). *Petiole scales* marginate with one apical setae (often broken off), concordantly bicolorous, lanceolate to ovate, 8.0–10.0 by 1.5–2.0 mm, tips weakly heli-

Fig. 1 *Alsophila commutata* Mett. a. Habit, showing branching trunks; b. lamina outline; c. petiole; d. gradually reduced basal pinnae, lowest one skeletonized; e. sori. — Photos by Fulgent P. Coritico.

cally twisted, dark brown scale body and margins usually light brown to whitish, not orange or rufescent; petiole scurf red to reddish brown. *Laminae* to 210 by 75 cm, bipinnate-pinnatifid to tripinnate (when fertile), weakly dimorphic, fertile pinnules slightly contracted, subcoriaceous, ovate to elliptic, basal pinnae gradually reduced, dark green adaxially, pale green abaxially. *Pinnae* with stalks to 0.5 cm long, alternate, largest ones 35–40 by 14–16 cm, 11–13 pairs, costae dark brown to black on both sides. *Pinnules* stalked 1.0–4.0 mm long, linear oblong to lanceolate, alternate, largest ones 6.0–7.5 by 1.3–1.5 cm, cordate to weakly truncate at bases, acute at tips, alternate, 0.7–0.9 mm between the costules. Segments adnate or in lower part free tertiary leaflets, 6.0–7.0 by 2.5–3.0 mm, oblique to straight with strongly crenate margins, the sinuses somewhat triangular, 1.0–1.5 mm between midveins, sterile segments flat, fertile segments not concave abaxially. *Veins* free, forked, pale adaxially, dark abaxially; basal basiscopic veins attached to the midveins. *Sori* near the costules, 4–5 pairs per segment. *Indusia* absent. *Spores* tetrahedral, trilete, with straight sides and broadly rounded corners, 35–40 µm. *Hairs and scales*: antrorsely curved, dark reddish brown hairs abundant adaxially on rachises, costae and costules; rachises and costae adaxially with few long, narrow pale brown scales and abaxially with persistent dark brown scales with pale margins; few pale brown bullate scales abaxially on costules and midveins.

Distribution — Malay Peninsula, Sumatra, and Borneo at 600–1500 (–2000) m; on the Philippines only on Mt Kiamo and Mt Limbawon (Mindanao) in montane forests at c. 1600–1700 m.

Specimens examined. Indonesia, Sumatra, Bukit Tinggi, c. S0°18' E100°21', 1100 m, 15 June 1918, *Bünnemeijer 3049* (K); Sumatra, Atjeh, Gunong Kemiri, c. N3°44' E97°29', 900–1600 m, 22 Aug. 1971, *Iwatsuki et al. S.875* (K); Borneo, Kalimantan Timur, Gunung (Mt) Mandam, north of Tabang, c. 600 m, 15 Jan. 1979, *Iwatsuki et al. B-2507* (K); Borneo, Kalimantan Timur, Gunung (Mt) Buduk Rian, south of Long Bawan, Krayan, N03°50' E115°42', 1500–1900 m, 18 Aug. 1981, *Kato et al. B-11427* (K); East Borneo, Mt Palimasan near Tabang on Belajan River, 800 m, 12 Sept. 1956, *Kostermans 12973* (K). – Malaysia, Borneo, Sabah, Mt Kinabalu, Mesilau River, 11 Feb. 1964, *Chew & Corner RSNB4331* (K); Sarawak, Mount Dulit, c. N3°22' E114°12', 1230 m, 9 Sept. 1932, *Richards 1638* (K). – Philippines, Mindanao, Bukidnon, Kibalabag, Malaybalay, Mt Kiamo, along the trail going to the peak 1, N08°15.30' E125°09.321', 1634 m, 14 June 2014, *Coritico FPC 133* (CMUH-00008408); Mindanao, Bukidnon, Kibalabag, Malaybalay, Pantaron Range, Mt Limbawon, along the trail going to the peak, N08°16.264' E125°10.853', 1698 m, 1 July 2015, *Coritico FPC 232* (CMUH-00008580).

Notes — In their descriptions of *A. commutata*, neither Copeland (1909) nor Holttum (1963) did mention the branching of the trunks, although it is the most obvious diagnostic feature of the species in the field. At first, we mistook the Philippine plants for *A. atropurpurea* (Copel.) C.Chr., due to the lack of indusia and the presence of skeletonized basal pinnae, so-called aphlebiae. This character combination defines many species of the *Gymnosphaera* clade (Korall & Pryer 2014) morphologically, and *A. atropurpurea* was the only member of this clade hitherto known from the Philippines (Holttum 1963). This is a low number compared to neighbouring islands (Holttum 1963) and the presence of further species was expected when we started our study. One of the expected species was the Bornean *Alsophila ramispina* Hook., a tree fern described by Copeland (1909) as bearing 3–5 branched black spines to 4 cm long at the petiole bases, which Holttum (1963) anatomically correctly identified as skeletonized basal pinnae "… all with laminae reduced to a narrow wing along veins and costae". *Alsophila commutata* differs in having comparatively coarsely dissected basal pinnae with broader remnants of laminar tissue along the free veins. The skeletonized basal pinnae are usually remote from the next regular pinnae in *A. ramispina* and *A. atropurpurea.* Pictures from Malaysia (Piggott 1988) show this gap between skeletonized and normal pinnae also for *A. commutata* but in the Philippine population, regular pinnae are gradually transient with the skeletonized basal pinnae, without any gap. The same can be found in some specimens from Sumatra (type of *A. heteromorpha*, K000698822). In their account of ferns from Sarawak, Borneo, Tagawa & Iwatsuki (1966) already pointed out the variability of this character in *A. commutata*.

Alsophila commutata is reliably distinguished from *A. atropurpurea* and *A. ramispina* by having short paraphyses not surpassing the sporangia (vs basally broad paraphyses with narrow filamentous apex surpassing the sporangia in the other two species). Among them, *A. ramispina* further shows the strongest tendency towards dimorphism between fertile and sterile leaves, with fertile pinnules sometimes only half as wide as sterile ones.

The information 'Mt Ophir' as type locality of *A. commutata* (Holttum 1963) comes from the sheet K000636430, where a pinna labelled 'Mt Ophir, Griffith' is mounted below an apex labelled '396. *Gymnosphaera squamulata* Bl., Malacca, Cuming'. The other sheets at K and those at BM and P have only the latter reference. Only the Cuming material should be considered as lectotype material (Holttum 1963), and consequently the information 'Mt Ophir' can be ignored when referring to the type locality.

Copeland (1909) based his *Cyathea recommutata* on *Alsophila commutata* Mett. Mettenius (1863) mentioned an '*A. commutata*' without indication of an author in his treatment of *Alsophila squamulata*, following a comparison with *Alsophila glabra* Hook.; there is no earlier publication citing this name. Mettenius states that "*A. commutata* (…) deviates in the hard-coriaceous lamina, covered with indument, half-round lobes, veins in lower number, paraphyses equalling the sporangia, partially with apex notably thickened" (pers. translation). Especially the last character is in contrast to his description of *A. squamulata*, which is stated to have "numerous articulate paraphyses overtopping the sporangia by a little or notably, at apex attenuate or obtuse" (pers. translation). This is still a distinguishing character between the two taxa, additional to the scale type and the dimorphism in the lamina (non-marginate scales, monomorphic lamina in *A. squamulata* vs marginate scales, dimorphic lamina in *A. commutata*). Today, *A. squamulata* is treated as *Sphaeropteris squamulata* (Blume) R.M. Tryon (Tryon 1970, PPG 1 2016), and *A. glabra* and *A. commutata* belong to the *Gymnosphaera*-clade of *Alsophila* (Korall & Pryer 2014).

The placement of the description of *A. commutata* in the original publication (Mettenius 1863) as a short paragraph under *A. squamulata*, without extra caption and printed in a smaller font makes us doubt that the author intended to describe a new species there. However, since Mettenius (1863) referred to publications of other authors who previously treated material of *A. commutata* as *A. squamulata* and summarized the differences between the two taxa, this constitutes a valid and effective publication of a new species. The collection *Cuming 396* and its illustration (Bauer & Hooker 1842) have to be regarded as original material (Art. 9.3, Melbourne Code; McNeill et al. 2012), which Holttum (1963) correctly identified as type (first-step lectotypification), and from which we designate one sheet as lectotype (second-step lectotypification).

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