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NOTES ON TAXONOMY OF *ATHYRIUM NIGRIPES* (BLUME) T. MOORE COMPLEX, AN INSIGHT FROM MOUNTAINS IN JAVA

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ABSTRAK

Wita Wardani, Bayu Adjie, Kusumadewi Sri Yulita, Andi Salamah 2023. Catatan Taksonomi untuk Kompleks *Athyrium nigripes* (Blume) T. Moore, Pemahaman Baru dari Pegunungan di Jawa. *Floribunda* 7(2): 51–63 — *Athyrium nigripes* adalah suatu jenis paku-pakuan yang memiliki variasi morfologi yang tinggi, tercatat terutama dari Jawa dan sedikit dari pulau lain di sekitarnya. Ada banyak perbedaan pendapat dalam hal pembatasan jenis ini yang berdampak pada kesimpangsiuran rentang distribusinya. Kajian ini berupaya menguraikan kerancuan batasan morfologi jenis yang melibatkan empat jenis yang berelasi, seluruhnya dideskripsikan dari Jawa, yakni *Athyrium nigripes, Aspidium costale, At. pulcherrimum* dan *At. nitidulum*, dengan pendekatan analisis fenetik. Hasil analisis tersebut menunjukkan ada empat klaster yang terbentuk yakni klaster I yang beranggotakan spesimen berukuran besar, termasuk di dalamnya spesimen tipe *At. pulcherrimum* dan *Asp. costale*, klaster II beranggotakan spesimen berciri standar dan termasuk di dalamnya spesimen tipe *At. nigripes*, klaster III beranggotakan spesimen dengan tepian bergerigi dan klaster IV beranggotakan kelompok *At. nitidulum*. Dengan demikian, *Asp. costale* terindikasi lebih dekat pada *At. pulcherrimum* daripada *At. nigripes*. Ukuran yang besar dan tingkat torehan/derajat pembagian daun dapat mengindikasikan pengelompokan utama di dalam jenis kompleks ini.

Kata kunci: *Athyrium nigripes* kompleks, Athyriaceae, Jawa, klastering

Wita Wardani, Bayu Adjie, Kusumadewi Sri Yulita, Andi Salamah 2023. Notes on Taxonomy of *Athyrium nigripes* (Blume) T. Moore Complex, an Insight from Mountains in Java. *Floribunda* 7(2): 51–63 — *Athyrium nigripes* is a highly variable species described and recorded mostly from Java and few from surrounding islands. There are different arguments on its delimitation and hence its extent of distribution. We attempted to elucidate disagreement on delimitation of four related species described from Java: *Athyrium nigripes*, *Aspidium costale*, *At. pulcherrimum* and *At. nitidulum* with phenetic approach. The analysis formed four clusters; cluster I consist of the large sized and include type specimen of *At. pulcherrimum* and *Asp. costale,* cluster II for plants with standard form and include type specimen of *At. nigripes*, cluster III only for serrated plants and cluster IV contain the *At. nitidulum* form. Since *Asp. costale* clustered in group I, this species is more closely related to *At. pulcherrimum* than to *At. nigripes* nested in group II. Large size and degree of division indicate major clustering within the complex species.

Keywords: *Athyrium nigripes* complex, Athyriaceae, Java, clustering

The genus *Athyrium* is a medium sized terrestrial fern, mainly distributed in the northern hemisphere that in the tropics grow only in humid high altitude (Rothfles 2012, PPG I 2016, Wei et al 2018). This genus can be differentiated from other *Athyriaceae* genera by a combination of characters, i.e., confluent groove with projections, inequilateral pinna or pinnule base, entire scale margin, linear to horseshoe-shaped indusium (Liu et al 2011). *Athyrium nigripes* (Blume) T. Moore firstly published in Blume's Enumeratio Plantarum Javae (1828) as *Aspidium nigripes*, based on specimen collected from the wetland at a valley between Mount Burangrang and Mount Tangkuban Parahu in West Java. Blume placed this name under the bipinnate frond section. *Aspidium costale*, a species that later is considered related, consists of four varieties, described in the tripinnate section. Moore (1857), in his Index Filicum, transferred *Aspidium nigripes* to *Athyrium*, but in later pages, he reduced it into *Athyrium tenuifrons* var. b *tenellum.* Hooker (1860) reversed this synonymy and accept *At. nigripes* instead. In the same publication, he synonymized Blume's *Aspidium costale* as *Asplenium gymnogrammoides*, a name described by Klotzsch in an unpublished manuscript that was validated by Mettenius (1859) as explained in Sledge (1956). Hooker (1874), in his subsequent account, included both name as synonym of *At. nigripes*. Since then, Blume's four varieties of *Aspidium costale* is known as *At. nigripes*, as adopted by Raciborski (1898) in his Pteridophyte Flora of Buitenzorg (old name for Bogor) under *Asplenium*, and by Alderwerlt (1908, 1917) in his accounts of Malayan fern flora. However, Backer and Posthumus (1939), in their fern flora of Java, recognized them as separate, following previous Hooker's (1860) treatment.

Sledge (1956) explained that synonymizing Klotzsch *Asplenium gymnogrammoides* with Blume's *Aspidium costale* was an error which continue to persist in Indian flora accounts. He found that Ceylon type specimen of *Aspl. gymnogrammoides*, as also many other gatherings from Ceylon and India, is quite different with Javan specimen *At. nigripes*. He suggested that Indian *Aspl. gymnogrammoides* is partly a form of *At. solenopteris*. However, he concluded that this Blume's *At. nigripes* is a rather scarce plant and the materials abundantly available at Kew and British Museum Herbarium is belong to *At. appendiculiferum* Alderw. (1914), a name described from Mount Tandikat in Sumatra. On the other hand, *At. nigripes* also recognized in Flora of China (Wang *et al* 2013) which Fraser-Jenkins *et al* (2018) suggested that the adopted concept is a misconception for gathering that should belong to *At. setiferum* C.Chr (Christensen 1906), a species initially published without description (nomen nudum) as *Allantodia tenella* Wall. (herbarium catalogue, dated 1821) that then corrected by Hope (1899) as *Asp. tenellum,* based on specimen from Nepal. In summary, Blume's *At. nigripes* is presumed not exist neither in India nor in China, and a species described by Alderwerlt (1914) from Sumatra is likely the same entity.

Our initial examination also shown that Copeland's *At. pulcherrimum* (1913), described from a plant collected in Mt. Pangrango, Java, might be another form of large *At. nigripes*. Backer and Posthumus (1939) erroneously included this name under *At. macorcarpum* together with the simply pinnate *A. puncticaule*. The use of names in relation to *At. nigripes* and *Asp.costale* is summarized in the following table:

Table 1. Names adopted for *Athyrium nigripes* and its presumed close relatives in different publications

Moore (1857)	**Hooker (1874)**	**Raciborski (1898)**	**Alderwerlt (1917)**	**Backer & Posthumus (1939)**	**Sledge (1956)**
At. tenuifrons var b *tene-llum* Syn. *At. nigripes*	*At. nigripes* Syn. *At. gymnogram-moides, Asp. costale*	*Aspl. nigripes* Syn. *Asp. costale*	*At. nigripes* Syn. *Asp. costale* *At. gymno-grammoides*	*At. nigripes* *At. gymno-grammoides* Syn. *Asp. costale*	*Asp. costale* *At. gymno-grammoides*

These interchanging synonymies indicate a wide range of morphological variety, instigate user to apply names differently. We applied phenetic approach to a gathering collected from Java, in the attempt to elucidate relationship within the morphological range and contribute species delimitation exercise for the name described from the island, i.e. *At. nigripes* (Blume) T. Moore, *Asp. costale* Blume, *At. pulcherrimum* Copel. and *At. nitidulum* (Kunze) Rac. The last name was tagged by Rosenstock (dated 1915) to the type specimen of *Asp. costale* type C that is kept in Leiden herbarium, while *At. nitidulum* type specimen' whereabouts is unknown. We refer to Raciborski's specimen and description (1898) in this study to clarify its relationship to the core *At. nigripes*. We confined area for investigation only to Java since there were very few specimens gathered from other location before us. Moreover, specimen examined by Blume, Raciborski, Backer and Posthumus that available in Bogor were mostly collected from Java.

MATERIAL AND METHODS

We examined 95 specimens of related *At. nigripes* taxa that available in Bogor Herbarium. However, only 43 specimens, that each representing single OTU, could be incorporated into the matrix. Some of them consist of two sheets of young and adult leaves. Only the adult specimen included to the matrix. These specimens are mostly collected from Mount Gede-Pangrango, a high mountain consists of two tops of about 3000 m asl that one with active volcanic crater, and the saddle that connect the two tops lies at about 2500 mm altitude. We excluded specimens that distinctly different such as those with winding frond or specimens that extremely incomplete. We also incorporated data derived from description of three species in their protologue whilst consulted image of the specimen type, i.e. *At. pulcherrimum*, *Asp. costale*, *Asp. nigripes*. For *At. nitidulum,* we use Raciborski's specimen and description (1898) instead of Kunze's (1848), since the later examined specimens is unknown and its description is fairly general.

We evaluate over 30 morphological characters but only 19 that has distinct variation across the heaps and thus scored, as presented in table 1 (matrix available as supplementary file). The quantitative character "length of stalk of basal pinnae" were log10-transformed to stabilized variation before scoring. The clustering analysis were perform using UPGMA applied in PAUP (Swofford 2003) with total character difference as the basis for distance measure and ties were broken randomly.

Table 1. Morphological character observed and used in clustering analysis

No.	Character	Character States
1	Lamina shape	Ovate=0; Oblong-ovate=1; Oblong lanceolate=2
2	Lamina apex	Gradually acuminate=0; Abruptly acuminate=1; Long acuminate-caudate=2
3	Pinnae apex[1]	Short acuminate=0; Long acuminate=1; Caudate=2
4	Pinnules apex	Rounded-dentate/serrate=0; Acute-dentate/serrate=1; Acuminate=2
5	Length of stalk of basal pinnae	Short to 4 mm=0; Medium 4 mm< to 8 mm =1; Long over 8 mm=2
6	Stalk of (last) basal pinnules of basal pinnae	No stalk=0; Short to 2 mm=1; Long >2 mm=2
7	Leaf partition	Bipinnate=0; Tripinnate=1
8	Overlaps Pinnae	Yes=0; No=1
9	Overlaps Pinnules	Yes=0; Slightly=1; No=2
10	Space between lobes of pinnules (especially of basal pinnae)[2]	Decent=0; Wide gaps=1; Tight gaps or incision not reaching midrib=2; Shallower lobes=3
11	Basal pinnules or lobes	Distinct in shape, size, direction and distantly separated (relative to the next) =0; Not so=1
12	Pinnae rachis color	Dark upper part, mostly straw color underneath=0; Dark all over=1
13	Types of scale present on rachis	Narrow and hair-like =0; Hair-like only=1; None=2
14	Presence of scale on rachis and costae	Present=0; Present but very rare=1; Absent=2
15	Hairs on rachis and pinnae rachis	Present inside the groove only=0; Observed mostly around the junction of pinnules, including inside the groove=1; Covering axis=2; Absent=3
16	Indusium shape	Short linear=0; Long (linear more than halfway) =1
17	Indusium position	Costular=0; Not costular=1; Both=2
18	Horseshoe/back-to-back indusium	Both present=0; Either one present=1; Not present=2
19	Insertion of costae to rachis or pinnae-rachis, or costule to costae	Not oblique=0; Oblique=1

[1]Short acuminate apex = almost acute; Long acuminate = gradually narrowed half way toward apex
[2]Decent space = as in standard form, gap slightly less than half wide of pinnule lobe

RESULT AND DISCUSSION

Variation within the complex

All examined specimens has common characters, i.e., pale stipe scale that might be darker toward rhizome, bipinnate to tripinnate (at least at basal pinnae) frond, basal pinnae widest, axis with groove, pinnae rachis or costae bearing fleshy projection or “spine” arise from one side of the groove, similar but longer projection also present on costule (midrib). These projections often not present at basal and adjacent intersection, mostly more prominent toward apex. General shape of lamina is ovate to oblong-lanceolate with decent stipe length, apices mostly acuminate.

The range of variation in this complex is wide and mostly continues, lies in sizes, degree of indumentum covering, degree of incision, arrangement of leaflets and indusium. Small plant might be fertile with rather bipinnatifid appearance, while larger size tends to be tripinnate at basal pinnae with overlapping or non-overlapping pinnules. There are plants with contracted lobes or pinnules on leaflets that widely separated. This type of plant is collected from open area such that around a volcanic crater or baren space on the top of a mountain. Other has distinctly larger basal lobe, found in relatively shaded-dry area in high altitude. The complex obviously affected by environmental condition which expressed in their plastic feature.

We categorized the variation based on general appearance as follow:

1. *A. pulcherrimum* type (Pul), plant with large frond, basal pinnae or auricle of pinnules distinctly larger and separated from the next, margin serrated.
2. Large form (Lrg), plant with large frond, basal pinnae with basal pinnule can be bipinnate, or deeply lobed almost to the midrib and fairly separated. Basal pinnae or auricle is indistinct.
3. Tripinnate form (Tri), large frond with finely divided leaves, basal and its following pinnae bipinnate, lesser incision approaching apex.
4. Contracted form (Cont), medium to large size frond with deeply lobed leaflet, lobes are narrow (contracted) and fairly separated.
5. *At. nigripes* type (Nigr), medium size frond, lamina oblong, pinnae oblong-lanceolate, deeply lobed that reaching midrib, decent space between leaflets, lobes not contracted, leaflets oblique.
6. Standard form (Std), medium size frond, lamina broadly ovate, leaflets not oblique, incision immediately shift to shallow lobes starting at or before middle pinnae
7. Standard form with oblique axis (StdOb), as standard form but with distinctly oblique axis
8. Serrated form (Ser), as standard form but with heavily serrated margin and broader leaflets
9. *At. nitidulum* type (Nit), large form but with oblique axis and leaflets, stipe scale rather dark, and hair covering axis (at least pinnae rachis).

Phenetic analysis of the *Athyrium nigripes* complex in Java

Our analysis shows that the gathering with 9 initial categories were polarized into 4 major groups (Fig.1). Group I is plants with large sizes, tripinnate or at least basal pinnae with pinnately arranged pinnules (Fig. 2). Leaflet ranged from contracted to broad and overlaps. However, type specimen of *At. pulcherrimum* and *Asp. costale* (type C) (Fig.3) belong to this group but clustered in its own branch. Group II (Fig. 4) consists of plants with medium sizes, basal pinnae deeply lobed but immediately shift to shallower incision at or before middle pinnae. Type specimen of *At. nigripes* nest in this group. Group III (Fig. 5) is a cluster of plants with distinctive serrated margin and rather longer lamina compare to medium sized plants. Some of these specimens were once identified as *At. gymnogrammoides*. Group IV (Fig.6) is also an exclusive cluster of specimens identified as *At. nitidulum* (sensu Raciborski) which distinct it their hair covering and rather dark stipe/rhizome scales.

This exercise confirms some of the assumption made by different authors. However, further investigation with broader taxon sampling and additional characters are indispensable. Our clustering demonstrates that, *Asp. costale* (type C) and *At. pulcherrimum* most likely are the same species. Both has distinctively larger and separated basal pinnule or lobe. As mentioned in the account, Blume separated *Asp. nigripes* (basionym of *At. nigripes*) from *Asp. costale* by their degree of division, i.e., bipinnate vs tripinnate. Nevertheless, there are notable continues variation between the two species. *Asp. costale* has four varieties which only type C and D specimen detected in the online resource (Fig. 3). Member of group I is belong to these varieties as they fit the description to some extent. Hence, large and more-divided version of *At. nigripes* might be included in this group. Raciborski suggested that this “nigripes-costale” group is highly variable that need decent investigation. Whenever both species treated as the same species, *Asp. costale* and *At. pulcherrimum* would be the synonyms for *At. nigripes*.

In addition, the type specimen of *At. nigripes* that nest in cluster II is a rather distinct specimen. It has shorter pinnae with oblique and narrow lobes, while most of the other specimen in the cluster tend to have lobes and leaflets inserted in almost horizontal line. Sledge (1956) suggested that this species might be a quite scarce plant, while Fraser-Jenkins (2018) believed that they are juvenile plant develop swiftly to fertile specimen. Despite of its placement in the distance tree, this rare form might or might not be different from other standard bipinnate form. Recollecting specimen of this type from its provenance would be fundamental in confirming *At. nigripes* and group II identity.

The serrated group in the third cluster is most similar to type specimen of *At. gymnogrammoides* from Srilanka (Fig.5). However, since the type specimen only contain an incomplete and small portion of a plant, we cannot confidently make any decent comparison. This third group distinctive in its bipinnate form with serrated margin, rather rounded and cuneate-truncate pinnules with shallow lobes. Such characters separated them from *Asp. costale*. However, the cluster is the immediate sister to nigripes-standard form cluster which make them can be treated as one.

The fourth cluster contains *At. nitidulum* sensu Raciborski (1898) (Fig 6). This species is recognized in different flora with divergent concept. The description of *Allantodia nitidula* (Kunze, 1848) mentions its elegant look and glabrous rachis, separated it from hairy *Allantodia paludosa*, a name that later treated as synonym of *At. nigripes* in Backer and Posthumus's Fern Flora of Java (1939). Alderwerelt (1908) discriminate the two based on indusium, i.e., horseshoe-shaped in *At. nitidulum* present only near apex, both horseshoe-shaped and double (back-to-back) indusium in *At. nigripes*. This combination of characters might present interchangeably, thus unreliable as sole identification hint. Nevertheless, uniting this cluster with sister cluster II and III is a plausible treatment with such limited observed variation.

The analysis clustered the complex into four groups. Group I comprise of specimen with large size and prominent division. Group III is immediate cluster to group II, and group IV is clustered next to both. We might treat all group as different species, or merge group II and III that resulted in three species, or gather Group II, III and IV as one species separated from group I. There is not enough confidence to delimit either alternative, due to inadequate samples, especially in the group III and IV, and the absence of additional specimen of *At. nigripes* type. However, this exercise demonstrate that size and degree of division might indicate different entities within this complex.

CONCLUSION

This study depicts the agreement and separation of continues variation within the *At. nigripes* complex. Large form with higher leave division is separated from the bipinnate form. Thus, *Asp. costale* is more closely related to *At. pulcherrimum* compare to *At. nigripes*. Although the bipinnate form comprise of three clusters, there is not enough evidence to differentiate them because of the absence of *Asp. nigripes* and *Al. nitidula* type specimen, and the limited amount of sampled material. For further clarification, it is essential to gather more specimen, include more characters, e.g., cytology, spore ornamentation, molecular sequences, and employ different approaches.

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Appendix

Tabel S1. List of morphological characters observed and coded for clustering analysis.

No.	Character	Character States
1	Lamina shape	Ovate=0; Oblong-ovate=1; Oblong lanceolate=2
2	Lamina apex	Gradually acuminate=0; Abruptly acuminate=1; Long acuminate-caudate=2
3	Pinnae apex[1]	Short acuminate=0; Long acuminate=1; Caudate=2
4	Pinnules apex	Rounded-dentate/serrate=0; Acute-dentate/serrate=1; Acuminate=2
5	Length of stalk of basal pinnae	Short to 4 mm=0; Medium 4 mm< to 8 mm =1; Long over 8 mm=2
6	Stalk of (last) basal pinnules of basal pinnae	No stalk=0; Short to 2 mm=1; Long >2 mm=2
7	Leaf partition	Bipinnate=0; Tripinnate=1
8	Overlaps Pinnae	Yes=0; No=1
9	Overlaps Pinnules	Yes=0; Slightly=1; No=2
10	Space between lobes of pinnules (especially of basal pinnae)[2]	Decent=0; Wide gaps=1; Tight gaps or incision not reaching midrib=2; Shallower lobes=3
11	Basal pinnules or lobes	Distinct in shape, size, direction and distantly separated (relative to the next) =0; Not so=1
12	Pinnae rachis color	Dark upper part, mostly straw color underneath=0; Dark all over=1
13	Types of scale present on rachis	Narrow and hair-like =0; Hair-like only=1; None=2
14	Presence of scale on rachis and costae	Present=0; Present but very rare=1; Absent=2
15	Hairs on rachis and pinnae rachis	Present inside the groove only=0; Observed mostly around the junction of pinnules, including inside the groove=1; Covering axis=2; Absent=3
16	Indusium shape	Short linear=0; Long (linear more than halfway) =1
17	Indusium position	Costular=0; Not costular=1; Both=2
18	Horseshoe/back-to-back indusium	Both present=0; Either one present=1; Not present=2
19	Insertion of costae to rachis or pinnae-rachis, or costule to costae	Not oblique=0; Oblique=1

[1]Short acuminate apex = almost acute; Long acuminate = gradually narrowed half way toward apex
[2]Decent space = as in standard form, gap slightly less than half wide of pinnule lobe

Appendix

Tabel S2. List of examined specimens of *Athyrium nigripes* complex and the morphological characters codes. Missing data or unknown coded as “-“.

No.	Specimen	Location	Tax. Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	At. pulcherrimum type specimen (photograph)	G. Pangrango	Pulch_T	0	1	1	1	1	1	1	0	1	2	0	0	-	-	1	0	0	1	0
2	Asp. costale type (photographs)	G. Gede	Cost_C	1	1	1	1	1	1	1	0	1	2	0	0	-	-	3	0	0	1	0
3	Mathews HB 571	G. Pangrango	Pul1	0	1	1	1	1	2	1	0	0	0	0	0	0	1	0	0	0	1	0
4	Clemens & Clem-ens 30519	G. Gede	Pul2	0	1	1	1	1	2	1	0	0	1	0	0	0	1	1	0	0	1	0
5	WT 1180	Above Kandang Badak, G. Pangrango	Pul3	0	1	1	1	1	2	1	0	0	1	0	0	1	1	0	0	0	1	0
6	M.A. Donk 346	G. Gede	Lrg1	0	1	1	1	1	2	1	0	0	0	0	0	1	1	0	0	0	1	0
7	Raciborski sn.	G. Pangrango	Lrg2	0	1	1	1	1	2	0	0	2	0	1	0	1	1	1	0	0	1	1
8	Hallier 446	G. Gede	Lrg3	1	1	1	1	1	2	0	0	2	0	1	0	0	0	3	0	0	1	1
9	Slooten 193	G. Pangrango	Lrg4	0	0	0	1	1	2	-	1	2	0	-	0	1	1	3	0	0	2	0
10	WT 1175	Above Kandang Badak, G. Pangrango	Lrg5	1	1	1	0	1	2	0	1	2	1	1	0	1	1	1	0	0	2	0
11	WT 1179	Above Kandang Badak, G. Pangrango	Lrg6	0	0	1	1	1	2	1	1	2	1	0	0	1	1	0	0	0	2	0
12	Swarts 3008	G. Gede	Tri1	0	0	1	0	1	0	1	0	2	0	0	0	0	1	0	0	0	1	1
13	Swarts 3009	Tjibodas, G. Gede	Tri2	0	0	1	0	1	0	1	0	2	1	0	1	0	1	3	0	0	2	1
14	Blume sn.	Kandang Badak, G. Gede	Tri4	0	0	1	1	2	1	0	0	1	0	1	0	0	1	3	0	0	2	1
15	v Leeuwen-Reijnvaan 12345	G. Kawi, Tjemoro Kandang	Tri5	0	0	2	1	2	2	0	0	2	0	0	0	0	0	0	0	0	1	1
16	Asp. nigripes type specimen (photograph)	Between G. Burangrang and G. Tangkuwan Prahu	Des_nig	1	0	0	0	0	1	0	1	2	0	1	0	2	2	1	0	0	1	1
17	M.A. Donk P345	Lebak Saat, Gede-Pangrango	Std1	2	0	0	0	1	1	0	1	1	0	1	0	0	0	1	0	0	2	0
18	Sapiin 2772	Tjibodas, G. Gede	Std2	0	0	0	0	1	1	0	1	2	0	1	0	2	2	1	0	0	2	0
19	Adelbert 165	G. Gede-Pangrango	Std3	0	0	0	0	1	1	0	1	2	2	1	1	2	2	3	0	0	2	0
20	Backer 13602	G. Gede	Std5	0	0	0	0	0	1	0	1	2	0	1	1	0	1	1	0	0	2	0

Appendix

Tabel S2. List of examined specimens of *Athyrium nigripes* complex and the morphological characters codes. Missing data or unknown coded as “-“.

No.	Specimen	Location	Tax. Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
21	Meijer 1518	Air panas, G. Gede	Std6	0	0	1	0	1	1	0	1	2	0	1	0	2	2	0	0	0	2	0
22	Posthumus 176	G. Pangrango	Std8	0	0	1	0	0	1	0	1	2	2	0	0	0	1	1	0	0	2	0
23	WT 1169	Below Air Panas, G. Gede -Pangrango	Std9	0	0	0	0	1	1	0	1	2	2	0	0	1	1	1	0	0	2	0
24	WT 1171	Below Air Panas, G. Gede -Pangrango	Std10	2	0	0	0	0	1	0	1	2	1	1	0	2	2	1	0	0	2	0
25	WT 1404a	-	Std11	0	0	1	0	1	1	0	1	2	2	0	1	0	1	0	0	0	2	0
26	v Leeuwen-Reijnvaan 12379	G. Kawi, Oro-oro	Std12	1	0	2	0	0	1	0	1	2	0	0	0	0	0	1	0	0	1	0
27	Raciborski sn.	Kandang Badak, G. Gede	StdOb1	0	0	2	0	1	1	0	0	2	0	0	0	1	1	0	0	0	2	1
28	Raciborski sn.	Kandang Badak, G. Gede	StdOb2	0	1	2	0	1	1	0	0	2	0	0	0	0	0	1	0	0	2	1
29	Backer 3326	G. Gede z.w. helling	StdOb3	0	2	2	0	1	1	0	0	2	0	0	0	0	0	1	0	0	2	1
30	Adelbert 215	G. Pangrango	StdOb4	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	0	2	1
31	M.A. Donk 696	Java (Patoeha?)	Ser1	1	0	0	0	0	1	0	1	2	2	0	0	0	1	0	1	0	1	0
32	Posthumus 3991	G. Tjemoro Kandang	Ser3	1	0	1	0	1	1	0	1	2	2	1	0	0	1	0	1	0	1	0
33	Raciborski sn.	Kandang Badak, G. Gede	Ser4	1	0	0	0	0	0	0	1	2	3	1	0	2	2	0	1	2	1	0
34	Raciborski sn.	Tjibodas	Ser5	1	0	0	0	0	0	0	1	2	2	1	0	2	2	1	1	2	1	0
35	Backer 12654	G. Patoeha	Ser6	2	0	1	0	0	1	0	1	2	2	0	0	0	1	0	1	0	1	1
36	v Leeuwen-Reijnvaan 8788	G. Soembing	Contd1	0	0	0	0	0	1	0	0	2	1	1	0	0	0	3	1	0	1	1
37	Jeswit 107	Smeroe gebergte	Contd3	2	1	1	0	1	1	1	0	2	1	0	1	0	0	1	0	0	2	1
38	WT 1182	Above Kandang Badak, G. Pangrango	Contd4	0	0	2	0	1	1	1	0	2	1	0	0	0	1	3	0	0	1	1
39	Raciborski sn.	Telaga Warna	Nit1	0	0	1	0	1	1	0	0	2	0	1	0	0	1	2	1	2	0	1
40	Raciborski sn.	Telaga Warna	Nit2	0	0	1	0	1	1	0	0	2	0	1	0	0	1	2	1	2	0	1
41	Raciborski sn.	G. Gede	Nit3	0	0	1	0	2	1	0	0	2	2	1	0	1	1	1	1	2	0	1
42	Donk P633	Tjimanggoe, G. Patoeha	Nit4	0	1	1	0	1	1	0	1	2	0	1	0	2	2	1	1	0	0	1
43	Donk P751	Tjimanggoe, G. Patoeha	Nit5	0	1	1	0	1	1	0	0	2	2	1	0	1	1	1	1	0	0	1

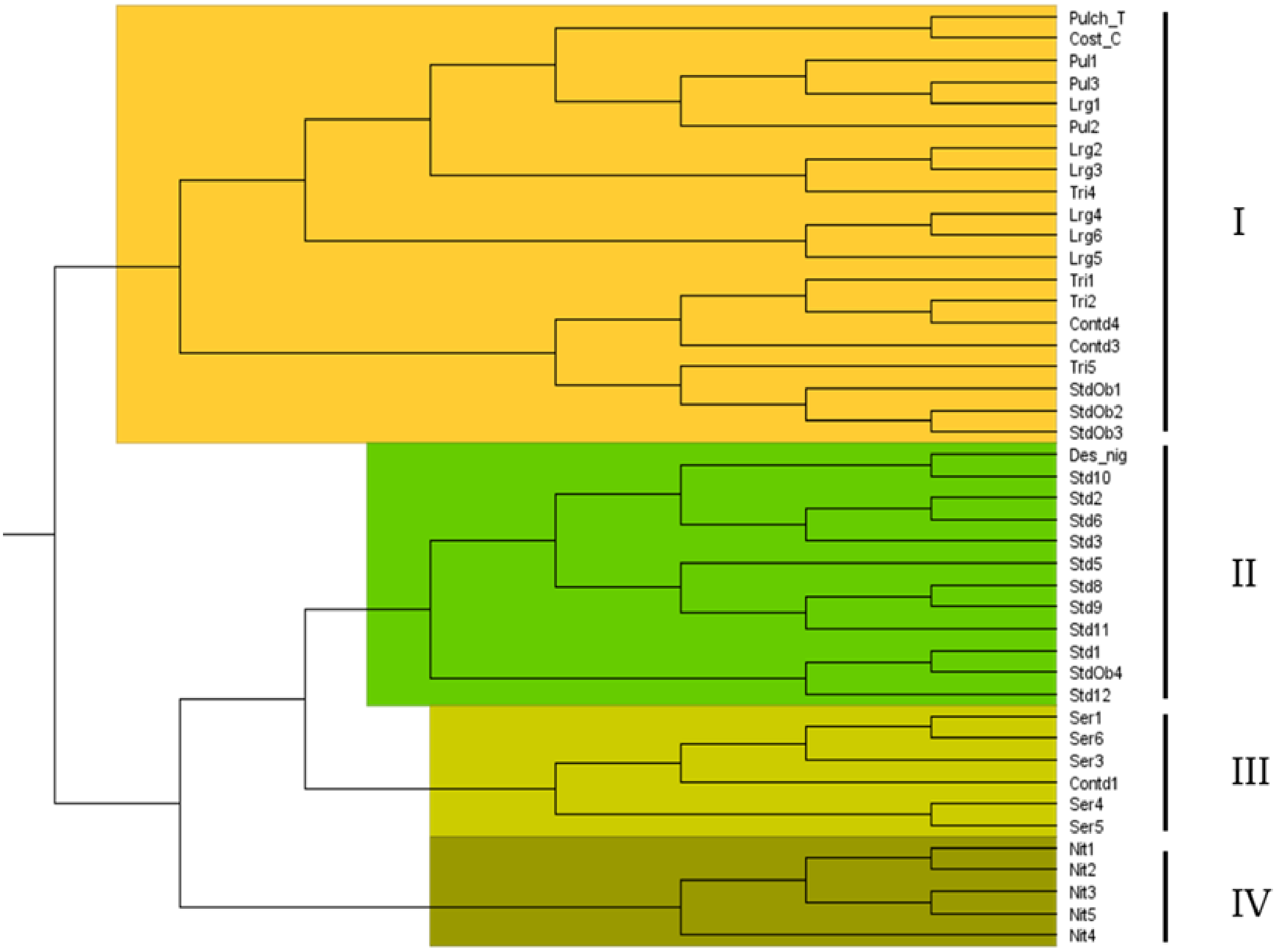

Fig. 1. Dendrogram of 43 OTUs collected from Java generated using UPGMA method, based on 19 characteristics. Code on the terminal indicate category of general appearance: Pul = *At. pulcherrimum* type; Cost = *Asp. costale* type; Lrg = large form; Tri= tripinnate form; Contd = contracted form; Std = standard form; StdOb = standard form with oblique axis; ; Ser = serrated form; Nigr = *At. nigripes* type; Nit = *At. nitidulum* type;

Fig. 2. Member of Group I (partly): A. Large form; B. Tripinnate form; C. Standard form with oblique axis; D. Contracted form. All were presumed as *At. nigripes*

Fig. 3. Comparison of the types nested in Group I, from left to right: *At. pulcherrimum*, *Asp. costale* Type C and Type D

Fig. 4. Member of Group II: *At. nigripes* type specimen (left) and the Standard form (right).

Fig. 5. Member of Group III with serrated margin (left) and type specimen of *At. gymnogrammoides* (right).

Fig. 6. *At. nitidulum* of the group IV (left); a closer image of basal pinna rachis with short hairs on its surface (right).