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Short Note
A First Record of *Microsorum musifolium* Copel. (Polypodiaceae) from Thailand

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***Microsorum musifolium* Copel. is firstly discovered from Waeng, the southernmost district of Narathiwat Province, Thailand. The species is described and illustrated. A key, including all the additional species, for the Flora of Thailand is constructed. Taxonomic confusion of *Microsorum musifolium* Copel. with *Microsorum punctatum* (L.) Copel. is noted.**

The wart ferns, *Microsorum* Link, consist of about 50 species worldwide, and belong to the family Polypodiaceae in the order Polypodiales[1]. These species are widespread in the temperate and tropical parts of the Old World, extending from the Pacific Islands to northeast Australia, Malaysia, Southeast Asia, southern China, from the Indian subcontinent to Madagascar and tropical Africa. In Thailand, 11 species have previously been recorded[2]. In 2001 a new species of *Microsorum*, *M. thailandicum* T. Boonkerd & Noot., was found to occur in a limestone mountain in Chumphon Province, peninsular Thailand[3]. Then, a new record, *Microsorum insigne* (Blume) Copel. was collected from Phu Hin Rong Kla National Park, Phitsanulok Province, lower northern Thailand[4]. Recently, another calciphyte, *M. siamense* T. Boonkerd, was discovered from limestone mountains in Yala Province, peninsular Thailand[5]. Thus so far, 14 distinct species of *Microsorum* have been recorded in Thailand.

Here, we report an additional species in Thailand, *Microsorum musifolium* Copel., which was found during the botanical trip to the Sirindhorn Waterfall, Waeng District, Narathiwat Province, peninsular Thailand. It was previously known to occur in southern Myanmar, peninsular Malaysia, Sumatra, Indonesia, Borneo, Philippines and New Guinea[6]. The species was first described by Blume in 1828 as *Polypodium musifolium* Blume from the specimens collected in an area near Buitenzorg in Java[6].

***Microsorum musifolium* Copel.**
(Fig. 1)

Microsorum musifolium Copel., Univ. Calif. Publ. Bot. 16: 112. 1929; Bosman, Monogr. *Microsorum*, Leiden Bot. Ser. 14: 94. 1991. – *Polypodium musifolium* Blume, Enum. Pl. Javae 2: 134. 1828. –*Pleopeltis musifolia* T. Moore, Index Fil. 78. 1857. –*Drynaria musifolia* J. Sm, Cat. Cult. Ferns 14. 1857.

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Type: Java, near Buitenzorg, *Blume s.n.* (holotype, L!).

Rhizome moderately long creeping, cylindrical to dorso-ventrally slightly flattened, 5.5 - 8.4 mm in diameter, not waxy ; roots densely set forming a thick mat; phyllopodia obscure, up to 10 mm apart. Rhizome anatomy: vascular bundles in cylinder 17 - 21, bundle sheaths collenchyma - tous, sclerenchyma strands at least 50, scattered, ground tissue without cavities. Rhizome scales densely set at apex, appressed, peltate, widest below or about the middle, 3.2 - 5.0 by 1.2 - 1.6 mm, clathrate, marginal region hyaline, margin entire, apex acuminate, central region dark, glabrous, inner layer of thickened cell walls smooth. *Fronds* simple, well proportioned to the rhizome diameter; stipes absent or indistinct, up to 6 mm in diameter, with a few scales; widest about or above the middle, 35 - 98 by 5 - 11.2 cm, light green when living, subcoriaceous, with short glandular hairs and a few scales, acicular hairs absent, base truncate to obtuse, margin entire-undulate, apex acute to acuminate. *Venation pattern*: veins forming a more or less regular row of nearly equally sized areoles between each pair of adjacent secondary veins, all veins clearly distinct; secondary veins 7 - 15 mm apart, more or less straight, dichotomously branched near the margin of the lamina; tertiary veins catadromous, 6 - 10 between adjacent secondary veins, interconnected by some quaternary veins; smaller veins variously anastomosing; free included veins simple, once- and in part twice-forked, pointing to all sides. *Sori* superficial, round, sometimes in part confluent, 1.2 - 1.5 mm in diameter, spreading all over the lamina or restricted up to the distal ½, absent in the marginal areoles, occasionally present in all areoles, 33 - 46 per cm^2, not on tertiary veins, occasionally in part on quaternary veins, irregularly scattered on the smaller anastomosing veins and on the free included veins. Paraphyses uniseriate, 2- or 3-celled. *Sporangia*: annulus (18-) 19- or 20-celled, indurated cells (12) 13 or 14, hypo- and epistomial cells together 6 or 7. *Spores* concavo-convex, hyaline, 43 - 53 by 30 - 37 µm, colliculate, the elevations not very prominent, rounded, about 5 µm wide.

Specimens examined.– *Boonkerd & Pollawatn 243-2* (BCU); *Elmer 20871* (K, P); *Enders 4022* (L); *Iwatsuki et al. 3252* (K); *Kato et al. B3252* (L); *Bernardi 234* (B); *Blume s.n.* (L); *Zollinger 3005* (P); *Beddome 1911* (K); *Henderson 19704* (K), *19708* (BM); *King 192* (K); *Little 469* (L); *Matthew 1928* (K); *Turneau 836, 905* (K); *Lauterbach*

TABLE 1. Comparison of eight qualitative characters of *M. musifolium* and *M. punctatum*

Character	*M. musifolium*	*M. punctatum*
Rhizome surface	not waxy	often waxy
Attachment of scales	peltate	pseudopeltate
Spreading of scales	appressed	distinctly or slightly spreading
Scales margin	entire	dentate to denticulate
Presence of hyaline marginal region on rhizome scales	present	absent
Lamina base	truncate to obtuse	narrowly angustate to cordate
Visibility of veins	all veins distinct	all veins or secondary and smaller veins more or less immersed and vague (at least in living specimen)
Spores shape	concavo-convex	plano-convex

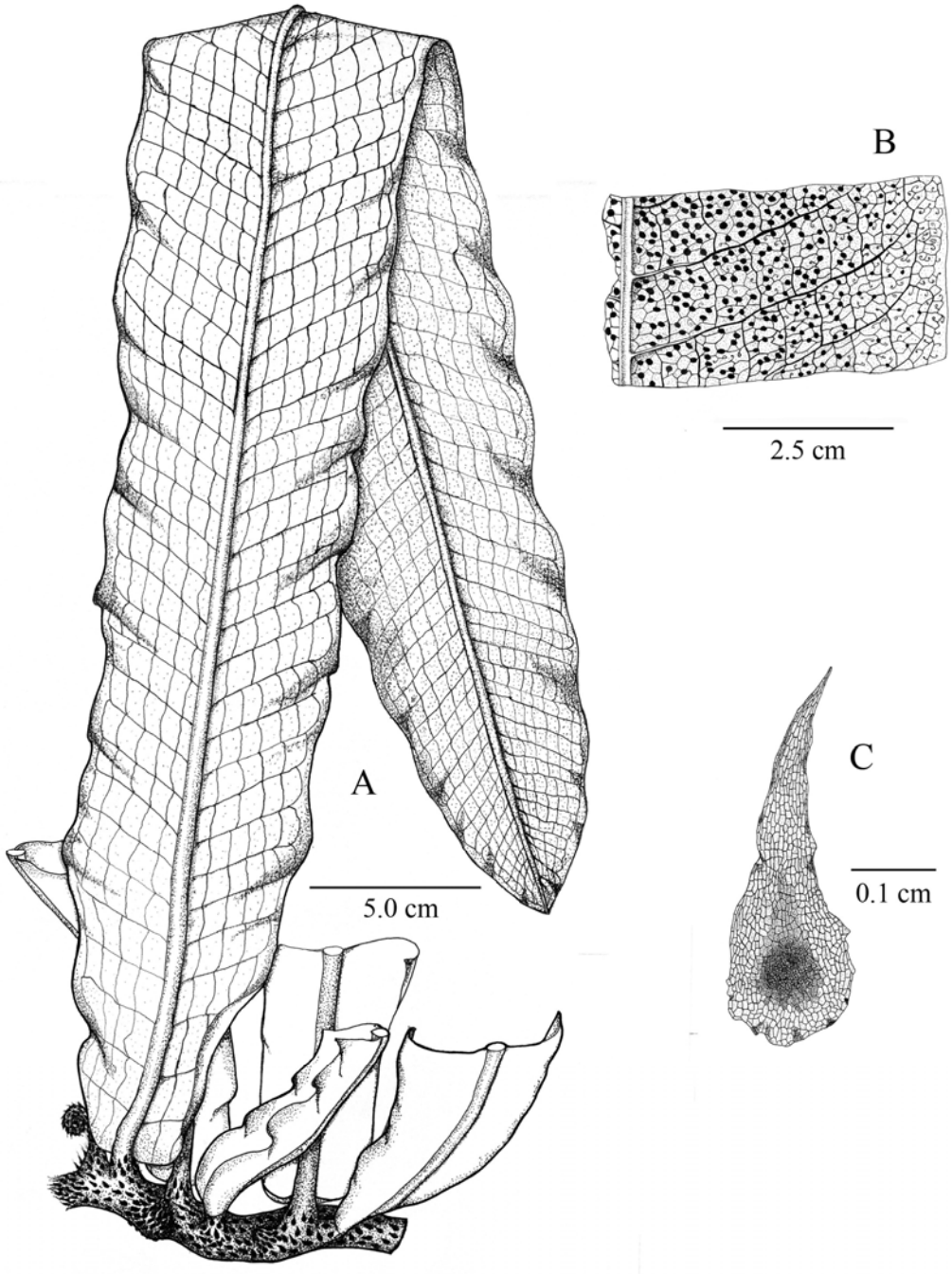

FIGURE 1. *Microsorum musifolium* Copel. (A) Habit, (B) Detail of sori and venation, (C) A rhizome scale. Drawn by Sahanat Petchsri from *T. Boonkerd & R. Pollawatn 243-2* (BCU).

TABLE 2. Measurements of 16 quantitative morphological characters of *M. musifolium* and *M. punctatum*

Characters	*M. musifolium*		*M. punctatum*	
	mean	± SE	mean	± SE
Lamina width (mm)	96.5[a]	16.5	57.8[b]	18.4
Lamina length (mm)	832[a]	157	736[a]	44
Stipe length (mm)	0.48[a]	0.11	101.4[b]	7.0
Stipe diameter (mm)	5.75[a]	1.04	4.53[b]	0.92
Diameter of phyllopodia (mm)	5.56[a]	1.33	4.39[b]	1.06
Phyllopodia length (mm)	6.13[a]	1.25	4.40[b]	1.27
Rhizome diameter (mm)	6.98[a]	1.40	5.74[b]	1.25
Distance between closest phyllopodia (mm)	12.5[a]	3.0	8.20[b]	1.88
Scale length (mm)	3.64[a]	0.40	3.30[a]	0.62
Scale width (mm)	1.42[a]	0.21	1.18[b]	0.24
Density of sori per cm^2	39.5[a]	6.6	38.4[a]	10.0
Diameter of sori (mm)	1.39[a]	0.15	1.28[a]	0.17
Diameter of sporangium (mm)	0.16[a]	0.01	0.17[a]	0.15
Number of annulus cell	18.9[a]	0.8	19.3[a]	1.0
Spore length (μm)	47.7[a]	4.9	51.7[b]	4.1
Spore width (μm)	33.3[a]	3.6	31.4[a]	3.1

Note: Values represent the mean ± 1 S.E., Mean with significant differences ($p<0.05$) denoted by different superscripts within each row.

567 (P); *Ledermann 7695, 8549, 8743* (B); *Schlechter 2764* (B); *Copeland 1537* (B); *Elmer 10500* (K, L); *Vanoverberg 3678* (P); *Gay 132* (K); *Hancook 342, 1892* (K); *Hose 1827* (BM); *J. Smith 1859* (BM); *Corner 30247* (K); *Haniff 21028* (K); *Brooks 357* (BM); *Lau 1796* (K); *de Wide & de Wide 12385* (L)

Thailand.– PENINSULAR: Narathiwat (Sirindhorn Waterfall).

Distribution.– Southern Myanmar, peninsular Malaysia, Sumatra, Indonesia, Borneo, Philippines and New Guinea.

Ecology.– Low epiphytes or lithophytes in tropical evergreen forests at low altitudes.

Note.– *Microsorum musifolium* was wrongly treated as a synonym of *Microsorum punctatum* (L.) Copel. by Nooteboom (1997)[7] despite their differences in at least eight qualitative characters, namely the rhizome surface, attachment of scales, spreading of scales, scale margin, presence of hyaline marginal region on rhizome scale, lamina base, visibility of veins and spore shape (Table 1). They also differed in some quantitative, vegetative characters (Table 2). Therefore *M. musifolium* should be recognized as a species of its own.

Previously, Tagawa and Iwatsuki (1989)[2] are likely to have made a mistake in describing fronds of *M. rubidum* as pinnate and so the key to species in the Flora of Thailand cannot be used to identify this species correctly. Likewise, a simple, entire frond-form of *M. pteropus*, which is commonly found, also has identification problems.

The key to the species of the *Microsorum* account[2], therefore, has been revised and includes all the new taxa for Flora of Thailand, viz. *M. thailandicum*, *M. insigne* and *M. siamense*.

Key to species of *Microsorum*

1. Sori superficial, not sunk in cavities
   2. Frond usually simple, entire or slightly undulate
      3. Rhizome slender, scandent, with fronds far apart……..……**1. *M. superficial***

3. Rhizome thick, creeping, never scandent
4. Lateral main veins distinctly raised at least on lower surface
5. Sori in two regular rows between adjacent main veins…..**2. *M. zippelii***
5. Sori irregularly scattered, abundant
6. Stipe distinct, winged to the base; lamina thinly herbaceous to paperaceous, light to dark green
7. Stipe winged on upper portion. Usually occurs on wet rocks in stream-beds, in spraying water..… ……...**6. *M. pteropus***
7. Stipe winged nearly to the base
8. Mountain plant; receptacles punctuate…… …...…...**3. *M. membranaceum***
8. Lowland plant; receptacles elongate…… ……**4. *M. heterocarpum***
6. Stipe indistinct or absent; lamina subcoriaceous, light green when living…….....**15. *M. musifolium***
4. Lateral main veins hardly visible
9. Living frond light green in colour…. ……...**5. *M. punctatum***
9. Living frond iridescent blue-green
10. Costa grooved on upper surface; hydathode absent……. ……...……**12. *M. thailandicum***
10. Costa slightly raised on upper surface; hydathode distinct on upper surface…….**14. *M. siamense***
2. Fronds of well-grown plants deeply lobed
11. Fronds trilobite. Stipes and midribs beneath scaly; dark green to blackish in colour…….. ……...**6. *M. pteropus***
11. Fronds pinnatifid with more than one pairs of lateral lobes
12. Fronds lobed to within 2-5 mm of the midrib; rhizome long creeping…..……**13. *M. insigne***
12. Fronds lobed to about 1 cm from the midrib; rhizome short creeping...……**7. *M. dilatatum***
1. Sori sunk in cavities
13. Sori uniseriate on either side of midrib; main veins distinct
14. Frond pinnate usually with more than 12 pairs of pinnae. Sori slightly sunk in cavities…….. ……...…**8. *M. cuspidatum***
14. Frond deeply lobed. Sori deeply sunk in cavities
15. Lamina light green. Lobes usually more than 15 pairs…….. ……**9. *M. rubidum***
15. Lamina dark green. Lobes usually less than 12 pairs…… ……...…**10. *M. nigrescens***
13. Sori in two rather irregular rows on either side of midrib; veins hardly visible……**11. *M. scolopendria***

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