REINWARDTIA
Vol. 23. No. 2. pp: 63–75
DOI: 10.55981/reinwardtia.2024.4769

ENUMERATION OF THE GENUS *ATHYRIUM* IN JAVA AND BALI

Received April 15, 2024; accepted October 17, 2024

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ABSTRACT
WARDANI, W., ADJIE, B., LESTARI, W. S., YULITA, K. S. & SALAMAH, A. 2024. Enumeration of the genus *Athyrium* in Java and Bali. *Reinwardtia* 23(2): 63–75. — We present a list of *Athyrium* species from Java and Bali based primarily on morphological examination. Some of disputed species were confirmed through molecular assessment. There are eight species of *Athyrium* in Java and two in Bali, none of them are endemic, but distribution of one species outside Java is uncertain. We provide the list with description, key to the species, and notes on taxonomy or distribution.

Key words: *Athyrium*, Bali, Java, species list.

ABSTRAK
WARDANI, W., ADJIE, B., LESTARI, W. S., YULITA, K. S. & SALAMAH, A. 2024. Enumerasi marga *Athyrium* di Jawa dan Bali. *Reinwardtia* 23(2): 63–75. — Kami menyajikan daftar jenis *Athyrium* dari Jawa dan Bali berdasarkan pengamatan morfologi. Beberapa jenis yang diperdebatkan dikaji lebih lanjut dengan pendekatan molekuler. *Athyrium* di Jawa terdiri dari delapan jenis sedangkan Bali memiliki dua jenis. Tidak ada jenis endemik namun ada satu jenis yang distribusinya di luar Jawa dan Bali belum dapat dipastikan. Daftar ini disertai deskripsi, kunci menuju jenis dan catatan taksonomi atau distribusinya.

Kata kunci: *Athyrium*, Bali, daftar jenis, Jawa.

INTRODUCTION

Athyrium is described in 1799 in an account for German's Flora, that was not widely used by workers of Asian flora in the early of 19th century. Carl von Blume (1828) described *Athyrium* species from Java under the name *Aspidium*. Gustav Kunze (1848) also published species of *Athyrium*, based on Heinrich Zollinger's collection, using the name *Allantodia*. It was Thomas Moore (1857) that transferred those names to *Athyrium*, while Mettenius (1859) placed it within *Asplenium*. The last account for Java (Backer & Posthumus, 1939) recognizes *Athyrium* that include *Anisocampium* and *Cornopteris*, but separate *Diplazium*.

This genus is known for having natural hybrid and complexes in its central distribution area, *i.e.* East Asia (Rothfels *et al.*, 2012). The wide range

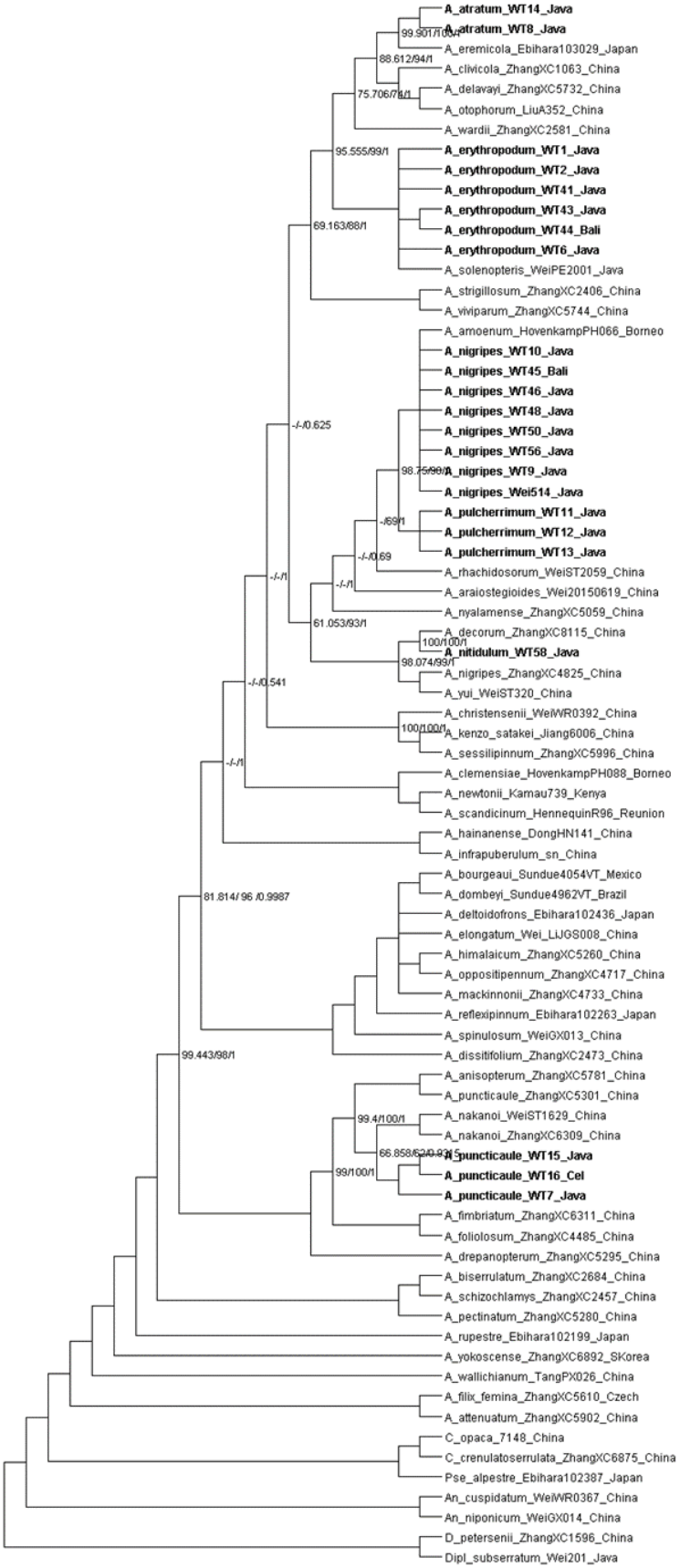

Fig. 1. Phylogenetic tree of *Athyrium* showing relationship of Java and Bali species (in bold font). Support values are in the order BS-MP/BS-ML/PP-BI, showed only on selected branches.

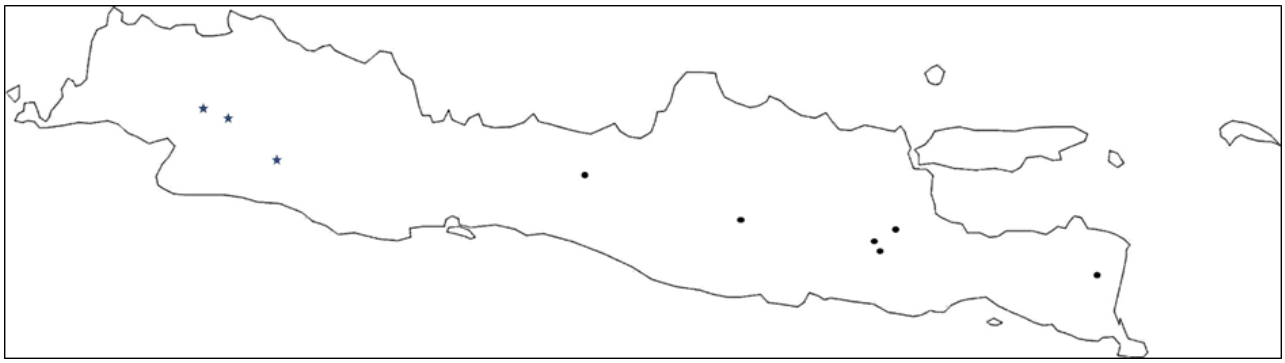

Fig. 2. Distribution map of *A. anisopterum* (black dots ●) and *A. puncticaule* (star ★) in Java. No specimen found in Bali.

morphotypes often lead to misidentification of *Athyrium* species, which include confusion with species of its sister genera, *e.g. Diplazium*, or application of names originated from another region. *Athyrium* can be recognized by its non-clathrate stipe scale, linear to U-shaped indusium, asymmetric pinnae/pinnule to auricle on acroscopic side (Rothfels *et al.*, 2012; Wang & Kato, 2013). However, juvenile, sterile specimen or specimen from a distinct habitat might not readily identified.

Following our phylogenetic assessment using samples from Java and Bali (Wardani *et al.*, submitted), delineation of some of disputed species is confirmed and support our treatment. This article presents a list of *Athyrium* species from Java and Bali, delimitated based mainly on morphology, with description and a key to the species.

MATERIALS AND METHODS

Morphological observation

Examination of herbarium material were conducted in BO with new material was obtained in the last six years from western Java and Bali, some are obtained from type locations. We also compare material available in photograph from herba-ria *i.e.* RBG Kew (K), Natural History Museum (BM), RBG Edinburgh (E), Naturalis Leiden (L), MNHN Paris (P), CAS Beijing (PE), BG Missouri (MO), NMNH Smithsonian Institution (US), Swedish MNH (S), Freie Universitat Berlin (B).

Molecular phylogeny

The phylogenetic trees presented here (Fig. 1) were taken from our study using five chloroplast markers, 21 newly generated sequences from Java and Bali that were combined with data available through NCBI (Wardani *et al.*, 2024). The result is supporting morphological examination, confirming relationship between the look-a-likes morphotypes.

RESULT AND DISCUSSION

Our examination show that Java has eight species, with one species namely *A. nigripes*, recorded to have various morphotypes. Our phylogenetic assessment (Fig. 1) confirms the relationship of *A. nigripes* with its alleged allies, *i.e. A. nitidulum*, *A. pulcherrimum*, and *A. erythropodum*. The tripinnate *A. pulcherrimum* was found in the same clade of *A. nigripes*, with sequences of both samples are almost identical, so we treat them as one species. Both *A. nitidulum* and *A. erythropodum* placed in different clade of *A. nigripes* and hence recognized as different.

We present the examination result below, with synonyms refer to the names that are used for species in Java. List of specimens consist of specimens physically observed, followed by specimens that are consulted from photograph. Six species out of eight are collected from Mt. Gede-Pangrango (Fig. 2 & Fig. 11), which make it important area for conservation of *Athyrium*.

TAXONOMIC TREATMENT

ATHYRIUM ROTH.

Athyrium Roth, Tent. Fl. Germ. 3:31, 58-59, 1799, nom.cons. Lectotype (Smith, Hist. Fil.: 327.8875): *Athyrium filix-femina* (L.) Roth.

Terrestrial. Rhizome short, erect, sometimes creeping. Stipe tufted, swollen, adaxial side often protruding, abaxial side flat, upper surface with grove, two vascular bundles create "V" shape in transverse slice, basal part scaly. Scale brown, reddish or dark brown, ovate-lanceolate, subulate, or linear-lanceolate, entire, basifixed, rarely present other than stipe. Lamina lanceolate, ovate, deltoid, pinnate to tripinnate, herbaceous, papery or leathery, glabrous or hairy, indumentum single glan-

Identification key to the species of *Athyrium* Java and Bali

1. a. No spine/prominent elongated protuberance on axis, lamina lanceolate, pinnate to bipinnate …….. 2
1. b. Spine present on upper side of rachis, costae of costule, lamina deltoid, ovate or oblong when bipinnate …… 3
2. a. Lamina bipinnatifid to bipinnate, no hairs on axis ……... *A. anisopterum*
2. b. Lamina pinnate to bipinnate, hairs on axis …… *A. puncticaule*
3. a. Pinnate, pinnae shallowly lobed …… *A. atratum*
3. b. Pinnate or bipinnate with incision of basal pinnae one level higher (bipinnate to tripinnate) …… 4
4. a. Scale on stipe dark, axis mostly hairy …… 5
4. b. Scale in stipe pale, darker toward basal, axis glabrous except inside the groove ……... 7
5. a. Lamina deltoid, pinnae wide with rounded lobes, almost overlapped …….. *A. triangulare*
5. b. Lamina mostly ovate, pinnae slender, apex lobes acute …… 6
6. a. Lamina coriaceous, stiff, lobed more than halfway, margin of lobes entire, all axis ascending except basal pinnae ..…… *A. nitidulum*
6. b. Lamina chartaceous, not stiff, incision very shallow, margin toothed, axis mostly in horizontal plane ……..……... *A. erythropodum*
7. a. Pinnae rather short, distance between pinnae or pinnules rather remote on elongated rachis that resemble to a creeper …… *A. solenopteris*
7. b. Pinnae or pinnules longer and wider, distance between pinnae or pinnules moderate, rachis not elongated …… *A. nigripes*

dular hair, capitate or multicellular hairs. All axis with confluent groove, spine-like protuberance presents on the side of the groove except on the basal part of costae, veins free, forking or pinnate. Sorus round, cordate, horseshoe-shaped, J-shaped, lunate, oblong, short linear, sit on the lateral side of vein or crossing over; indusium shape as sorus, membranaceous, erose or ciliate, rarely entire, persistent.

1. ATHYRIUM ANISOPTERUM Christ – Bull. Boiss. 6:962-963 (1898) — Type: *A. Henry* 10109 (holotype: P!; isotype: MO!) Manmei, Yunnan, Cina.

Terrestrial. *Rhizome* short, erect, stipe arranged in a clump. *Stipe* green or stramineous, to 30 cm, glabrous. Scale on base of stipe pale brown, lanceolate. *Lamina* wide lanceolate, or ovate, to 50 cm long and 20 cm wide, membranaceous to herbaceous, pinnate to bipinnatifid. *Pinnae* stalked more than 5 mm, lanceolate to 10 cm long and ±1 cm wide, no spine on adaxial side of costae, glabrous, asymmetric, acroscopic side of basal lobes wider than basiscopic, apex, rounded or acute, margin crenate, larger plant with 1–3 free pinnule on basal pinnae. *Rachis* glabrous, sometimes with hair-like scale. *Sori* large, indusiate, round reniform, curved, horseshoe or J-shaped, indusium margin ciliate.

Distribution in Java. Dieng Plateau, Mt. Lawu, Mt. Kawi, Mt. Welirang, Mt. Arjuno, Idjen Plateau.

Other distribution. Malesia: Borneo, Sulawesi, Peninsular Malaysia, Philippine; Sri Lanka, India, Bhutan, Nepal, China, Myanmar, Thailand, Vietnam, Taiwan.

Specimens examined. INDONESIA. Java, W. *Meijer 2752, 2757* (BO), *C.G.G.J. van Steenis 7129* (BO), *O. Posthumus 389* (BO), *Docters van Leeuwen-Reijnvaan 12323* (BO), *R. Brinkman 437* (BO), *C.A. Backer 21692, 25324*, s.n. (BO), *C.A. Backer & O. Posthumus 338* (BO), (photos) *Kato et al. 1440* (L), *1476* (Kinabalu) (L), *G. Roedl Linder 114* (L). Sulawesi, *Bunnemeijer 12077*, *12167* (BO). MALAYSIA. Malay Peninsula, *M.R. Hendersen SFN 23462* (K), E.A. Turnan 844 (K), R. Molesworth-Allen 5021 (K), R.E. Holttum SFN 31324 (K), A.G. Piggot 3098 (K).

Note. This species is not found in western part of Java, probably replaced by *A. puncticaule* (Fig. 2). These two species are similar and nested in the clade of Section Polystichoides (Wei *et al.,* 2018), differed in the indumentum covering rachis.

2. ATHYRIUM ATRATUM Bedd. – Suppl. [Handb.] Ferns Brit. India 33. (1892) non (Christ) Copel (1908) — Type: *G. Watt 6159* (K) Manipur, India.
Athyrium gedeanum (Rac.) Christ, J. Bot. (Morot) 19:68 (1905) – *Asplenium gedeanum* Rac. Pterid. Buitenz. 223. (1898) — Type: *Raciborski sn* (holotype: BO! K!) G. Gede, Jawa.

Terrestrial. *Rhizome* erect, stipe tufted, stramineous. *Stipe* to 40 cm long, scales at base dark, rather shining when dry. *Lamina* linear to oblong lan-

Fig. 3. Type specimen of *Athyrium gedeanum* deposited in BO (left) and the living plant in its type locality (right). Photos by Wita Wardani.

Fig. 4. *Athyrium erythropodum* with black scale on stipe (top right) and short hairs on pinnae rachis (below right). Photos by Wita Wardani.

ceolate, 40 cm long, 12–16 cm wide, apex acute, coriaceous, glossy, glabrous except a small portion on basal pinnae. *Pinnae* to 8 cm long, to 1.6 cm wide at basal part, lanceolate, apex acute, basal part cordate, auricle on acroscopic part more prominent, margin serrate, irregularly undulate to bipinnatifid with dentate apex lobes. basal pinnae shorter with wider distance to the next compare to upper pinnae. *Rachis* glabrous. Vein pinnate. *Sorus* linear, short, slightly curved, usually near costa.

Distribution in Java. Mt. Gede-Pangrango, Mt. Prau Dieng Plateau.

Other distribution. Sumatra, India.

Specimens examined. INDONESIA. Java, Raciborski s.n. (BO), *Lorzing 532* (BO), *W. Wardani 1174, 1183* (BO). Sumatra, *H. Surbeck 90* (BO), *Osawa et al. A-615* (BO), *K. Iwatsuki et al. 982* (BO), *C.G. Matthews 506* (BO), *WT 1173, 1184* (BO).

Note. Description is based on specimen observation and protolog of *A. gedeanum* (Fig. 3).

3. ATHYRIUM ERYTHROPODUM Hayata – I*con. Pl. Formosan. 4: 233–234, f. 163 (1914)* — Type: *Ito s.n.* (TI) G. Arisan, Taiwan.
Athyrium mearnsianum (Copel) Alderw., Malayan Ferns Fern Allies, Suppl. 279 (1917) – *Athyrium nigripes* (Blume) T. Moore, *var. mearnsianum* Copel. pro parte., Phil. Journ. Sci. 3 C. 291. (1908) — Type: *Elmer 6543* (US) Mt. Santo Thomas, Luzon, *Bur. Sci. (Mearns, E. A.) 4184* (BO!) Haight's in the Oaks, Benguet, Luzon.

Terrestrial. *Rhizome* short, erect. *Stipe* tufted, 8–20 cm long, reddish and darker on basal part. Scale on basal stipe lanceolate, 4–5 mm long 3–4 mm wide, bicolor with pale margin, upper scale almost all pale. *Lamina* deltoid, bipinnate, 25–50 cm long, 10–40 cm wide, apex long acuminate, chartaceous. *Pinnae* ovate to wide lanceolate, 5–25 cm long, 1.5–5 cm wide, stalk 3–5 mm, apex acuminate to falcate, sometimes ascending but mostly in horizontal plain. Basal pinnules with stalk 2–3 mm, upper pinnules with shorter stalk to sessile, margin serrate to acutely dentate, apex acute, acroscopic side auricled, shallowly lobed but larger pinnules on lower pinnae deeply lobed. *Rachis* reddish on adaxial side, dark when dried, abaxial side stramineous, short hairs on both surface as well as inside the groove, but getting scarce toward basal. Spine on costae, more prominent toward apex. No protuberance on the midrib. *Sori* linear, curved to J-shaped, close to midrib, 1.4–1.7 mm long, margin entire.

Distribution in Java and Bali. Mt. Gede-Pangrango, Mt. Burangrang, Mt. Bukit Tunggul, Mt. Patuha, Dieng Plateau, Mt. Anjasmoro, Mt. Welirang, Mt. Batukaru (Bali).

Other distribution. Flores, Timor, Philippine, Taiwan.

Specimens examined. INDONESIA. Java, *Sapiin 2768* (BO), *2749* (BO), *M.A. Donk P695bis* (BO), Posthumus 3968, 3611 (BO), *T. Nakai s.n.* (BO), *W. Wardani 1166, 1167* (BO), *Backer 21884* (BO). Bali, *W. Wardani 1404b* (BO). Sulawesi, *Posthumus 3498* (BO). Flores, *Posthumus 3364* (G. Mandaswai = Mt. Poco Mandasawu), *3240* (BO). Timor, *de Voogt 2345* (Mt. Mutis) (BO).

Note. First record of this species outside Taiwan was reported from Philippine by Liu (2008), followed by record for Java and Flores by Wardani & Bayu (2018), and for Bali (Wardani *et al.*, 2022). Here we add Timor in distribution. Specimen in BO was reidentified by the author of *Athyrium* of Taiwan (Liu *et al.*, 2009) that hence become our reference. However, all of the specimens that we examined is bearing short hairs on axis (Fig. 4), which character is not mentioned in the book nor in the protologue, and mostly have less acute apex compare to Taiwan's specimens. Further clarification with specimen from Taiwan and Philippine would be valuable. We include specimens that was identified as *A. mearnsianum*, a Philippine species that firstly published as a variety under *A. nigripes* (Copeland, 1908). Alderwerlt (1917) transferred it to species, recognized that it different in the black scale, the acutely dentate-serrate margin and the absent of spine from pinnules midrib. However, among the four specimens Copeland mentioned in his protologue, which are three specimens from Benguet and one from Mt. Data, the last one is rather different. Copeland 1877 kept in Berlin herbarium (B) has bipinnatifid pinnules instead of serrate-dentate margin (Fig. 5). The bipinnatifid feature is a character of *A. nitidulum* (see in the section) which probably lead to some workers treat them as one. But, Copeland 1877 deposited in Swedish herbarium (S) has smaller pinnules on pinnae that apart one to another, with dissimilar leaves incision. Therefore, the gathering of *A. mearnsianum* type specimen appeared to consist of more than one species. Hence, we treat *A. mearnsianum* partially as a synonym of *A. erythropodum*.

4. ATHYRIUM NIGRIPES (Blume) T. Moore – Index Fil. (T. Moore) XLIX Chr 224 Npfl. 224 (1857) – *Aspidium nigripes* Blume Enum. Pl. Javae 2:162 (1828); *Asplenium nigripes* (Blume) Mett. Abhandl. Senckenb. Naturf. Ges. 3(1): 195

Fig. 5. Type specimen of *Athyrium mearnsianum* Copeland 1877 from Mt. Data (left) and Elmer 6543 from Benguet (right), with small box showing the different pinnules incision. Photos taken from plants.jstor.org (left) and pteridoportal.org (right).

Fig. 6. *Athyrium nigripes* of bipinnate (left) and tripinnate (right) version. Photos by Wita Wardani.

(1859) — Type: *Blume* s.n. (L, K!) on a valley between Mt. Burangrang and Mt. Tangkuban Perahu, Java.
Athyrium pulcherrimum Copel., Philipp. J. Sci. 8C: 141, pl. 3 (1913) — Type: *Bryant, WPO 990* (US) G. Pangrango, Jawa.
Aspidium costale Blume — Type: *Blume s.n.* (L) G. Gede, Jawa.

Terrestrial. *Rhizome* erect, stipe tufted, green, stramineous when dried, 15–30 cm long, trigonous. Scale pale concolor but darker toward basal, 6–10 mm long 3–5 mm wide. *Lamina* bipinnate to tripinnate, ovate lanceolate, 25–40 cm long, apex acuminate. *Pinnae* with stalk, oblong lanceolate, 8–10 cm long, apex acute, wide pinnae might overlap, basal pinnae wider and more ovate compare to upper pinnae, deflexed. Longest pinnules on basal pinnae, 1.5–2 cm long or more, deeply lobed to pinnate. Pinnules stipitate, oblong, obtuse, auricled, often this segment separated, but shallower incision toward apex. Larger pinnules pinnate with basal secondary pinnules on acroscopic side often distinctly wider. Basiscopic side of pinnules cuneate, margin of lobes entire to slightly serrate, apex rounded. Adaxial side of axis dark, with spine on pinnae rachis, costa, costules, and midribs, longer toward apex. *Sori* linear, curved, very close to midrib, indusium margin lacerate.

Distribution in Java and Bali. Mt. Gede-Pangrango, Mt. Burangrang, Mt. Bukit Tunggul, Mt. Patuha, Mt. Papandayan, Mt. Ciremai, Mt. Tengger, Mt. Kawi, Dieng Plateau, Mt. Cemorokandang, Mt. Semeru, Mt. Batukaru (Bali).

Other distribution. Borneo, Sulawesi, Moluccas, New Guinea, Sumatra.

Specimens examined. INDONESIA. Java, *C.A. Backer 3326* (BO), *13602* (BO), *12654* (BO), *5131* (BO), *Raciborski s.n.* (BO), *Mousset 1152* (BO), *Docters van Leeuwen-Reijnvaan 12345* (BO), *12379* (BO), *A. Schwartz 2009* (BO), *Posthumus 3991* (BO), *176* (BO), *A.G.H. Adelbert 165* (BO), *215* (BO), *M.A. Donk P345* (BO), *P704* (BO), *P735* (BO), *P699* (BO), *C.G.G.H. van Steenis 4307* (BO), *W. Meijer 1518* (BO). *D.F. van Slooten 193* (BO), *J. Jeswit 102* (BO), *107* (BO), *S.M. Popta 201* (BO), *Sapiin 2772* (BO), *Mathews HB 571* (BO), *M.A. Donk P346* (BO), *WT 1181, 1182 & 1183* (BO), (photos) *Lobb 272* (BM), *Horsfield s.n.* (BM). Moluccas, (photo) *G.H. de Vriese & J.E. Teijsman s.n.* (L). New Guinea, (photo) *Pleyte s.n.* (L). Sulawesi, (photo) *Posthumus 3498* (L). Sumatra, (photos) *de Wilde & de Wilde-Duyfjes 16299* (L) *C.G.G.H. van Steenis 9954* (L).

Note. This name is often used for different entities, either in Java or in other region such as India and China. Their morphotypes are vary that leads to misidentification. Here we delimit the concept based on specimens collected from Java, Bali and its surrounding. There are indications of high plasticity which not all variation confirmed. Some striking morphotypes has very small pinnules, arranged in distant pinnae, found only in exposed areas in high altitude. We include Copeland's *A. pulcherrimum* here as it is the tripinnate version of *A. nigripes* (Fig. 6), reported only from Mt. Gede-Pangrango and Dieng Plateau at altitude more than 2,600 m asl. However, similar specimen has been reported earlier from the same locality by Blume (1828) which named it *Aspidium costale*. There are four varieties under this species that the type specimen of two of them are available online from L. Both has the same appearance as the tripinnate *A. nigripes*. Record of *A. pulcherrimum* from Borneo (Kinabalu) is incorrect as the specimen has character distinct to *A. amoenum*, an endemic from Kinabalu. Specimen Lorzing 531 deposited in L is a tripinnate version, while the one in BO more to the bipinnate version of *A. nigripes*. Record for Timor was a mistake that is corrected here.

5. ATHYRIUM NITIDULUM (Kunze) Milde – Bot. Zeitung (Berlin) 28: 370 (1870) – *Allantodia nitidula* Kunze Bot. Zeitung (Berlin) 6: 191. (1848); *Asplenium nitidulum* (Kunze) T. Moore., Abhandl. Senckenb. Naturf. Ges. 3(1): 213. 1859 Index. Fil. (T. Moore) 43 (1860) — Type: *Zollinger 358* (Unknown) Java.

Terrestrial. *Rhizome* erect, tufted with stipe. *Stipe* green, stramineous when dry, stiff, to 18 cm long, lower part covered with dark brown scale, darker toward rhizome. *Lamina* ovate to deltoid, bipinnate, to 35 cm long, apex acuminate, stiff, coriaceous. *Pinnae* lanceolate, apex acuminate, pinnate, ±11 cm long ±4 cm wide, stipitate, opposite or subopposite. Pinnules ovate to oblong, apex round to acuminate, stipitate on lower pinnae, lobed almost to the costule, shallower toward apex, margin lobes dentate. All axis ascending, bearing short hairs. Gap between lobes proportionate to its wide. Spines emerge on costae and costule but absent on lower part of pinnae or lower segment of pinnules. *Sori* linear, curved, J-shaped across vein, might stretch from near costa to margin, one in every lobe. Indusium entire to erose.

Distribution in Java. Telaga Warna (Bogor), G. Gede, Situ Lembang (Bandung).

Other distribution. Uncertain.

Specimens examined. INDONESIA. Java, *Raciborski s.n. 1488300 & 1488327* (BO), *M.A. Donk*

Fig. 7. *Athyrium nitidulum* sensu Raciborski with dark stipe scale, deep incision and short hairs on axis. Photos by Wita Wardani.

Fig. 8. *Athyrium puncticaule*, showing scales on stipe, hairs and scale on rachis. Photos by Wita Wardani.

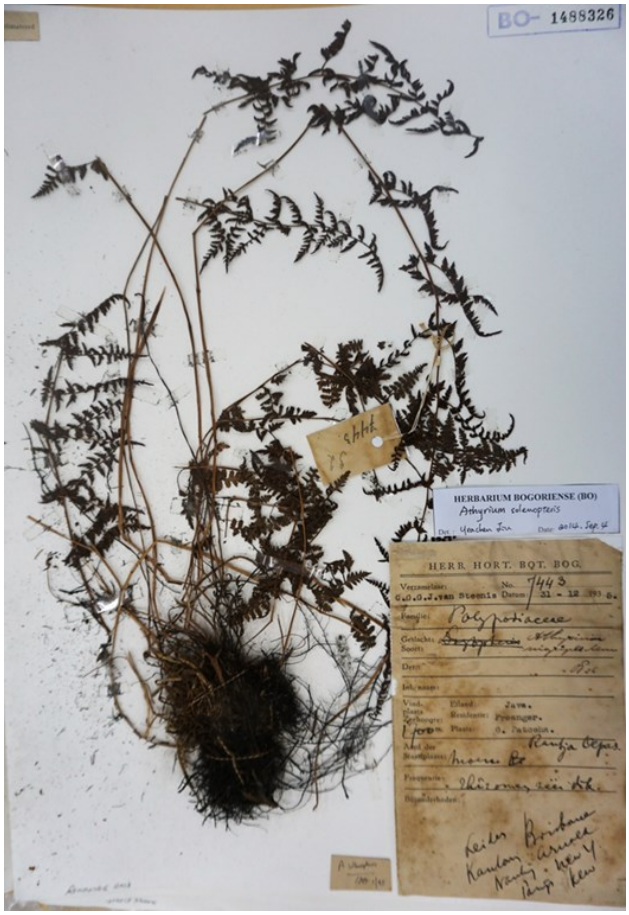

Fig. 9. *Athyrium solenopteris* showing the elongated stipe and rachis with lanceolate lamina, small pinnule and slender pinnae. Photos by Wita Wardani.

Fig. 10. Type specimen of *Athyrium triangulare* (*R.H.C.C. Scheffer* sn.) (BO), with short hairs on pinnae stalk, spine on costa near apex, and dark stipe scale. Photos by Wita Wardani.

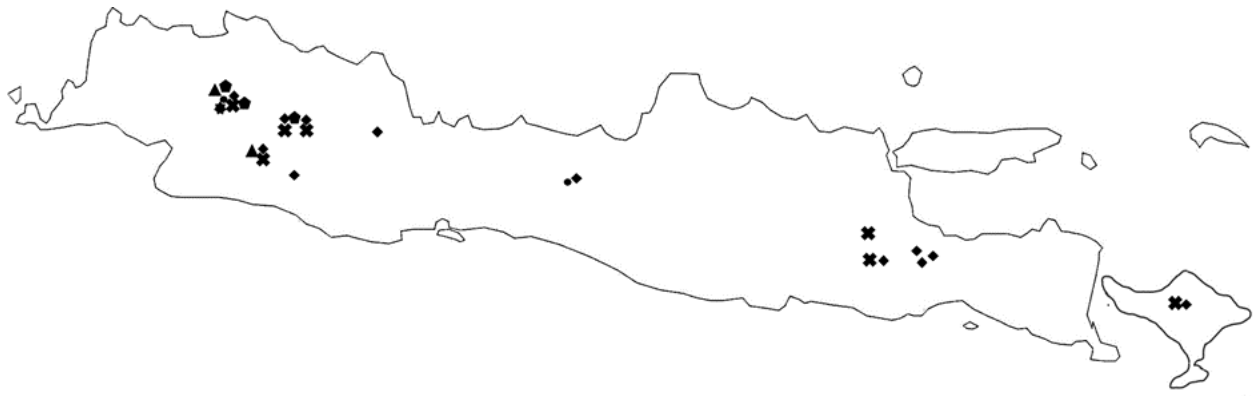

Fig. 11. Distribution map of *Athyrium* species in Java and Bali: ● *A. atratum*; ✖ *A. erythropodum*; ◆ *A. nigripes*; ⬟ *A. nitidulum*; ▲ *A. solenopteris*; ✹ *A. triangulare.*

P751 (BO), *M.A. Donk P633* (BO), *W. Wardani 1423*, (photos) *Schiffner P227* (L).

Note. Type specimen of this species, Zollinger 358 from Java is not yet found. Therefore, we refer to Raciborski (1898) who collected specimen from Mt. Gede, deposited in BO (Fig. 7) and L, and recognized this species in his account on the fern of old time Bogor. Raciborski's concept is in line with description in the protologue. The name *A. nitidulum* is often applied to large specimens of *A. nigripes*, and in the contrary. However, both species can be distinguished by their texture, hairy axis, and blackish stipe scales. The type specimen of *A. mearnsianum* Copeland 1877 from Mt. Data, Philippine kept in B (Fig. 5) has incision similar to *A. nitidulum*. Yet, we omit this specimen as we could not confirm whether short hairs are present on the axis. Distribution outside Java and Bali is uncertain since we have not found specimen from those area.

6. ATHYRIUM PUNCTICAULE (Blume) T. Moore – Index. Fil. (T.Moore) 186 (1860)
Aspidium puncticaule Blume, Enum. Pl. Javae 2: 159 (1828) — Type: *Leg. ign. s.n.* Mt. Parang, Jawa.
Aspidium macrocarpon Blume, Enum. Pl. Javae 2: 162. (1828); *Athyrium macrocarpum* (Blume) Bedd., Ferns South. India. 51 (1863) — Type: *Blume s.n.* (K) Jawa.

Terrestrial. *Rhizome* erect. *Stipe* tufted, 10–15 cm long, hairy. Scale on basal part brown, lanceolate, margin entire, 5 mm long 2 mm wide, spread to upper part. *Lamina* lanceolate, 20–40 cm long, 8 –10 cm wide, herbaceous or chartaceous, pinnate with abaxial lobes of basal pinnae separated forming bipinnatifid appearance. *Pinnae* with short stalk, trapezoid-oblong to lanceolate, lobed halfway to the costae that shallower to the apex, 1–2 lower pinnae pinnate in larger individuals, auricled on acroscopic side, basiscopic side cuneate, apex acute, margin crenate to dentate at the tip of lobes, basal pinnae deflexed. Pinnules with stalk. All axis hairy, narrow scales also scattered on rachis, no spine or protuberance. *Sori* the tip or near the tip of vein, between midrib and margin, horseshoe-shaped, reniform or short linear on distal part, indusium margin undulate, lacerate or fimbriate.

Distribution in Java. Mt. Gede-Pangrango, Mt. Patuha, Mt. Salak (see Fig.2).

Other distribution. Borneo, Sulawesi, Lombok, Moluccas (Seram), Philippine, Sumatra, India, Sri Lanka, Indochina, Taiwan.

Specimens examined. INDONESIA. Java, *Sapiin 2888* (BO), *2890* (BO), *Lorzing 2425* (BO), *2549* (BO), *A.G.L. Adelbert 144* (BO), *192* (BO), *Raciborski s.n.* (BO), *Holttum s.n.* (BO), *Bakhuizen v.d. Brink 4130* (BO), *J.G. Hallier 494* (BO), *A.H.G. Alston 12853* (BO), *C.G. Matthew 585* (BO), *W. Wardani 1173*, *1184* (BO), *Lobb s.n.* (K). Lombok, *de Voogt 2641* (BO). Moluccas, *Kato et al. C-1567* (BO), *C-12148* (BO), *C-3300* (BO). Sulawesi, *W. Santoso 281* (BO). Sumatra, *C.G. Matthew 519* (BO). MALAYSIA. Borneo, *J. & M.S. Clemens 29033* (BO), *31745* (BO), *31798* (BO), *31959* (BM), *32518* (BO), *32816* (BM), *33226* (BM), *Parris 6647, 11451* (K), *Holttum SFN 25526* (K), *S.H. Collenette 21524* (K).

Note. This name is not recognized in Malayan Fern Flora (Alderwerlt, 1908), and mentioned as a synonym for A. *macrocarpum* in the fern of Java account (Backer & Posthumus, 1939). The name *A. puncticaule* and *A. macrocarpon* published in the same Blume's account for Java (1828), that the former is mentioned earlier in the "pinnate leaves" section. Later on, Beddome (1892) corrected the epithet *macrocarpon* into *macrocarpum*. This species differs from *A. anisopterum* on its indumentum (Fig. 8).

7. ATHYRIUM SOLENOPTERIS (Kunze) T. Moore – Index Fill.43. 1857 [and 187.1860] – *Allantodia solenopteris* Kunze, Linnaea 24:266 (1851); *Asplenium solenopteris* (Kunze) Mett., Abhandl. Senckenb. Naturf. Ges. 3(1)"240. (1859) (as "selenopteris"); *Asplenium nigripes var. solenopteris* (Kunze) C.B.Clarke, Trans/ Linn. Soc. London. 2 Bot., 1: 491. (1880) — Type: *Revd. B. Schimdt; J.C. Zenker & C.E. Weigle s.n.* (B, K) Nilgiri Hills, Tamil Nadu, India.

Terrestrial. *Rhizome* erect or oblique, basal part covered with brown ovate acuminate scales. *Stipe* not tufted, stramineous when dried, slender, to 30 cm long, sparsely scaly. *Lamina* glabrous, to > 45 cm long, ovate acuminate or lanceolate, never deltoid, bipinnate to tripinnate. *Pinnae* remote, 15–20 cm long with remote pinnules in larger tripinnate plant. Pinnules to 4 cm long, slender, stipitate, deeply lobed that almost to the costae, lobes rounded, dentate, acroscopic side slightly auricled, basiscopic side cuneate. Herbaceous. Glabrous. *Sori* oblong, slightly curved near the midrib, indusium membranaceous undulate.

Distribution in Java. Cisarua (Bogor), Rancaupas (Bandung).

Other distribution. India, Sri Lanka.

Specimens examined. INDONESIA. Java, *Leg. ign. s.n.* (BO), *Zippelius, A. s.n.* (BO), *van Steenis 7443* (BO), (Photo) *Zippelius, A. 297* (L).

Note. This species is often associated with *A. nigripes* with relation to *A. gymnogrammoides*. However, the distinctive long rachis and remote short pinnae or pinnule (Fig. 9) separate them. This species is collected only from western part and is not common in Java.

8. ATHYRIUM TRIANGULARE Alderw. – Bull. Jard. Bot. Buitenzorg Ser. 2, XX. 8 (1915) — Type: *R.H.C.C. Scheffer* s.n. (BM, BO!) Tjibeureum, Java, Indonesia.

Terrestrial. *Rhizome* erect, tufted with stipes. Scale on rhizome and stipe subulate-acuminate, dark. *Stipe* stramineous but basal part dark, 10–25 cm, sparsely scaly. *Lamina* deltoid, bipinnate, 10-18 cm long. *Pinnae* 7–10 cm long, acuminate, basal pinnae oblong oblique, upper pinnae lanceolate. Pinnae closer toward apex that abruptly shifted into a pinnate ultimate pinna with dentate margin and round apex. Pinnule to 2 cm long, rounded apex, entire to serrate margin, basal part cuneate and short auricled. Coriaceous. *Rachis* and pinnae stalk with short hairs. Spine only on costae, not on the midrib. *Sori* short, near costule/midrib.

Distribution in Java. Mt. Gede-Pangrango.

Other distribution. India.

Specimen examined. INDONESIA. Java, *R.H.C.C. Scheffer* s.n. (BO).

Note. No specimen in BO that exactly agree with the type (Fig. 10). This species was described from Mt. Gede-Pangrango, at a place known as Cibeureum which currently face invasive plant species issue. Distribution in India is related to a variety under *A. praetermissum* according to Fraser-Jenkins *et al.* (2018).

CONTRIBUTORSHIP

W.W. carried out the field work, specimen identification, wrote the initial manuscript. B.A., K.S.Y, W.S.L. and A.S. devised the project, *i.e.* field work, laboratory work, and improving manuscript. All authors are equally contributed to the writing of the manuscript as a main contributor.

ACKNOWLEDGEMENTS

This research is supported by the Indonesian Institute of Science (LIPI) (to 2021) and National Research and Innovation Agency (BRIN) (since 2021) through their internal research program in 2016, and 2020–2023.

REFERENCES

ALDERWERELT VAN ROSENBURGH, C. R. W. K. VAN. 1908. *Malayan Ferns. Handbook to the Determination of the Fern of The Malayan Islands*. Landsdrukkerij, Batavia.

ALDERWERELT VAN ROSENBURGH, C. R. W. K. VAN. 1917. *Malayan Ferns and Fern allies. Handbook to the Determination of the Fern of The Malayan Islands. Supplement* 1. Landsdrukkerij, Batavia.

BACKER, C. A. & POSTHUMUS, O. 1939. *Varenflora voor Java*: 137. 's Lands Plantenuin, Buitenzorg.

BEDDOME, R. H. 1873. *The Ferns of Southern India*. Higginbitham and Co., Madras.

BLUME, C. L. VON. 1827. *Enumeratio Plantarum Javae et Insularum Adjacentium Minus Cognitarium vel Novarum ex Herbaria Reinwardtii, Kuhlii, Hasseltii et Blumii*, 2. Hartmann, The Hague, Pp. 162, 170.

COPELAND, E. B. 1908. A revision of the Philippine species of *Athyrium*. *Philippine Journal of Science* v. 3C: 291–292.

FRASER-JENKINS, C. R., GANDHI, K. N. & KHOLIA, B. S. 2018. *An Annotated Checklist of Indian Pteridophytes Part-2 (Woodsiaceae to Dryopteridaceae)*. Bishen Singh Mahendra Pal Singh. Dehra Dun. India.

http://plants.jstor.org/stable/10.5555 al.ap.specimen.b+20+0028965. (Accessed 13 June 2020).

https://pteridoportal.org/portal/taxa/index.php? taxon=8866#.（Accessed 31 July 2023).

METTENIUS, G. H. 1859. Uber einige farngattungen. IV. *Asplenium* tafel IV-VI. *Abhandlungen Herausgegeben von der Senckenbergischen Naturforchenden Gesellschaft* 3: 237.

MOORE, T. 1857. *Index Filicum: A Synopsis, With Characters, of the Genera, and an Enumeration of the Species of Ferns, with Synonyms, References*. *Vol. 49*. Pamplin, London.

LIU, Y. -C., CHIOU, W. -L., LIU, H. -Y. 2009. *Fern Flora of Taiwan: Athyrium*. Taiwan Forestry Research Institute, Taipei.

RACIBORSKI, M. 1898. *Die Pteridophyten der Flora von Buitenzorg*. Buchhandlung und Druckerei vormals E.J. Brill. Leiden. Pp. 229–230.

ROTHFELS, C. J., LARSSON, A., KUO, L. -Y, KORALL, P., CHIOU, W. -L. & PRYER, K. M. 2012. Overcoming deep roots, fast rates, and short internodes to resolve the ancient rapid radiation of eupolypod II ferns. *Systematics Biology* 61(3): 490–509.

SLEDGE, W. A. 1956. The nomenclature and taxonomy of *Athyrium nigripes* (Bl.) Moore, *A. solenopteris* (Kunze) Moore and *A. praetermissum* sp. nov. *Annals and Magazine of Natural History* 9(102): 453–464.

WANG, Z. R., HE, Z. R. & KATO, M. 2013. Athyriaceae. In: WU, Z. Y., RAVEN, P. H. & HONG, D.Y. (Eds.). *Flora of China,* Vol. 2–3 (Pteridophyte). Science Press, Beijing and Missouri Botanical Garden Press, St. Luis, MO. Pp. 418–534.

WARDANI, W. & ADJIE, B. 2018. The genus *Athyrium* Roth in Malesia: A checklist with working names and distributions. *Sibbaldia* 16: 39–48.

WARDANI, W., ADJIE, B., YULITA, K. S. & SALAMAH, A. 2022. Two new records of *Athyrium* for Bali. *Reinwardtia* 21(2): 43–47.

WARDANI, W., SALAMAH, A., ADJIE, B., YULITA, K. S., FRASER-JENKINS, C. R., WEI, R. & SUNDUE, M 2024. Phylogenetic relationships of Malesian Lady Ferns (*Athyrium*) provide insight into long-standing species complexes. *Phytotaxa* 658(2): 121–135.

WEI, R., EBIHARA, A., ZHU, Y. -M., ZHAO, C. -F., HENNEQUIN, S. & ZHANG, X. -C. 2018. A total-evidence phylogeny of the lady fern genus *Athyrium* Roth. (Athyriaceae) with a new infrageneric classification. *Molecular Phylogenetics and Evolution* 119: 25–36.