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Taxonomic and nomenclatural notes on Philippine ferns. IV. *Asplenium pahli* (Polypodiales, Aspleniineae, Aspleniaceae), a new species from Leyte, Philippines

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Abstract

Asplenium pahli, a new species from Leyte, Philippines, is described. Morphological and distribution range differences between *A. pahli*, *A. anisodontum*, *A. caudatum*, *A. falcatum*, *A. gueinzianum*, and *A. planicaule* are discussed. The habitat and climate of Eastern Leyte is described.

Keywords: Philippine pteridophyte taxonomy, Philippine new species

Introduction

While studying the species confused with *Asplenium caudatum* G.Forster (1786: 80) at US and P, the author accidentally found four specimens collected by C. A. Wenzel (*Wenzel 572*) on the island of Leyte in Central-Eastern Philippines. These plants were in the folders of *A. caudatum* but labeled *A. adiantoides* (Linnaeus 1753: 1098) Lamarck (1786: 306), *A. falcatum* Lamarck (1786: 306) or *A. anisodontum* C.Presl (1849: 73). They do not belong in *A. caudatum*, *A. falcatum*, *A. anisodontum* or any of the other species confused with them (Salgado 1996, 2020). The purpose of this study is to show the differences between the ferns collected by Wenzel on 5 February 1914 and the species confused with it.

Chester A. Wenzel collected in the island of Leyte in Central-Eastern Philippines in the years 1913–1915, near the towns of Dagami and Jaro (Steenis-Kruseman 1950). *Wenzel 572* was collected on 5 February 1914, at 500 m elevation, but no specific location was reported. In 1914, at this elevation, the forest was “unexplored and unsettled” according to Wenzel’s letter to Sir David Prain, Director of the Royal Botanic Gardens, Kew, England (Wenzel 1913; Figure 1). In Eastern Leyte at 500 m, the humidity is higher than at lower elevations, and the rains are distributed throughout the year (Goode 1912; PAGASA 2020) conditions conducive to the growth of lowland tropical rain forest. The present situation in this area has changed since the time of Wenzel’s collection. The lowland tropical rain forest where *Wenzel 572* was collected has since been logged and converted to secondary growth forest or to agriculture (Lasco *et al.* 2001; Mongabay 2020).

Materials and methods

The character states such as habit, indument type, size, shape, color, dimensions, dissection, and fertility, of morphological features such as roots, rhizome, fronds, pinnae, and sori were used to distinguish *Wenzel 572* from other species of *Asplenium* confused with it. The author visited collections at B, BM, BR, K, L, LIV, MA, NY, P, PR, PRC, S, UPS, US, W and Z. The virtual herbarium collections at F, LE, MICH, MU, MW, PH, and UC were consulted. The folders of *A. caudatum*, *A. adiantoides*, *A. falcatum*, *A. anisodontum*, and indeterminate specimens were searched to find misidentified plants of *Wenzel 572*. Information on the original or additional labels was recorded. Drs. Christopher Fraser-Jenkins and Boonkerd Thaweesakdi were consulted about the identity of *Wenzel 572*. Because of superficial resemblance, *Wenzel 572* specimens were compared with the types of *A. gueinzianum* Kuhn (1868: 103) and *A.*

planicaule Wallich (1828: Cat. No. 189) ex Mettenius (1859: 201). The terminology used in the descriptions is that of Lellinger (2002). The abbreviations of authors follow the International Plant Names Index (IPNI). The designation of holotype follows the International Code of Botanical Nomenclature (ICBN). The Creative Commons licenses of the owner's herbaria for use of images were confirmed by the author. A written license from the Royal Botanic Gardens, Kew Archives was obtained to publish Wenzel's letter to Sir David Prain.

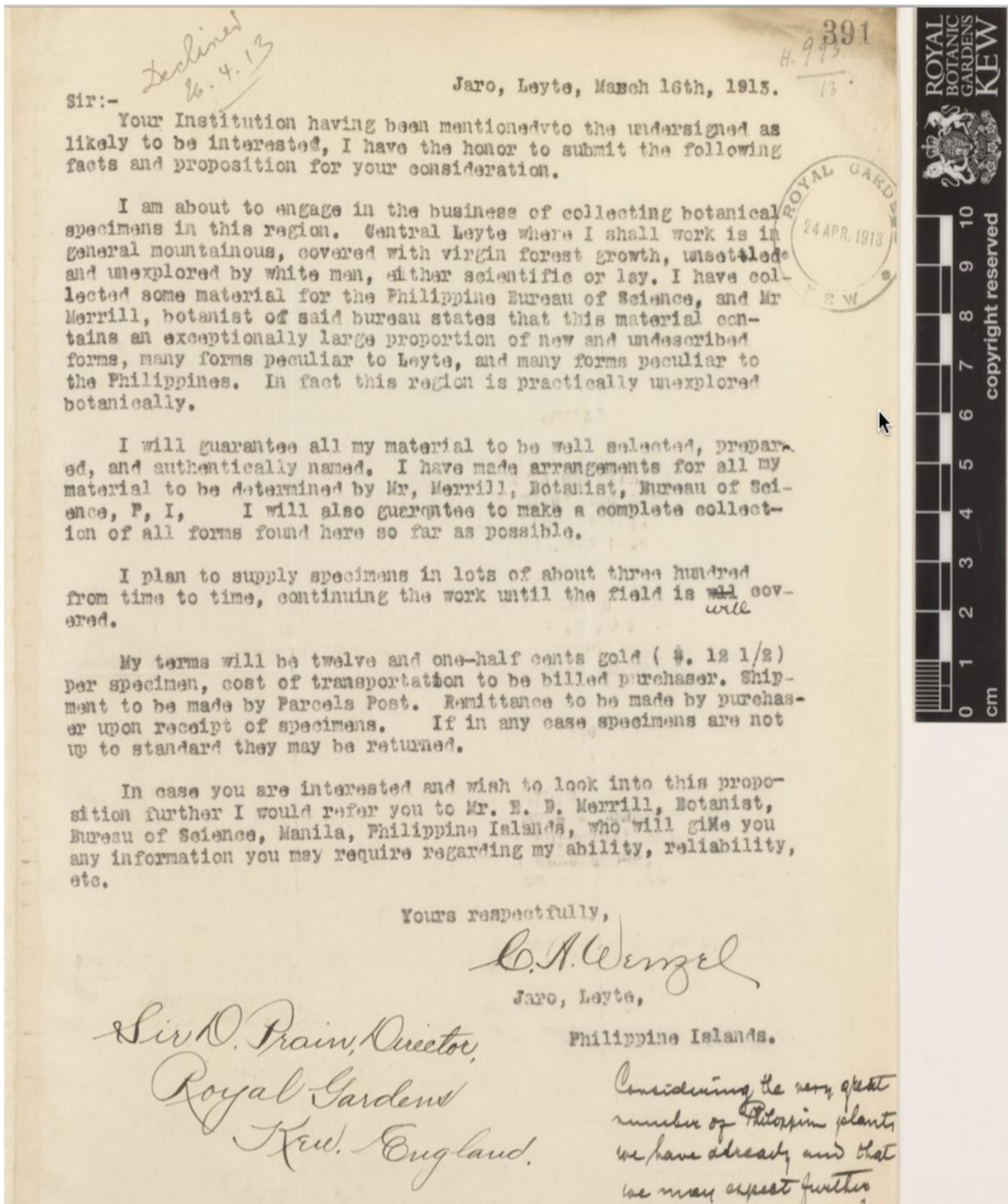


FIGURE 1. Letter of C.A. Wenzel to Sir David Prain, Director of the Royal Botanic Gardens, Kew. Wenzel proposes to collect for the Royal Botanic Garden in an unexplored area of central Leyte. Image reproduced with the kind permission of the Board of Trustees of the Royal Botanic Garden, Kew. Available at: <https://plants.jstor.org/stable/10.5555/al.ap.visual.kdcas9949>

Results

A total of five specimens of *Wenzel 572* were found: one at US, one at F, and three at P. No other specimens were found in the consulted herbaria. The plant at F and one at P are missing the rhizome; the others are complete specimens. The labels contain the same information: collector's name and number (*Wenzel 572*), date of collection (5 February 1914), elevation (500 m). All plants were distributed with the double title "Plants of the Philippines. Plants of Leyte." The original labels of the specimens at P were replaced with newer ones of an unknown date, but the information copied is the same as that on the original labels. The P specimens were identified as *A. adiantoides* on the new labels; the US and F specimens were identified as *A. falcatum* on the original labels. Copeland added a label to the US specimen identifying it as *A. anisodontum* (US01516038!).

Taxonomic Treatment

Asplenium pahli Salgado, *sp. nov.* (Figure 2).

Type:—PHILIPPINES, Leyte, 500 m, 5 February 1914. *C.A. Wenzel 572* (holotype P00370339! designated here, isotypes P00370338!, P00370340!, C0364253F (F!), US01516038!).

Diagnosis:—*Asplenium pahli* and *A. anisodontum* have a proliferous rachis but differ in the pinna shape and serration. *A. pahli* differs from *A. caudatum*, *A. falcatum*, *A. gueinzianum*, *A. planicaule* and *A. polyodon* in the proliferous rachis, the pinna margins being irregularly serrate, sinuses of different depth and width, fewer sori distant from the costa, not contiguous, and straight or slightly falcate.

Terrestrial. Rhizome short, erect, 0.4–0.5 cm thick, paleae and palea bases few, scattered, clathrate, black, lanceate, margin entire, < 1mm long, upper part of the paleae often broken off, cells small, polygonal. Roots many, crowded at the base of fronds, brown, thin, fragile when dried. Fronds erect, pinnate, crowded at the apex of the rhizome, spirally arranged, 25–45 cm long. Stipes 10.5(13.0–17.0)21.0 cm long, adaxial side grooved, abaxial side rounded, greenish, glabrous or glabrescent, with sparse paleae, paleae bicolorous, base and margin light brown, central area black, lanceate, ≤1 mm long, adpressed against the surface, margin entire, irregular with an occasional acute projection formed by a clathrate cell wall, palea apex acute. Lamina oblong, 15–35 cm long, (5.5)6.5–8 cm wide, base truncate, pinnate, chartaceous, 12–15 alternating pinna pairs, pinnae slightly reduced at near apex. Rachis proliferous, abaxial side rounded, adaxial side with a wide U-shaped groove with prominent ridges, greenish, glabrescent, with adpressed small paleae, ≤1 mm long, lanceate, black, margin entire, apex acute, paleae on both sides of the rachis. Pinnae 3.2–4.0 cm long, 1.0–1.3 cm wide in the middle, noncontiguous, alternating, generally trapezoid, stalked to sessile, stalk ≤1 mm long, naked or with few paleae, lamina adaxial side glabrous, abaxial side glabrous or with a few reduced paleae on the costa, costa prominent of both sides, adaxial side grooved with prominent ridges gradually disappearing toward the pinna apex, abaxial side rounded, basal pinna pair sub-opposite or alternating, generally oblong, of the same length and shape as median pinnae or slightly smaller; pinna base basicopic side cuneate, acroscopic side cuneate to broadly cuneate, pinna apex acute, pinna margins irregularly serrate, sinuses of different depth and width, acroscopic margin with 5–6 oblique widely separated teeth, larger teeth with 2–3 apical teeth, teeth blunt or acute, basicopic margin serration similar to acroscopic margin, 3–5 oblique widely separated teeth, lamina apical segment usually missing, when present deformed with a proliferous bud at the insertion with the rachis. Venation free, costa visible with prominent ridges, 5–7 pairs of veins oblique to the costa, abaxial side veins not visible, adaxial side veins hardly visible, once forking, ending near the margin; hydathodes absent. Sori in a single row distal from pinna base, on both sides of the costa, originating about 1 mm from costa, oblique, widely separated, 3–6 sori on the acroscopic side, 2–5 on the basicopic side, 5–7 mm long, occupying middle portion of lamina, ending before reaching the margin. Indusium thick, brown, entire, rolls back to expose mature sporangia, margin entire or slightly jagged.

Distribution and ecology:—Island of Leyte, Central-Eastern Philippines. A terrestrial species growing on the eastern slopes of the Leyte Cordillera, at 500 m elevation, in lowland tropical evergreen rainforest. Climate warm and humid; rainfall evenly distributed throughout the year (Pagasa 2020).

Etymology:—The species epithet honors Brother George Pahl, FSC, Ph.D., an American biologist and university professor who taught, mentored, and inspired thousands of students in the United States and the Philippines during his teaching career spanning more than 50 years.



FIGURE 2. *Asplenium pahli* Salgado, Wenzel 572, holotype (P). Note the plantlets near the apex of two fronds. Muséum national d'histoire naturelle, Paris, France. Collection: Vascular plants P00370339. License CC Attribution 4.0 International. Available at: <https://science.mnhn.fr/institution/mnhn/collection/p/item/p00370339>

Conservation status:—*A. pahli* was collected in an area near the towns of Dagami and Jaro that is presently denuded of its original primary growth forest (Lasco *et al.* 2001; Mongabay 2020). The only collection known is that of Wenzel in 1914. This is a possible indication that *A. pahli* is endangered or possibly extinct in its type locality. There might be more plants scattered in the remaining stands of old growth deep in the Leyte Cordillera.

Asplenium caudatum, *A. falcatum*, *A. anisodontum* and *A. pahli* represent different species as shown by the characters presented in this key.

1. Fronds non proliferous2
1. Fronds proliferous3
2. Basal pinnae not decreasing in size, lamina base truncate; acroscopic basal pinna lobe with a prominent sharp tooth, sori single row, oblique to costa *A. falcatum*
2. Basal pinnae gradually decreasing in size, lamina base attenuate; acroscopic basal pinna lobe without a prominent sharp tooth, sori in two rows, one parallel to costa and one oblique to costa *A. caudatum*
3. Fronds up to 120 cm long. Stipe and rachis dark brown; rachis hirsute, paleae projecting away from the stipe and rachis, oblong to lanceate or reduced to long twisted biserrate filaments, margin with prominent biserrate projections up to five cells long, palea base and margin concolorous with the rest of the palea, apex a long twisted biserrate filament; median pinnae falcate, 10.0–15.6 cm long, 0.9–1.2 cm wide; sori close and parallel to costa then curving towards the margin, 7–11 mm long, contiguous *A. anisodontum*
3. Fronds up to 45 cm long. Stipe and rachis greenish; rachis with a few scattered paleae, paleae adpressed against the stipe and rachis surface, deltoid to lanceate in shape, margin entire and irregular, with an occasional short, acute projection caused by a cell wall, palea base and margin bicolorous with light brown margins and black central area, apex acute; median pinna straight, 3.5–4.0 cm long and 1.0–1.3 cm wide; sori distant from the costa, straight or slightly falcate, oblique, 5–7 mm long, not contiguous *A. pahli*

Discussion

Asplenium anisodontum (Figure 3) has a confusing taxonomic history. The name *A. anisodontum* has been applied to plants superficially similar but not conspecific and of different distribution. Salgado (1996) clarified the identity of *A. anisodontum*, which was confused with *A. longissimum* Blume (1828: 178) and *A. acutiusculum* Blume (1828: 178). *A. anisodontum* is found in the Philippines, but it is not conspecific with *A. pahli* as shown by the key and photos (Figures 2–5). *A. pahli* is a much smaller plant with restricted distribution to the island of Leyte. *A. anisodontum* is widely distributed in the Philippines and found in Sumatra, Borneo, and Sulawesi. The confused nomenclature of *A. falcatum* and *A. adiantoides* has been elucidated by Salgado & Fraser-Jenkins (2013). *A. adiantoides* is an African plant distinct from the S Asian *A. falcatum*. The name *A. falcatum* was commonly misapplied to plants ranging from India to Polynesia, superficially similar but not conspecific. Morton (1967) considered *A. falcatum* an illegitimate name and proposed to replace it with *A. polyodon* G.Forst. (1786: 80; Figure 7). This change was an illegitimate *nomen novum*, as explained by Salgado & Fraser-Jenkins (2013). *A. polyodon* is a distinct plant found in Australasia (Figures 7). Salgado & Fraser-Jenkins (2013) reported that the name *A. falcatum* should be applied to the plant described by Burman in *Thesaurus Zeylanicus* (1737: t. 43) and cited by Linnaeus under *Trichomanes adiantoides* in *Species Plantarum* (1753: 1098). *A. falcatum* is distinct from *A. pahli*, in having a sharp pointed tooth on the basal acroscopic lobe of the pinnae (Figure 5, 6). It is native to India, Sri Lanka, Myanmar, and Thailand. *A. falcatum* is absent from most of SE Asia, Malesia, and the Philippines. Salgado (2017) reported that Philippine plants commonly named *A. falcatum* or *A. polyodon* belong to *A. macrophyllum* Swartz (1800: 52) or *A. simile* Blume (1828: 181), a synonym of *A. oxyphyllum* Kunze (1846: 441). Salgado (2020) discussed the identity and distribution range of *A. caudatum*, a Polynesian plant restricted to the Society and Marquesas Islands.

Wenzel 572 was compared with the type of *A. gueinzianum*. It differs from *A. pahli* in its distant pinnae, deeply cut and almost separate basal acroscopic pinna lobe, and deeply incised margins. *A. pahli* lacks the acroscopic basal lobe characteristic of *A. gueinzianum*. *A. gueinzianum* is an African and S Asian species that has not been found in the Philippines. *A. pahli* was compared with the type of *A. planicaule* (= *A. yoshinagae* (Makino 1900: pl. 64) subsp. *indicum* (Sledge 1965: 264) Fraser-Jenk. (1992: 97)) published by Mettenius. It differs from *A. pahli* in its flattened stipe, pinna margin with deep and oblique incisions, secondary veins on the adaxial side prominent, and contiguous, and overlapping sori extending into the lobes, in contrast with *A. pahli*'s terete stipe, shallower incisions, secondary veins not prominent, and distant sori of same lengths not extending into the lobes. The range of *A. yoshinagae* subsp. *indicum* extends from the Indian subcontinent, South and Central China, East and West Himalayas, Myanmar, SE Asia to Borneo. To our knowledge, it has not been collected in the Philippines.



FIGURE 3. *Asplenium anisodontum* C.Presl, *Cuming 128*, isotype (B). Courtesy of the Herbarium Berolinense, Berlin, Germany. Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License. Available at: <http://herbarium.bgbm.org/object/B200011341>



FIGURE 4. *Asplenium anisodontum* C.Presl, *Cuming 128* (B). Note the pinna shape, serration and soral arrangement. Courtesy of the Herbarium Berolinense, Berlin, Germany. Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Public License. Enlargement of a section by Salgado of the specimen available at: <http://herbarium.bgbm.org/object/B200011341>



FIGURE 5. *Asplenium pahli* Salgado *sp. nov.*, Wenzel 572, P00370340 (P). Note the serration of the pinna and the soral arrangement. License CC Attribution 4.0 International. Enlargement of a section by Salgado of the specimen available at: <https://science.mnhn.fr/institution/mnhn/collection/p/item/p00370340>



FIGURE 6. *Asplenium falcatum* Lam. Hermann s.n., BM000621974, Herb. Hermann 3: 47, no. 385 (BM). Note the pinna shape and basal acroscopic tooth, serration and soral arrangement. Courtesy of the Herbarium, British Museum of Natural History, London, England. License CC0-10. Specimen available at: <https://plants.jstor.org/stable/10.5555/al.ap.specimen.bm000621974>



FIGURE 7. *Asplenium polyodon* G.Forst. R. Schodde 316 (BM). Note pinna shape, serration and soral arrangement. Courtesy of the Herbarium, British Museum of Natural History, London, England. Photo by A.E. Salgado; not published.

Specimens examined

Asplenium anisodontum C.Presl

Holotype (designated by C. Presl 1849):—PHILIPPINES. Luzon: *Cuming 128* (PRC *non vide*); isotypes L0050982!, L0050983!, BM001045207!, BM001045208!, BM001045209!, BM001045210, B 20 0011335!, B 20 0011341!, E 00210809!, MICH1003398B!, MW0000516!, US00065552!, W0052502!.

Asplenium caudatum G.Forst.

ISLANDS OF THE PACIFIC OCEAN. Isotypes, islands of the Pacific Ocean, *G. Forster s.n.* (BM001048371!); *G. Forster s. n.* (LIV!); islands of Pacific Sea, *G. Forster s.n.* (GOET012797!).

FRENCH POLYNESIA, Society islands, Tahiti: vers 1200 m, *Nadeaud s. n.* (P!); Herbar E. Drake, *Savatier s. n.* (two sheets, P!); Herbar E. Drake, *Nadeaud s. n.* (P!); Vallée de la rivière Paho, Toahotu, crête sud, 149°16'W, 17°47'S, 650 m, *Florence & Jourdan 11075* (US01517559!); Island of Moorea: Mt. Muaroa, elev. 429 m, 17.54735°S, 149.84485°W, 12 August 2010, *J. Nitta 570* (P00847390!). Marquesas Islands, Ua Pou Island, Poumaka, mid-elevation wet forest, 680 m, 9° 23' 26", 140° 4' 58", 30 October 2017, *Schuettpelz, E. Wood, K.R. & Butaud, J.-F. 1857* (US01936878!); Hivaoa, *F.W. Christian s.n.* (P!); Fatu Hiva, *K.R. Wood 4491*, 2 sheets (P!).

Asplenium falcatum Lam. = *Trichomanes adiantoides*

Lectotype (designated by Salgado & Fraser-Jenkins 2013):—SRI LANKA: 1737, *J. Burman Thesaurus Zeylanicus t. 43*. Epitype (designated by Salgado & Fraser-Jenkins 2013):—SRI LANKA. North Central Province: Ritigala, 14 January 1951, *W.A. Sledge 873* (US01514788!).

SRI LANKA, 1717. *P. Herrmann s.n.*, Historical Collections, Herb. Herrmann 3: 47, no. 385, (BM000621974!). North Western Province: Kurunegala District, *R.B. Faden & A.J. Faden 76/400* (US01514785!). INDIA. Courtallam: East India Company; s. coll. (K001109576!, K00119577!); Assam: Darrauz District, Balipara forest; *M. Gustav s.n.* (US01514780!).

Asplenium gueinzianum Mett. ex Kuhn

Holotype (verified by R. Vianey):—SOUTH AFRICA: Port Natal: *Gueinzus s.n.* (B20 0015752!).

Asplenium pahli Salgado

Holotype (designated here by A.E. Salgado):—PHILIPPINES. Leyte, *C.A. Wenzel 572*, P00370339!; isotypes P00370338!, P00370340!, US01516038!, UC267862!, C0364253F! (F).

Asplenium planicaule Wall. ex Mett. = *Asplenium yoshinagae* (Makino) subsp. *indicum* (Sledge) Fraser-Jenk.

Lectotype (designated by Morton 1973):—NEPAL. 1820, Numerical List (Catalogue) No. 189-1, *Wallich s.n.*, isotypes BM001045235!, K001109500!, K001044577!, NY214847!, UC267862!. INDIA. Srinugur [Srinagar], 1820, Numerical List (Catalogue) No. 189-2, *W. Moorcroft s.n.*, isotypes K001109501!, NY214848!; Nilgiris, Flora of Madras, 6000 ft [1828 m], May 1886, *Gamble 17334* (US01515892!).

CHINA. Yunnan, Yangbi Xian, W side of Diancang Shan mountain range. En route from Xueshanhe to Dapingzi, growing on crevices of a ledge, 25° 43'N, 100° 02'E, 2300-3000 m, 17 June 1984, *Sino-American Botanical Expedition to Yunnan Province 242* (US3043222!); Yunnan Red River forest across from Maubao Mongtze, *W. Hancock 187* (K001092464!). COUNTRY UNKNOWN. Himalayas, *J.F. Royle s.n.* (PH00025140!);

Note: Morton (1973) designated *Wallich* No. 189 (B) as the lectotype of *A. planicaule*. The present author was not able to locate this specimen. There are doubtful isotypes at BM, K, LE, PH and S: BM001045200!, BM001045235!, BM000523633!, BM000523634!, BM000523635!, K001044578!, LE00008417!, PH00004925!, S-P-1376! (S), UC267862!.

Asplenium polyodon G.Forst.

Lectotype (Lectotype designated by Nicolson & Fosberg 2003: 123) *G. Forster s.n.* (UPS-THUNB 24832!) :—AUSTRALIA. Queensland: South-east region, Queen Mary Falls, 8 miles SE of Killarney, 13 December 1956. *R. Schodde 316* (BM!); North of Moreton Bay, from Glasshouse Mountain to Mount Flinders and Stradbroke Island, 1850-1851, no coll. (BM!); West Springbrook, 2,200 ft [670 m], 9 October 1938. *A. Goy & L.S. Smith 544* (BM!). NEW ZEALAND, North Island, Hawera, Mere Mere Rd., Hughie & Black's Gully, 200 ft [61 m], 2 January 1956. *A.M. Lysaght 1* (BM!); Auckland District: Waitemata Co., Huia, 5 August 1950, *K. Wood s.n.* (BM!).

TABLE 1. List of taxa and morphological characters compared in this study.

TAXA/CHARACTERS	A. PAHLI	A. ANISODONTUM	A. YOSHINAGAE var. INDICUM	A. FALCATUM	A. GUEINZIANUM	A. CAUDATUM
FRONDS PROLIFEROUS	proliferous	proliferous	not proliferous	not proliferous	not proliferous	not proliferous
FROND LENGTH	up to 45 cm long	up to 120 cm long	up to 60 cm long	up to 70 cm long	up to 40 cm long	up to 100 cm long
LAMINA BASE PINNAE	not reducing	not reducing, distant	not reducing	not reducing	not reducing	reducing, somewhat distant
LAMINA APICAL SEGMENT	often missing deformed or replaced with a bud or small plantlet	up to 9 cm long, evenly lobed, lobes reducing to a caudate apex; plantlet subapical	up to 5 cm, lobed reducing to an acute apex	up to 7.2 cm long, sharply serrate with a larger toothed basal lobe	1 cm long, reduced to a thin lamina with one or two basal lobes or adnate pinnae	up to 5 cm long, evenly lobed reducing to a short acuminate apex; plantlet absent
PINNA SHAPE	straight	falcate	straight	straight to slightly falcate	straight	straight
PINNA MARGIN	wide sinuses, irregularly toothed, teeth sharp	notched or with angular incisions, evenly toothed, teeth small rounded or sharp and prominent	pinna margin with deep and oblique incisions	basal acroscopic lobe usually with a prominent acute tooth, margin doubly dentate with prominent teeth	deeply incised, acroscopic lobe almost forming a pinna	evenly lobed, lobes with smaller teeth
COSTA ADAXIAL SIDE	grooved with prominent ridges	grooved, no prominent ridges	grooved with thick prominent ridges	grooved without prominent ridges	shallowly groove, not prominent ridges	costa slightly grooved; without prominent ridges
SORI ROWS AND POSITION	one row, oblique to costa, not contiguous, distant from pinna base, not extending into lobes	one row, oblique to costa, imbricate, close to pinna base	two or more rows, contiguous and overlapping, extending into the lobes	one or two rows, oblique, parallel, not always contiguous, short and long sori mixed	scattered, small, parallel to costa or oblique extending into lobes	two rows, parallel and oblique to costa, close to pinna base, some extending into lobes
SORI LENGTH AND SHAPE	5-7 mm long, straight	up to 1.2 cm, close and diverging from costa	up to 1.2 cm, straight	up to 1 cm long, straight	straight, <0.5 cm	straight

Conclusion

Asplenium anisodontum, *A. caudatum*, *A. falcatum*, *A. gueinzianum* and *A. yoshinagae* subsp. *indicum* are different species from *A. pahli*. No intermediate specimens between these species and *A. pahli* were found. Except from *A. anisodontum*, the distribution ranges of these species are different from that of *A. pahli*. It is concluded here that *A. pahli* is a new Philippine species.

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