Research note

# Confirmation of the Occurrence and Distribution of Three Fern Species in Taiwan

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【Summary】

The occurrence and distribution of 3 poorly known fern species in Taiwan are confirmed herein. They are *Crepidomanes grande* (Copel.) Ebihara & K. Iwats. (an overlooked species), *Radiogrammitis setigera* (Blume) Parris (a rediscovered species), and *Prosaptia nutans* (Bl.) Mett. (a poorly known record in Taiwan). This paper provides morphological descriptions, diagnostic photos, and taxonomic notes for their identification. Their conservation statuses in Taiwan are also evaluated according to the IUCN Red List categories and criteria.

**Key words:** *Crepidomanes grande*, fern, Grammitidaceae, Hymenophyllaceae, Polypodiaceae, *Prosaptia nutans*, *Radiogrammitis setigera*, Taiwan.

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研究簡報

# 三種蕨類植物在臺灣的分布確認

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## 摘 要

本文為三種蕨類植物在臺灣分布之確認報導，該三種蕨類植物依序為大球稈毛蕨(*Crepidomanes grande* (Copel.) Ebihara & K. Iwats.，為一長期被學界忽略之分類群)、剛毛輻禾蕨(*Radiogrammitis setigera* (Blume) Parris，係一個再發現的稀有蕨類)，以及俯垂穴子蕨(*Prosaptia nutans* (Blume) Mett.；2010年由B.S. Parris報導為臺灣新紀錄蕨類，但因相當稀有，故鮮為世人所知)。本文除了提供該三種蕨類植物之形態特徵、野外彩色照片，及其分類與發現等相關歷史緣由外，亦根據國際自然保育聯盟(IUCN)的評估準則，針對上述三種植物提出在臺灣的稀有及保育等級建議供參。

**關鍵詞：**大球稈毛蕨、蕨類、禾葉蕨科、膜蕨科、水龍骨科、俯垂穴子蕨、剛毛輻禾蕨、臺灣。

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## INTRODUCTION

In the long history of taxonomic research of ferns in Taiwan, neglection and misidentification have frequently occurred. *Crepidomanes grande* (Copel.) Ebihara & K. Iwats., for example, was first recorded in Taiwan as *Trichomanes preslianum* Nakai (Nakai 1926), which was later treated as a synonym of *Nesopteris grandis* (Copel.) Copel. (Copeland 1938). *Nesopteris grandis* was mentioned in the first edition of the *Flora of Taiwan* (DeVol 1975), but was ignored in subsequent studies (e.g., Kuo 1985, 1997, Tsai and Shieh 1994, Lu and Yang 2005) because no voucher was available. Another example is *Radiogrammitis setigera* (Blume) Parris, which was collected in Taiwan by Y. Ymamoto in 1930, but with no more records since. Additionally *Prosaptia nutans* (Blume) Mett. was stated to be distributed in Taiwan with no further information in the *Flora of Peninsular Malaysia* (Parris 2010), and its existence has been highly doubted.

This paper confirms the occurrence of these 3 species in Taiwan and presents their relevant information, including morphological descriptions, diagnostic photographs, taxonomic notes, and conservation statuses in Taiwan according to the IUCN Red List categories and criteria (IUCN 2001, 2003).

## TAXONOMIC TREATMENTS

HYMENOPHYLLACEAE 膜蕨科

***Crepidomanes grande*** (Copel.) Ebihara & K. Iwats., Blumea 51: 239. 2006. .....大球桿毛蕨(Fig. 1)

**Basionym:** *Trichomanes grande* Copel., Philipp. J. Sci. ser. C 6: 70. 1911. － Typus: *E.B. Copeland 1739*, from Mindanao (San Ramon), the Philippines (holotype: not seen; isotype: P, photo!).

**Homotypic synonym:** *Nesopteris grandis* (Copel.) Copel., Philipp. J. Sci. 67(1): 66. 1938; id. Fern Fl. Philipp. 1: 76. 1958; Ching,

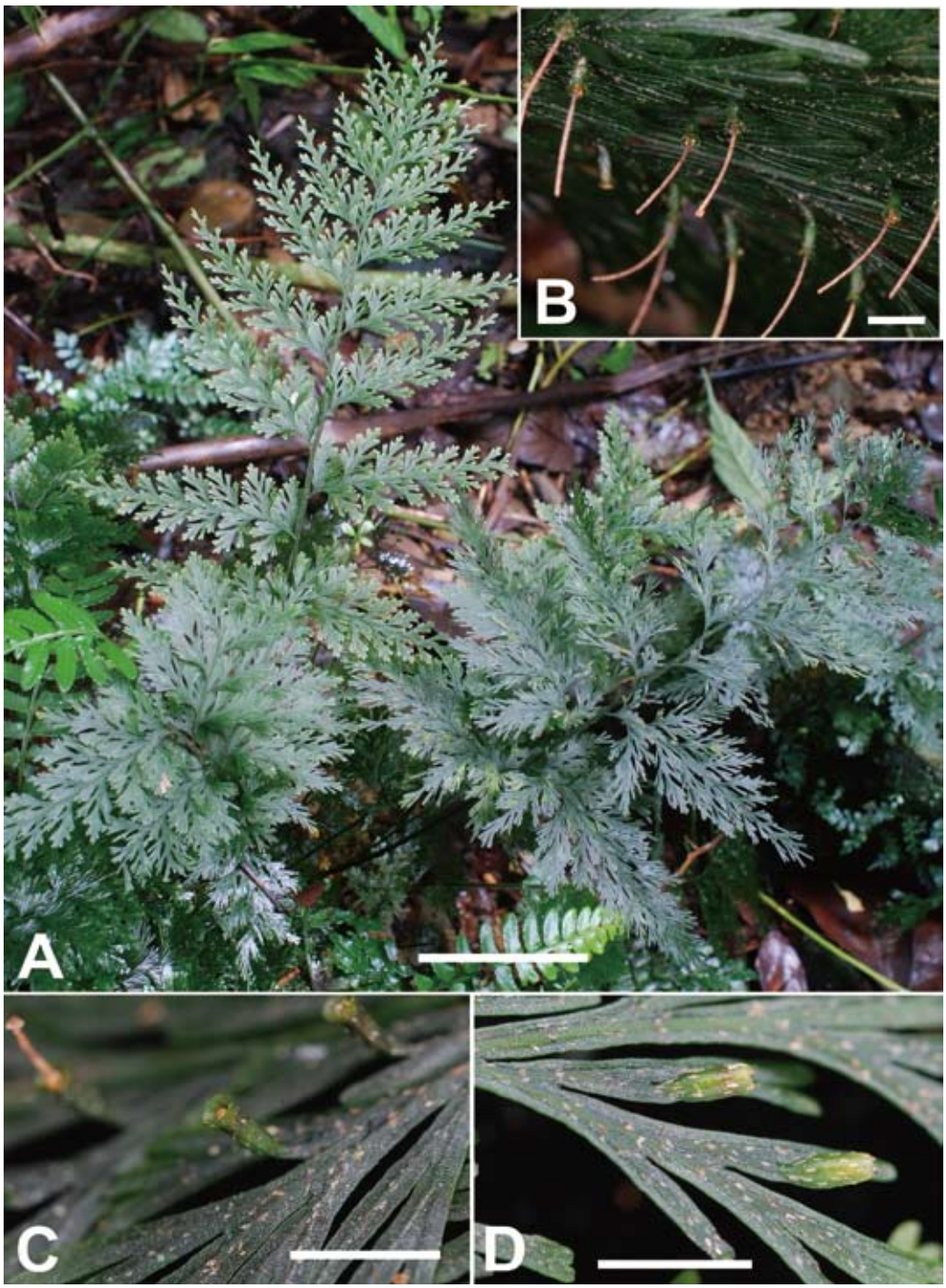


**Fig. 1.** ***Crepidomanes grande*** **(from** ***T.C. Hsu 5695*****). A, habit; bar = 5 cm; B, portion of abaxial side of lamina with several tubular sori curved downward; bar = 1 cm; C, tubular sori of** ***C. grande*****; bar = 1 cm; D, tubular sori of** ***C. thysanostomum*** **(for comparison with** ***C. grande*****); bar = 1 cm. Photographs by Tian-Chuan Hsu.**

Fl. Reipubl. Popul. Sin. 2: 195. 1959; DeVol, Taiwania 14(1): 101. 1968; id. Fl. Taiwan 1: 102. 1975; Shieh, J. Sci. Engin. 15: 49. 1978.

**Heterotypic synonyms:** *Trichomanes anceps* Hook. var. *β*, Hook., Sp. Fil. 1: 135, *t. 40C* (*f. 2*, *3*). 1846, nom. illeg. — Specimens cited: *Cuming 162* and *274* (both are candidates for the lectotype; not seen), from the Philippines.

*Trichomanes preslianum* Nakai, Bot. Mag. Tokyo 40: 261. 1926; Sasaki, List Pl. Formosa, *Pteridophyta* 4. 1928; Makino and Nemoto, Fl. Jap. 11. 1931; Masamune, Short Fl. Taiwan 3. 1936; Hsieh and Yang, Nomen. Pl. Taiwan 8. 1969. — Typus: *K. Miyake s.n.* 1899, from Lanyu (= Botel Tobago, Ins. Koto, or Orchid Island), Taiwan (syntype: TI; not seen); *T. Kawakami & S. Sasaki s.n.* 1912, from Lanyu, Taiwan (syntype: TI; not seen).

**Misidentified synonyms:** *Trichomanes thysanostomum* auct. non Makino (1899): Kuo, Taiwania 30: 17, 55. 1985, pro parte. — *Nesopteris thysanostomum* auct. non (Makino) Copel. (1938): Nakaike, Enum. Pterid. Jpn. Fil. 34. 1975, pro parte excl. typus; DeVol, Taiwania 14: 101. 1968, pro parte (cited specimens: *K. Miyake s.n.* 1899 and *T. Kawakami & S. Sasaki s.n.* 1912; synonym: *Trichomanes maximum* sensu T. Ito) excl. typus; id. Fl. Taiwan 1: 99. 1975, pro parte (cited specimens: *K. Miyake s.n.* 1899 and *T. Kawakami & S. Sasaki s.n.* 1912; synonym: *Trichomanes maximum* sensu T. Ito) excl. typus; Tsai and Shieh, Fl. Taiwan (2nd ed.) 1: 122. 1994, pro parte (cited specimens: *K. Miyake s.n.* 1899 and *T. Kawakami & S. Sasaki s.n.* 1912) excl. typus, synonyms & pl. 45.

*Trichomanes maximum* auct. non Blume (1828): Ito, Zoku Taiwan Shokubutsu Zusetsu (= Illustrations of Taiwan Ferns), *t*. 393. 1928.

**Morphology:** Medium to large evergreen filmy ferns, terrestrial or growing on rocks. Rhizomes short, erect with several fronds in a tuft, densely covered with blackish-brown multicellular hairs. Roots wiry, blackish, rather thick. Stipes ca. (7~)10~20(~35) cm long, somewhat fragile, dark-green to grayish-brown, slightly covered with hairs; hairs on stipes appressed, brown to dark-brown, multicellular, ca. 2~3 mm long. Laminae quadri- or even pentapinnate, dark green, ovate-oblong, ca. 12~45 cm long, 8~15 cm wide; rachises narrowly winged, both surfaces loosely covered with white to light-brown clavate hairs; lateral pinnae ca. 7~10 pairs, 5~8 cm long, lower ones shortened; ulitimate segments ca. 0.3~0.4 mm wide, entire. Veinlet single per segment, both sides covered with clavate hairs. Sori borne on distal portion of fronds, solitary at apex of segments; indusia (involucres) tubular but distal portion (mouths) slightly enlarged and becoming somewhat trumpet-like, mouths slightly dilated and often covered with clavate hairs when young but soon caducous when maturing, receptacles exserted prominently, ca. 3~5 mm long.

**Distribution:** S. China, Indonesia (Java), Papua New Guinea, the Philippines, Samoa Islands, Solomon Islands, and Taiwan.

**Habitat:** Growing on somewhat shaded and very humid ground, slopes, or rocks under broadleaf evergreen forests at elevations of ca. 200~400 m. So far, scattered small populations have only been found in southeastern Taiwan.

**Conservation status:** VU [B1ac (ii, iv)].

**Voucher specimens from Taiwan:** Shawuchun Stream, Pingtung Co., *P.F. Lu 17522* (TAIF), *T.C. Hsu 5695* (TAIF); Nanjenshan, Pingtung Co., *T.T. Lin et al. s.n.*, 15 Mar. 1981 (TAIF); Luliao Stream, Pingtung Co., *P.F. Lu 19919* (TAIF); Mt. Bei-i, Pingtung Co., *C.M. Kuo 14335* (TAI); Mt. Wanlide, Pingtung Co., *L.Y. Kuo 882* (TAIF).

**Taxonomic note:** *Trichomanes grande* was first published by Copeland (1911), and its holotype (*Copeland 1739*) was collected from Mindanao, the Philippines. However, the earliest collections of this species can be traced back to H. Cuming's plant investigation (*Cuming 162*, *pro part*. and *274*) in the Philippines between 1836 and 1840. Hooker (1846) named these 2 specimens *Trichomanes anceps* Hooker var. *β* (an illegitimate scientific name because of the Greek letter *β*), which was treated as a synonym under *T. grande* by Copeland (1933).

*Trichomanes grande* or its homotypic synonym was reported to occur in Taiwan (e.g., Ching 1959, DeVol 1968, 1975, Shieh 1978), possibly because Copeland (1938) treated *T. preslianum* Nakai as a synonym of *Nesopteris grandis* (= *T. grande*). *Trichomanes preslianum*, which was published by Nakai (1926) based on 2 specimens (viz. *K. Miyake s.n.* 1899 (TI) and *T. Kawakami & S. Sasaki s.n.* 1912 (TI)) collected from the island of Lanyu (Orchid Island) of Taiwan, was only recognized by some documents (e.g., Sasaki 1928, Makino and Nemoto 1931, Masamune 1936, Hsieh and Yang 1969). Because no specimen was found in local herbaria, the occurrence of *T. grande* in Taiwan was further doubted (DeVol 1968, 1975, Liu et al. 2013), and has been entirely ignored in formal Taiwanese fern checklists for over 3 decades (e.g., Kuo 1985, 1997, Tsai and Shieh 1994, Lu and Yang 2005).

Copeland (1938) established the new genus *Nesopteris* based on *T. grande* and included 3 other species under this new genus. Among *Nesopteris* species, *T. grande* and *T. thysanostomum* Makino are very similar but can be distinguished by their mouths of tubular indusia (involucres) (enlarged and more or less dilated vs. not enlarged and truncate), rims of indusium mouths (mature ones usually without clavate hairs vs. mostly bearing persistent clavate hairs), wings of mature tubular indisia (almost wingless vs. mostly narrow-winged), and the curvature of the tubular indisia (usually curved downward vs. almost straight). These dissimilarities are rather minute but quite stable in both field observations and herbaria examinations, so we do not agree with Kuo (1985) who considered them conspecific. Both species are sometimes confused with *T. maximum* Blume (= *Vandenboschia maxima* (Blume) Copel.) in general features but differ from the latter by the short and erect (or suberect) rhizomes (vs. creeping rhizomes). Therefore, the illustration for *N. thysanostoma* (pl. 45) in the *Flora of Taiwan* (2nd ed.) vol. 1, should be corrected to *Vandenboschia maxima* due to its creeping rhizome.

Historically, *Trichomanes grande*, *T. thysanostomum* and closely-related taxa were placed either in the genus *Trichomanes* (Morton 1968, Kuo 1985), *Nesopteris* (Copeland 1938, 1958, Ching 1959, DeVol 1975, Shieh 1978), or *Cephalomanes* (K. Iwats. 1984, Kuo 1997), but they are now placed within the recircumscribed *Crepidomanes* based on molecular phylogenetic studies (Ebihara et al. 2006).

POLYPODIACEAE 水龍骨科

***Radiogrammitis setigera*** (Blume) Parris, Gard. Bull. Singapore 58(2): 240. 2007; Moore and Parris, Fl. China 2-3: 843. 2013. .. .....剛毛輻禾蕨(大禾葉蕨) (Fig. 2)

**Basionym:** *Polypodium setigerum* Blume, Enum. Pl. Javae 2: 123. 1828. － Typus: *C.L. Blume s.n.*, *s.a.*, from Java, Indonesia (lectotype: L, photo!, designated by Parris (1983); isolectotype: K, not seen; L, not seen).

**Homotypic synonym:** *Grammitis setigera* (Blume) Ching, Bull. Fan Mem. Inst.

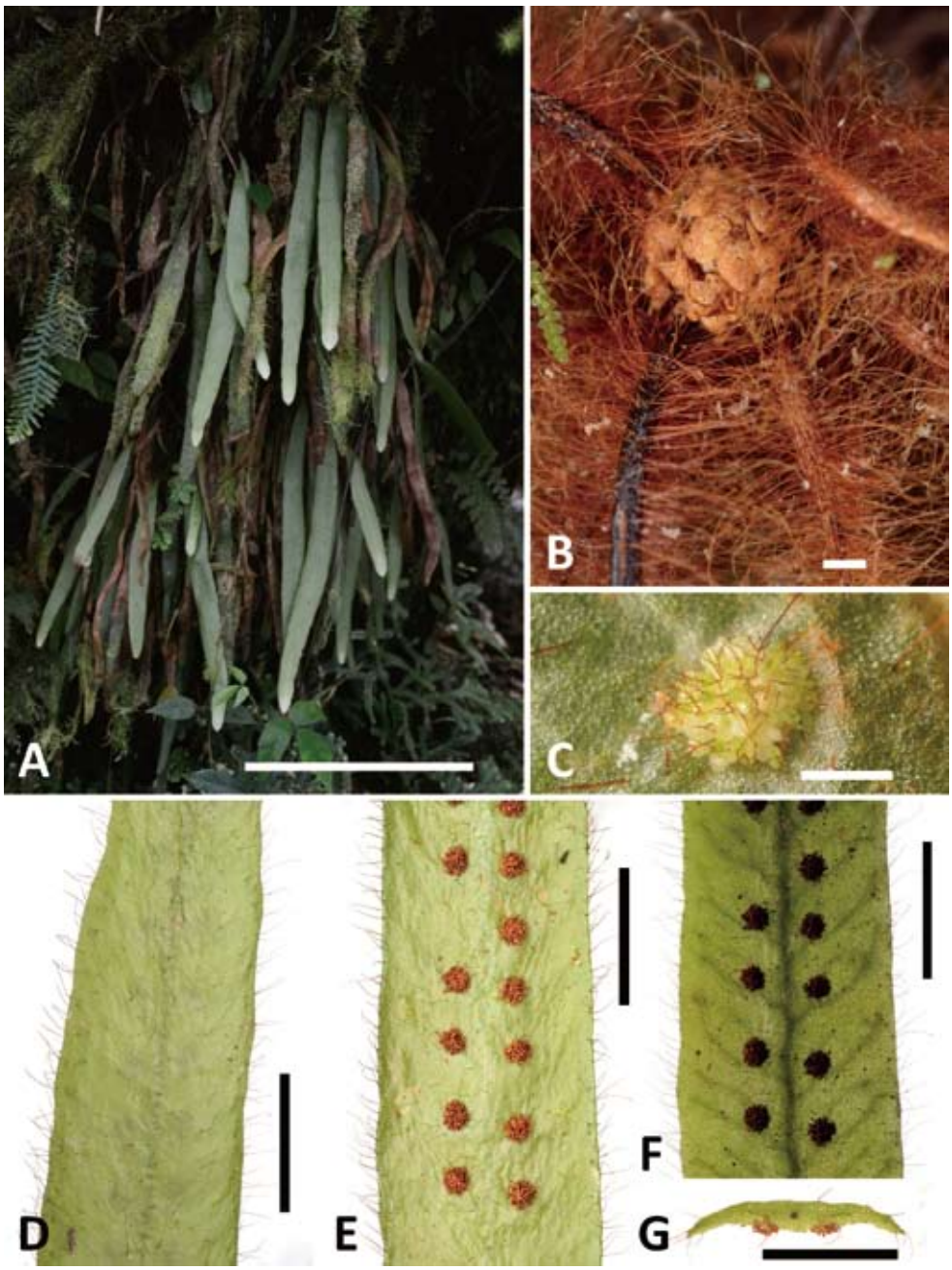


**Fig. 2.** ***Radiogrammitis setigera*** **(from** ***T.C. Hsu 6680*****). A, habit; bar = 10 cm; B, ovate scales on rhizome and linear hairs of stipe bases; bar = 1 mm; C, a round sorus mixed with brown hairs; hairs mostly solitary, a few 2 per tuft; bar = 1 mm; D, portion of adaxial side of frond; hairs mostly solitary, a few 2 per tuft; bar = 1 cm; E, portion of abaxial side of frond; bar = 1 cm; F, portion of abaxial side of frond showing pinnately free venation with transmitted light; bar = 1 cm; G, cross-section of frond showing sori and mid-vein; bar = 1 cm. Photographs by Tian-Chuan Hsu.**

Biol. Bot. 10: 241. 1941, non J. Sm. (1875: 181).

**Heterotypic synonyms:** *Grammitis fasciculata* Blume, Fl. Javae Fil. 2: 112, *t.* 47, *f.* 2. 1829, nom. illegit. superfl. pro *P. setigerum* Blume. ─ *Polypodium fasciculatum* (Blume) C. Presl, Tent. Pterid. 180. 1836, nom. illegit. superfl. pro *P. setigerum* Blume. ─ Typus: *C.L. Blume s.n.*, *s.a.*, from Java, Indonesia (type: L, photo!).

*Polypodium heanophyllum* Copel., Philipp. J. Sci. 40: 310. 1929. ─ Typus: *Copeland's Pteridophyta Philippensis Exsiccata 158* [*Sphalm. 185*], from Mt. Matutum, Mindanao, the Philippines (lectotype: MICH, photo!, designated by Parris (1983); isolectotype: BM, photo! K, not seen; SING, photo! UC, photo!).

*Grammitis intromissa* (H. Christ) Parris, Fern Gaz. 12(3): 180. 1981; Kuo, Taiwania 30: 44. 1985; id. Man. Taiwan Vasc. Pl. 1: 72. 1997; Shieh et al., Fl. Taiwan (2nd ed.) 1: 527. 1994; Zhang, Fl. Reipubl. Popul. Sin. 6(2): 319. 2000; Lu and Yang, Taiwania 50(2): 162. 2005; Knapp, Ferns and Fern Allies of Taiwan 240, *ph. 246-18a*, *f. 6.232*. 2011. ─ *Polypodium intromissum* H. Christ, Verh. Naturf. Ges. Basel 11: 440. 1896. ─ Typus: *Sarasin 1368*, from summit regions of Wawokaraeng, Gunung Lampobatang, Sulawesi, Indonesia (lectotype: BAS, not seen, designated by Parris (1983)).

*Grammitis latifolia* DeVol, Fl. Taiwan 1: 223. 1975. ─ Typus: *Y. Yamamoto 88*, 3 Apr. 1930 (holotype: TAI! isotype: TAI!), from Taito-montibus, Co. Taitung, Taiwan.

**Morphology:** Small to medium-sized epiphytes. Rhizomes short, suberect, covered with scales; scales ovate, yellowish-brown. Stipes congested, not articulate to rhizomes, 1.5~2.5 cm long, densely covered with brown hairs. Laminae broadly linear, ca. 10~30 cm long, 0.9~2.0 cm wide (there is a tendency of being longer when locations are nearer the Tropics), apices acute or obtuse, bases cuneate, margins slightly undulate, texture fleshy; costae visible on abaxile side; hairs solitary, reddish-brown, 2~3 mm long, widely spreading, abundant on stipes, leaf margins, and abaxial surface, but more sparingly so on adaxial surface. Venation obscure, free, and not reticulate. Sori round, in shallow depressions, arranged in a single row on each side of costa, exindusiate.

**Distribution:** Indonesia (Java and Sulawesi), the Philippines (Mindanao), and Taiwan.

**Habitat:** Epiphytes of warm-temperate rain forests at elevations of about 1200~1300 m. At present, only 1 population has been discovered in Taiwan.

**Conservation status:** CR [B1ac (ii, iii, iv), B2ac (ii, iii, iv)].

**Voucher specimens from Taiwan:** Taito-montibus, Taitung Co., *Y. Yamamoto s.n.* Apr. 4. 1930 (TAI); Mt. Chiling, Taitung Co., *T.C. Hsu 6680* (TAIF).

**Taxonomic note:** The first record of *R. setigera* in Taiwan was the 2 specimens (*Y. Yamamoto 88* and *s.n.* 4 Apr. 1930; both in TAI) collected by Y. Ymamoto at Taito-montibus in southeastern Taiwan in 1930. These very precious specimens are also the types of *Grammitis latifolia* DeVol. However, there was no more collection of this species in Taiwan for more than 80 years until recently.

*Polypodium setigerum* Blume (1828), in fact, is the earlier valid name for *Grammitis intromissa*. When this name was transferred to the genus *Grammitis* Swartz (e.g., Ching 1941), it became a later homonym of *G. setigera* J. Sm. published in 1875. However, if we accept the taxonomic opinion suggested by Parris (2007) and remove this entity to the new genus *Radiogrammitis* Parris, the correct name of this species should be changed to *Radiogrammitis setigera* (Blume) Parris.

According to phylogenetic studies (Ranker et al. 2004, Labiak et al. 2010, Hirai et al. 2011), the traditionally defined *Grammitis* is not monophyletic, necessitating re-delimitation and classification. Subsequently Parris (2007) established *Radiogrammitis* as one of the segregates from *Grammitis s.l.* This genus, characterized by redial rhizomes with stipes in whorls and non-clathrate scales, is adopted here.

POLYPODIACEAE 水龍骨科

***Prosaptia nutans*** (Blume) Mett., Reise Novara 1. 214. 1870; Parris, Fl. Penins. Malay. ser. 1: 178. 2010; Moore and Parris, Fl. China 2-3: 847. 2013. .....俯垂穴子蕨(Fig. 3)

**Basionym:** *Polypodium nutans* Blume, Enum. Pl. Javae 2: 128. 1828. － Typus: *C.L. Blume s.n.*, *s.a.*, from Java, Indonesia (holotype: L, photo!).

**Homotypic synonym:** *Ctenopteris nu-*

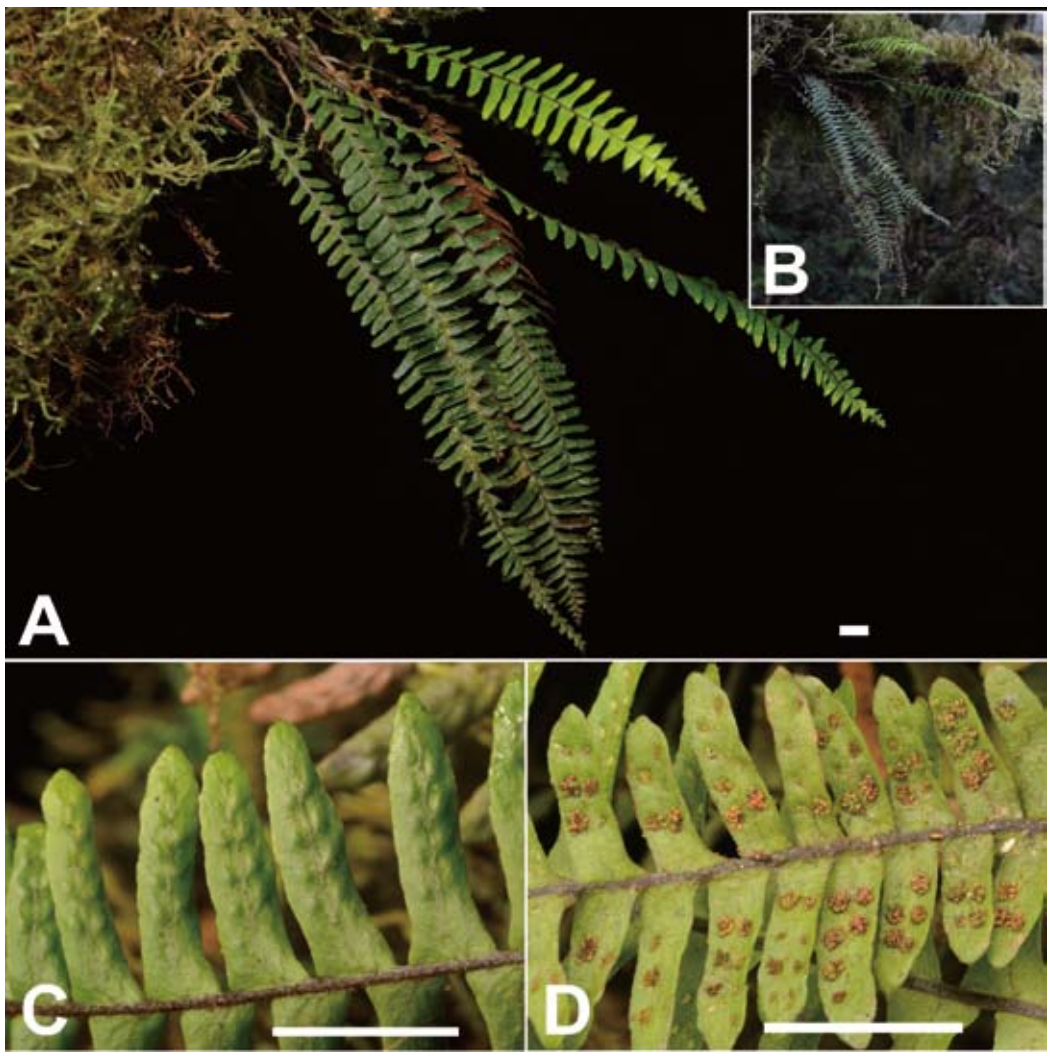


**Fig. 3.** ***Prosaptia nutans*** **(from** ***T.C. Hsu 6283*****); all bars = 1 cm. A and B, habit and habitat; C, portion of adaxial side of lamina; D, portion of abaxial side of lamina showing sori. Photographs by Tian-Chuan Hsu.**

*tans* (Blume) J. Sm., Hist. Fil. 185. 1875; Parris, Kew Bull. 41: 497. 1986.

**Morphology:** Small epiphytes in mossy forests at mid-mountains. Rhizomes short-creeping. Stipes approximate, ca. 1~4 cm long, densely covered with simple non-septate hairs. Laminae pinnate, narrowly lanceolate to narrowly oblanceolate in outline, acute to acuminate at apex, gradually narrowing towards base, ca. 10~20 cm long and 1.6~3.0 cm wide, abaxial surface around sori sparsely covered with simple non-septate hairs, but densely covered on both sides of rachises; pinnae ca. 30~40 pairs, widest at middle, narrowly oblong, obtuse to acuminate at apex. Veins usually not visible, pinnate and free. Sori exindusiate, circular to broadly elliptic, in 2 rows per pinna, superficial or slightly sunken on abaxial surface, in middle or somewhat close to midveins (costae).

**Distribution:** Indonesia, Malaysia, Papua New Guinea, the Philippines, and Taiwan.

**Habitat:** Epiphytes in warm-temperate rain forests at elevations of about 1200~1500 m. In Taiwan, only a few small populations are scattered in mountains at the boundaries between Pingtung and Taitung Counties of southeastern Taiwan.

**Conservation status:** EN [B1ac (ii, iii, iv), B2ac (ii, iii, iv)].

**Voucher specimens from Taiwan:** Katebola Stream, Taitung Co., C.*F. Chen 4346* (TAIF), *Y.H. Chang 20130205-051 & 20130205-052* (TAIF), *T.C. Hsu 6283* (TAIF).

**Taxonomic note:** Although Parris (2010) and Moore and Parris (2013) reported that *P. nutans* is distributed in Taiwan, no specimen was cited therein. Herein, we list specimens collected recently and confirm the occurrence of this species in Taiwan. *Prosaptia nutans* is distinguishable from other *Prosaptia* species in Taiwan by having superficial or only slightly sunken sori.

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