

臺灣蕨類植物誌四新增類群

Four new records for the Fern Flora of Taiwan

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Abstract

On account of intensive field and herbaria investigations in Taiwan, new data about the biodiversity and taxonomy of the ferns in Taiwan are proposed. Three native species, *Adiantum roborowskii* var. *faberi* (Baker) Y.X. Lin & J. Prado (Pteridaceae), *Diplazium hachijoense* Nakai (Athyriaceae) and *Polystichum erosum* Ching & K.H.Shing (Dryopteridaceae) and a naturalized species *Cheilanthes viridis* (Forssk.) Sw. (Pteridaceae) are recorded in Taiwan for the first time. We provide the background data of taxonomy, distribution, habitats, photographs, conservation status, and notes for each species.

摘要

經由近年頻繁的野外及標本考察，本文報導臺灣蕨類新資訊，包含三種新紀錄分類群：峨眉鐵線蕨 (*Adiantum roborowskii* var. *faberi* (Baker) Y.X. Lin & J. Prado)、薄蓋雙蓋蕨 (*Diplazium hachijoense* Nakai) 及蝕蓋耳蕨 (*Polystichum erosum* Ching & K.H.Shing)，以及一新歸化種綠碎米蕨 (*Cheilanthes viridis* (Forssk.) Sw.)。本文亦提供分類、生物地理分布、照片及註記相關資訊。

Key words :Taiwan, Pteridophytes, newly recorded species, naturalized species

關鍵字：臺灣、蕨類、新紀錄種、新歸化種

Introduction

Ferns and lycophytes in Taiwan represent an incredibly high diversity which could be due to large extent to warm and wet weather, altitude variation, diverse habitats, and geographical distribution (Moore et al. 2010). Since the latest comprehensive studies (TPG 2019; Hsu et al. 2019a; 2019b), new taxa were continuously reported (Chao et al. 2019; 2021; Hsu et al. 2019c; Lu et al. 2019; Chang et al., 2020; Chang & Hsu 2021; Ebihara et al. 2021; Fan et al. 2021), and currently 816 taxa including natural hybrids and infraspecific taxa has been accepted (TPG 2021).

Apparently, the exact diversity of ferns and lycophytes in Taiwan has not been fully expressed. There are still dozens of taxonomically uncertain materials discovered by researchers and amateurs in recent years, some of which have been introduced as undetermined species (“sp.”) by Knapp (2011, 2013), Knapp and Hsu (2017) and Hsu et al. (2019a; 2019b). After examining floristic documentation and herbarium collections from adjacent georegions, we are now confirming the identity of three native taxa, namely *Adiantum roborowskii* var. *faberi* (Baker) Y.X. Lin & J. Prado (Pteridaceae), *Diplazium hachijoense* Nakai (Athyriaceae) and *Polystichum erosum* Ching & K.H. Shing (Dryopteridaceae). Meanwhile, we recognize a newly naturalized species *Cheilanthes*

viridis (Forssk.) Sw. (Pteridaceae) from northern Taiwan. In this paper, background data of nomenclature, distribution, habitats, taxonomy and conservation status for each species are provided. In addition, their conservation status in Taiwan based on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List Categories and Criteria (IUCN 2017) is evaluated.

Materials and methods

Morphological data of the studied species were mainly gathered from field trips in Taiwan during 2010–2020 and from the specimens preserved in HAST, TAI, TNM and TAIF. The identities of these materials were clarified by consulting related taxonomic literature and also images of related type materials and general collections from the databases of B, BM, K, MO, NY, P, PE and US. We used GeoCAT (Bachman et al. 2011) to help assessing the Extent of Occurrence (EOO) and the Area of Occupancy (AOO) of the discussed species in Taiwan.

Results and discussion

Taxonomic Treatments

Adiantum roborowskii var. *faberi* (Baker) Y.X. Lin & J. Prado, Fl. China 2–3: 249. 2013. [Pteridaceae]. Fig. 1.

≡ *Adiantum faberi* Baker, J. Bot. 26(7): 225. 1888.

≡*Adiantum roborowskii* f. *faberi* (Baker) Y.X. Lin, Fl. Reipubl. Popularis Sin. 3(1): 212. 1990.

Type: CHINA. Sichuan Province: Mt. Omei, 1000m, 1887, *Faber 1033* (syntypes: B 20-0004243 image!, B 20-0004244 image!, MO 1865038 image!, NY 00127467 image!, P 00607858 image!).

Chinensis name: “峨嵋鐵線蕨”, adapted from Lin et al. (2013).

Distribution: This variety was previously recorded from SW China and is newly recorded from Taiwan.

Habitat: Lithophytic, growing in *Abies-Tsuga* upper-montane coniferous forest (Li et al. 2013) on stream-side, semi-shaded cliff at ca.2000–2500m elevation in Taiwan.

IUCN Red List Category and Criteria: VU [D1+2]. This species has quite limited EOO (ca. 50 km²), AOO (ca. 10 km²) and mature individuals (< 1000) in central Taiwan estimated from currently available data, though no significant threat has been detected. We hence evaluated it as Vulnerable.

Specimens examined: TAIWAN. Hualien County: Xiulin Township, en route from Ho Huan Chin Kuang to Ping Feng Shan, 2600 m, 5 September 2009, *Huang 4223* (HAST, the central frond only; others are *Adiantum taiwanianum*); Mt. Pingfeng, 2500–2800 m, 25 July 2015, *Hsu 7974* (TAIF); Nantou County: Renai Towbship, Da Yu Ling, 2420 m, 8 November 2014, *Knapp 3537* (P); Pilu Stream, 2000m, 06 April 2006, *Lu 11625* (TAIF); Sung chuan kang, 2450 m, 12 March 2006, *Tsai 01060* (TNM); Sung chuan kang,

2300–2600 m, 14 September 2014, *Hsu 7248* (TAIF); *Hsu 7249* (TAIF); Sung chuan kang, 2400–2500m, 21 June 2020, *Chang ZXC002075* (TAIF). CHINA. Chongqing: Nan chuan District, 800m, 17 March 1995, *Liu 15412* (PE, TAIF). Hubei Province: Li chuan City, 830m, 16 June 2009, *Dong 428* (TAIF).

Note: This taxon has been introduced by Hsu et al. (2019a: pp.231) as “*Adiantum* sp.” with a comprehensive set of images. Among the congeners in Taiwan (TPG 2019), *Adiantum roborowskii* var. *faberi* is closely related to *A. monochlamys* Eaton and *A. taiwanianum* Tagawa in sharing tripinnate fronds and 1 (rarely 2) sori per pinnule. It could be distinguished from *A. taiwanianum* by having larger fronds (20–40 vs. 4–18 cm long) and larger fertile pinnules (5–10 vs. 2–5 mm long) with usually flat (usually strongly revolute) margins and rounded cuneate (vs. cuneate) bases. Meanwhile, it differs from *A. monochlamys* by having orbicular-flabellate (vs. obovate to obtriangular) fertile pinnules with sub entire or shallowly crenate (vs. obtusely to sharply toothed) upper margins.

Cheilanthes viridis (Forssk.) Sw., Syn. Fil. 127. 1806; Schelpe, Fl. Zambesiaca: 133; Crouch et al., Ferns S. Africa: 390, pl. 2011; Yatskievych, Lundellia 23: 22, f. 2. 2020. [Pteridaceae]. Fig. 2.

≡*Pteris viridis* Forssk., Fl. Aegypt.-Arab.: 186. 1775.

≡*Pellaea viridis* (Forssk.) Prantl., Bot. Jahrb. Syst. 3: 420. 1882.

See Roux (2009) for other synonyms.

Type: YEMEM. Montium Hadiensium, *P.*

Forsskål s.n. (lost, according to Roux 2009).

Chinese name: “綠碎米蕨” .

Distribution: *Cheilanthes viridis* is native and widely distributed from South Africa through East Africa toward the Arabian Peninsula and some adjacent islands (Miller 1996; Roux 2009). It also

distributes in Brazil with uncertain origin (Prado et al. 2013) and naturalized in several countries such as USA (Yatskievych 2020), India (Fraser-Jenkins et al. 2017), Sri Lanka (Fraser-Jenkins et al. 2006), Australia (Bostock 1998) and New Zealand (Webb et al. 1995). The record in Taiwan likely



Figure 1. *Adiantum roborowskii* var. *faberi*, from Chang ZXC002075. A–B. Habitat and habits. C. Scales on stipe base. D. Adaxial sterile pinnules. E. Abaxial sterile pinnules. F. Adaxial fertile pinnules. G. Abaxial fertile pinnules. Scale bars = 1 cm.

represents its first record as a naturalized species in East Asia.

Habitat: In Taiwan, *Cheilanthes viridis* is found growing on a semi-shaded roadside stone pitching concrete wall accompanied with *Pilea microphylla* (L.) Liebm. and *Lemmaphyllum microphyllum* C. Presl in the urban area of Tucheng, New Taipei City.

IUCN Red List Category and Criteria: NA. *Cheilanthes viridis* is presumed as a naturalized species in Taiwan.

Additional specimens examined: TAIWAN. New Taipei City: Tucheng District, Tucheng, ca. 20 m, 9 January 2021, Hsu 13219 (TAIF). INDIA. Tamil Nadu State: Kodaikanal Botanic Garden, 1400 m, 27 November 2006, Chiou et al. 15214 (TAIF); Chiou et al. 15239 (TAIF); Tirunelveli, Kothayar Forest, 700–900 m, 28 November 2006, Chiou et al. 15263 (TAIF).

Note: *Cheilanthes viridis* is readily distinguished from the other species of subfamily Cheilanthesoideae (Pteridaceae) in Taiwan (TPG 2019; 2021) by its relatively large (ca. 15–50 × 6–15 cm), 2-pinnate to 3-pinnatifid laminae and ovate-deltoid to ovate-elliptic, sometimes trifid but never pinnatifid segments (Fig. 2). In fact, its gross outline superficially resembles an unrelated native species, *Lindsaea heterophylla* Dryand. (Lindsaeaceae), but could be differentiated by having false indusia that open toward midribs (Fig. 2H–J; *L. heterophylla* has true indusia that open toward margin).

This species is currently only known from a single wild population in northern

Taiwan, but presumably more records will be added in the future considering its potential of naturalization. The population in Taiwan was first photographed and documented by a citizen naturalist Helen Shine on May 2020 in the “Plant Investigation and Phenology Observation” website (<https://plant.tbn.org.tw/>; accessed 8 January 2021), and the images were named by other data contributors as either “genus *Cheilanthes*” or *Lindsaea heterophylla*. Street view images available in Google Map (<https://maps.google.com.tw/>; accessed 8 January 2021) revealed that a few individuals had grown there on August 2019, and a significantly expansion of population size could be observed by comparing our present observation (Fig. 2A) with these earlier images. Although *C. viridis* has long been a horticultural plant in Europe (Walters 1986), it is in fact seldom sold or cultivated in Taiwan (personal observation), and the origin of the naturalized population is thus uncertain.

The systematics within Cheilanthesoideae remains unsettled, and so as the generic placement of *Cheilanthes viridis* (Prado et al. 2013; Yatskievych 2020). Here we tentatively follow the latest study (Yatskievych 2020) which placed it under *Cheilanthes*, though this species is genetically distantly related to the other Taiwanese Cheilanthesoideae (Schuettpehl et al. 2007; Zhang et al. 2007). Several infraspecific taxa are recognized in its native areas (Crouch et al. 2011), and the naturalized population in Taiwan belongs to var. *viridis* when subdivided.

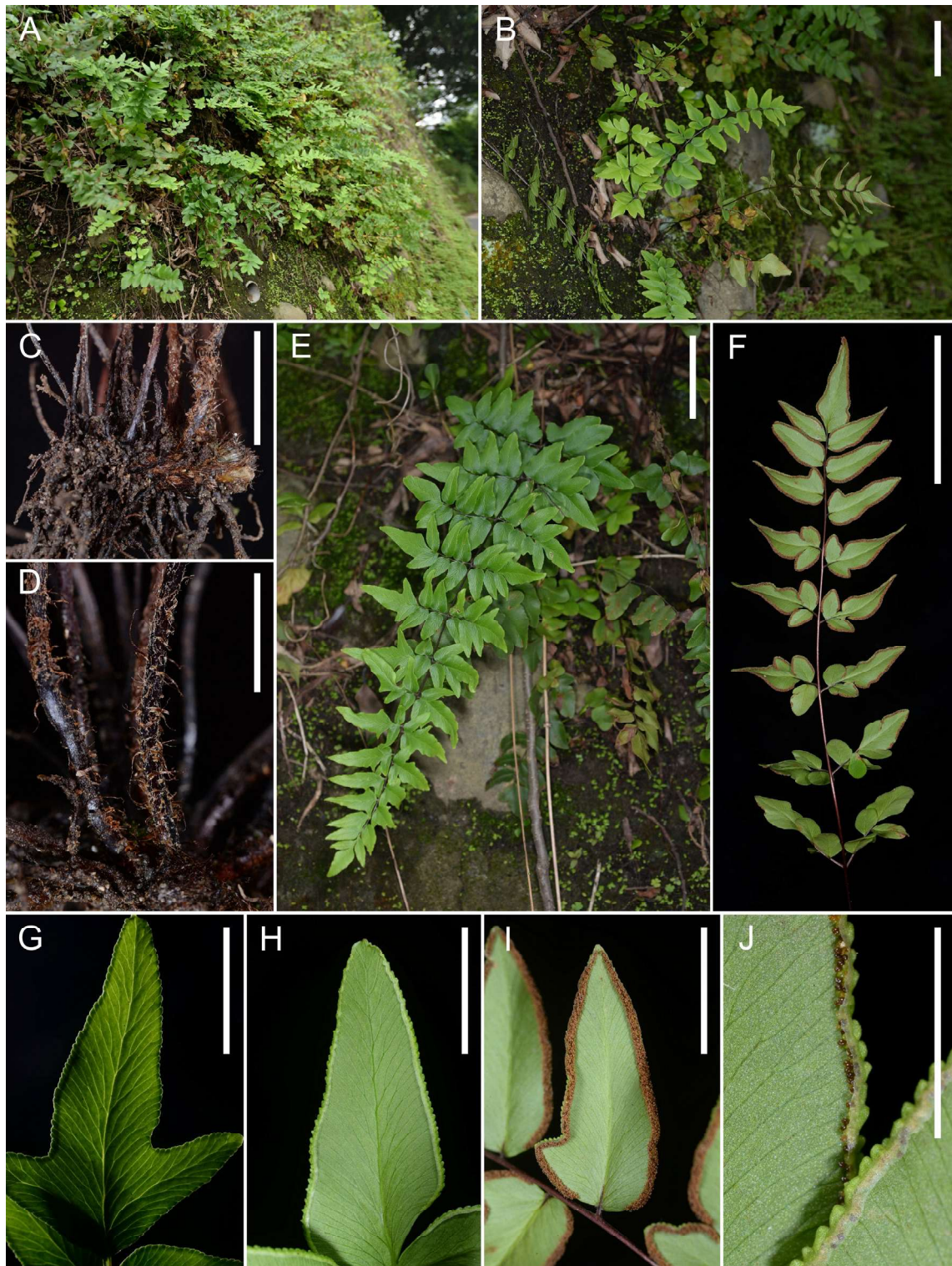


Figure 2. *Cheilanthes viridis*, from Hsu 13219. A–B. Habitat and habits. C. Rhizome. D. Scales on stipe base. E. Adaxial lamina. F. Abaxial lamina. G. Segment with transmitted light, showing venation. H–J. Sori. Scale bars: B, E, F = 5 cm; C, G–I = 1 cm; D, J = 5 mm.

Diplazium hachijoense Nakai, Bot. Mag. (Tokyo) 35(417): 148–149. 1921; Kato, Fl. Japan 1: 227. 1992; Ebihara, Standard Ferns Lycophytes Japan 2: 329, 340, pl. 2-061-6–9. 2017. [Athryiaceae]. Fig. 3.

≡ *Athyrium hachijoense* (Nakai) Ohwi, Bull. Natl. Sci. Mus. 3(2): 100. 1956.

≡ *Allantodia hachijoensis* (Nakai) Ching, Acta Phytotax. Sin. 9(1): 55. 1964.

See Ebihara and Kasetani (2018 onwards) for other synonyms.

Type: JAPAN. Hachijo Island (“insulae Hachijo”), *T. Nakai s.n.* (TI not seen).

Chinese name: “薄蓋雙蓋蕨”, adapted from He and Kato (2013).

Distribution: Korea, Japan, S and SW China and Taiwan

Habitat: Terrestrial, growing in *Pyrenaria-Machilus* winter monsoon forest (Li et al. 2013) under humid shaded forest on mountain slopes at ca. 700–900m in Taiwan.

IUCN Red List Category and Criteria: NT [D1+2]. This species is currently only found in the forests around Mt. Datun in Yangmingshan National Park, where it is locally very abundant and no potential threat is observed. It is hence evaluated as Near Threatened considering the small estimated AOO (ca. 5 km²) and mature individuals (< 2500).

Specimens examined: TAIWAN. New Taipei City: Sanzhi District, Erhtzuping, 850 m, 7 October 2001, *Lu 2037* (TAIF); Erhtzuping, 800m–900m, 23 April 2016, *Hsu 8424* (TAIF). Taipei City: Beitou District,

Palaka Road, 800m–900m, 23 April 2016, *Hsu 8422* (TAIF); Beitou, 850 m, 23 April 2016, *Knapp 4105* (P); 830 m, 23 April 2016, *Knapp 4106* (P); Mt. Datun, 700m, 17 July 2016, *Lu 29608* (TAIF).

Note: This species has been introduced as “*Diplazium* sp. 2” by Hsu et al. (2019b: 91) with a comprehensive set of images. It belongs to a taxonomically and genetically complicated species group with bipinnate to tripinnatifid fronds due to hybridization and polyploidization (Hori and Murakami 2019). Among the morphologically similar species in Taiwan, *D. hachijoense* could be distinguished by having lanceolate, appressed, fugacious scales on stipe base (vs. linear-lanceolate, spreading and ±persistent scales in *D. conterminum*, *D. dilatatum*, *D. okinawaense*, *D. pseudodoederleinii*, *D. taiwanense* and *D. virescens*), sori medial on lateral veins of ultimate segments and spaced from both costulae and segment midribs (vs. sori usually adjacent to costulae in *D. doederleinii* and adjacent to segment midribs in *D. laxifrons*). Preliminary plastid DNA data from Taiwanese materials support that *D. hachijoense* and *D. laxifrons* (= *D. amamianum* recognized by Hori and Murakami 2019) share the same maternal parentage (TPG, unpublished data).

Polystichum erosum Ching & K.H.Shing, Acta. Phytotax. Sin. 10: 303. 1965. Fig. 4

Replaced basionym: *Polystichum lacerum* Christ, Bot. Gaz. 51: 352. 1911. *nom. illeg., non.* (Thunb.) C. Presl, Epimel. Bot. 56. 1851.



Figure 3. *Diplazium hachijoense*, from Hsu 8422. A. Habit. B. Rhizome. C. Scales on stipe base. D. Pinnules. E. Sori. Scale bars: B = 5 cm; C, E = 1 cm; D = 2 cm.

Type: CHINA. Sichuan Province: Baoxing (“Mupin”), August 1908, *E.H. Wilson* 2608 (holotype: BAS; isotypes: BM-001048684 image!, LE, US-00067511 image!, W).

Chinese name: “蝕蓋耳蕨”, adapted from Zhang and Barrington (2013).

Distribution: S and SW China and

Taiwan

Habitat: Lithophytic, growing in *Abies–Tsuga* upper-montane coniferous forest (Li et al. 2013) on stream-side, shaded cliff at ca. 2300–2500m elevation in Taiwan.

IUCN Red List Category and Criteria: VU [D1+2]. *Polystichum erosum* is currently

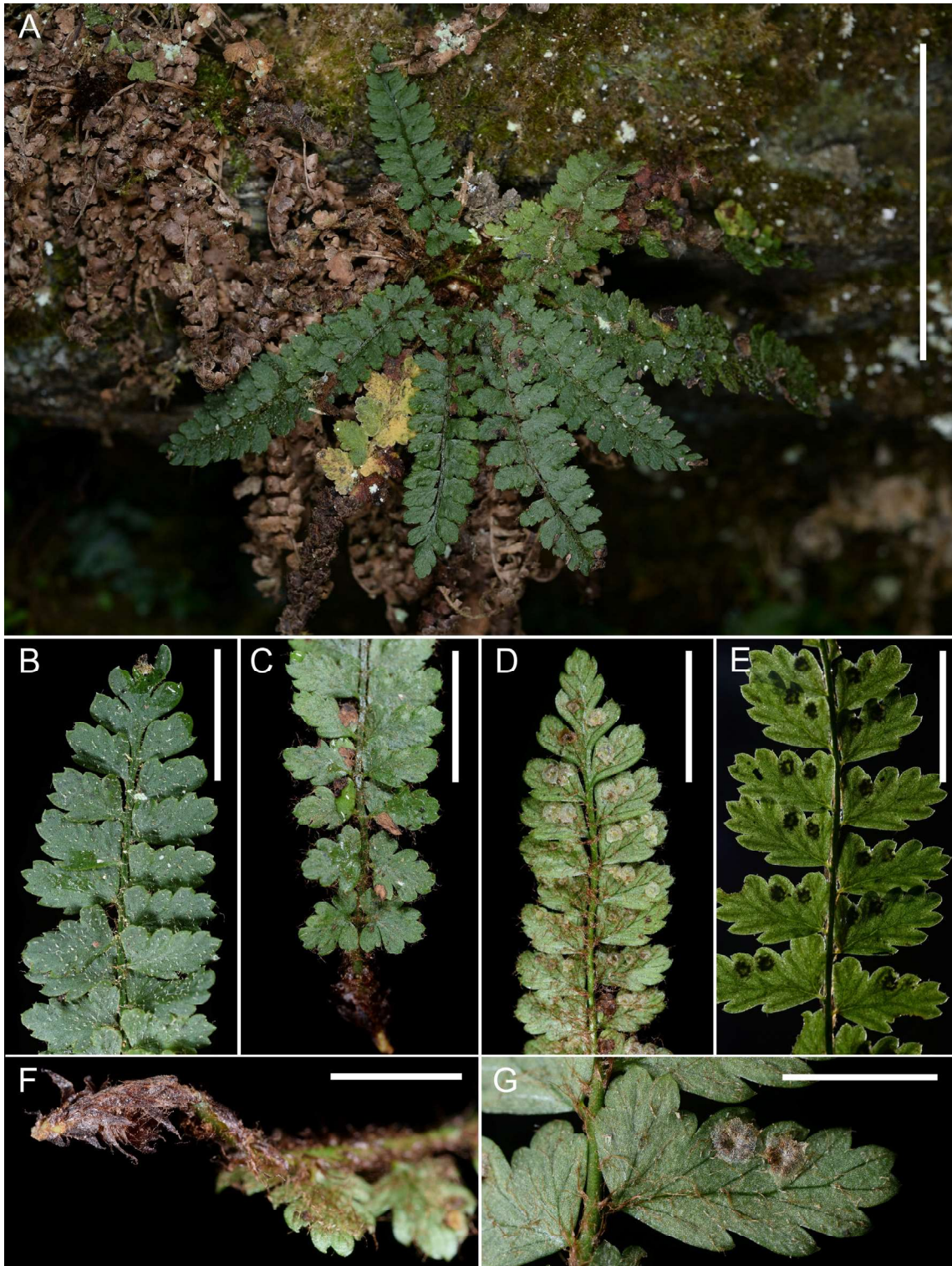


Figure 4. *Polystichum erosum*, from Hsu 11929. A. Habitat. B–C. Adaxial lamina. D. Abaxial lamina. E. Lamina with transmitted light, showing venation. F. Scales on stipe base. G. Abaxial pinna and sori. Scale bars: A = 5 cm; B–E = 1 cm; F–G = 5 mm.

only observed from two locations with totally < 50 mature individuals in central Taiwan. However, we estimate much larger EOO (ca. 100 km²), AOO (ca. 10 km²) and number of mature individuals (< 1000) based on the facts that similar habitats in this region are mostly uninvestigated, and its small, shaded-growing habits are also easily overlooked. Therefore, we evaluate this species as Vulnerable.

Additional specimens examined: TAIWAN. Taichung City: Heping District, from Hsiangkuliao to Chungyangchien Stream shelter, ca. 2300 m, 20 August 2019, *Hsu 11929*; *Chang ZXC001713* (TAIF); from Chungyangchien Stream shelter to Mt. Chungyangchien, ca. 2450 m, 21 August 2019, *Hsu 11967* (TAIF). CHINA. Sichuan Province: Emeishan City, Mt. Emei, 2200–2400 m, 5 August 2011, *Hsu 4390* (TAIF); same locality, 1700–1800 m, 6 August 2011, *Hsu 4413* (TAIF); Chengdu City, Mt. Xilingxue, 1300–2100 m, 12 August 2011, *Hsu 4468* (TAIF); *Hsu 4469* (TAIF); 2100–2700 m, 13 August 2011, *Hsu 4497* (TAIF).

Note: Among the documented *Polystichum* species in Taiwan (DeVol and Kuo 1975, Shieh et al. 1994, TPG 2019), *P. capillipes* (Baker) Diels and *P. thomsonii* (Hook.f.) Bedd. are morphologically similar to *P. erosum* Ching & K.H.Shing in sharing bipinnatifid, lanceolate frond and basal pinnae with a pair of pinnatisect or free segments. It is easily distinguished by having sparse, linear brown scales on both surface of lamina (vs. covered with clavate brown microscales adaxially in *P. capillipes* and

glabrous in *P. thomsonii*), often bearing 1 proliferous bulbil on rachis apex (vs. 1 proliferous bulbil on junction of basal pinnae and stipe in *P. capillipes* and non-proliferous bulbil in *P. thomsonii*) and only 1–2 pairs of basal pinnae pinnatisect (vs. more than 3 pairs of pinnae pinnatisect with basal auricle segments in *P. capillipes* and *P. thomsonii*).

In Taiwan, *Polystichum erosum* was possibly first collected by Chia-Yu Tsai (蔡佳育) around a branch of Piluchi (畢祿溪) in 2005, but the voucher specimen was lost and only some photos are preserved (Pi-Fong Lu, personal communication on January 2021).

Acknowledgements

We especially thank Pi-Fong Lu and Ralf Knapp for kindly sharing their valuable field data and knowledge about the pteridophytes in Taiwan; Hsin-Chieh Hung, Ming-Yu Kuo, Shun-Chuan Lu, Wei-Jie Huang and Shih-Wen Chung for their assistance in field trips; Tzu-Tong Kao for consulting modern systematics of Cheilanthes. We also appreciate the curators of B, BM, HAST, K, MO, NY, P, PE, TAI, TAIF, TNM and US for herbaria and/or database access.

Literature cited

- Bachman, S., J. Moat, A. W. Hill, J. de la Torre and B. Scott. 2011. Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys* 150: 117–126.
- Bostock, P. D. 1998. Adiantaceae (except Cheilanthes). pp. 248–271. In: A. E.

- Orchard (ed.) and P. M. McCarthy (vol. ed.), Flora of Australia, Vol. 48. Ferns, Gymnosperms and Allied Groups. ABRIS/CSIRO, Melbourne, Australia.
- Chang, Z. X., L. Y. Kuo, P. F. Lu and Y. M. Huang. 2020. New addition to the *Asplenium normale* complex (Aspleniaceae): an endemic forma in Taiwan. *Taiwania* 65(2): 253–260.
- Chang, Z. X. and T. C. Hsu. 2021. Discovering ferns at the rural landscape in Taoyuan. *Nature Conservation Quarterly* 113: 22–37 (in Mandarin).
- Chao, Y. S., Y. F. Huang, S. Y. Dong, Y. M. Huang and H. Y. Liu. 2019. *Bolbitis lianhuachihensis* (Dryopteridaceae), a new species from Taiwan. *PhytoKeys* 131: 69–81.
- Chao, Y. S., W. L. Chiou, A. Ebihara, T. C. Hsu, Y. H. Chang, and C. Y. Lin. 2021. Taxonomic and nomenclatural novelties in the *Pteris fauriei* group (Pteridaceae). *Taiwania* 66(3): 307–316.
- Crouch, N. R., R. R. Klopper, J. E. Burrows and S. M. Burrows. 2011. Ferns of Southern Africa. A Comprehensive Guide. pp. 776. Struik Nature, Cape Town, South Africa.
- DeVol, C. E. and C. M. Kuo. 1975. Dryopteridaceae. pp. 383–400. *In*: H. L. Li, T. S. Liu, T. C. Huang, T. Koyama and C. E. DeVol (eds.). Flora of Taiwan, Vol. 1 (Dryopteridaceae). Epoch Publishing, Taipei, Taiwan.
- Ebihara, A. and F. Kasetani. (2018 onwards). Index to Ferns and Lycophytes of Japan. <http://jpfern.la.coocan.jp/names/> [accessed 9 February 2021].
- Ebihara, A., N. Nakato, Y. H. Chang and L. Y. Kuo. 2021. *Coryphopteris castanea* (Thelypteridaceae), a polymorphic diploid species distributed in Taiwan and Japan. *Bulletin of the National Museum of Nature and Science, Series B* 47(2): 71–77.
- Fan, X. P., L. Zhang, R. Knapp, H. He, X. F. Gao and L. B. Zhang. 2021. *Hypodematum shingii* sp. nov. (Hypodematiaceae; Polypodiales): replacing the misapplied “*H. crenatum*”, a widespread fern from Asia. *Phytotaxa* 482(1): 87–92.
- Fraser-Jenkins, C. R., B. Verdcourt and T. G. Walker. 2006. Pteridaceae. pp. 352–427. *In*: Shaffer-Fehre, M. (ed.). A Revised Handbook of the Flora of Ceylon 15: Pteridophyta (Ferns and Fern Allies). Amrind Publishing Company Private Limited, New Delhi, India.
- Fraser-Jenkins, C. R., K. N. Gandhi, B. S. Kholia and A. Benniamin. 2017. An Annotated Checklist of Indian Pteridophytes. Part-1 (Lycopodiaceae to Thelypteridaceae). Bishen Singh Mahendra Pal Singh, Dehradun, India.
- He, Z. R. and M. Kato. 2013. Athyriaceae. pp. 530 *In*: Z. Y. Wu, P. H. Raven and D. Y. Hong (eds.), Flora of China, Vol. 2–3 (Pteridophytes). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis, USA.
- Hori, K. and N. Murakami. 2019. Origin of the *Diplazium hachijoense* complex (Athyriaceae). *PhytoKeys* 124(1):57–76.

- Hsu T. C., C. W. Chen, R. Knapp and H. C. Hung. 2019a. Illustrated Flora of Taiwan: Ferns and Lycophytes I. Owl Publishing House, Taipei, Taiwan.
- Hsu T. C., C. W. Chen, R. Knapp and H. C. Hung. 2019b. Illustrated Flora of Taiwan: Ferns and Lycophytes II. Owl Publishing House, Taipei, Taiwan.
- Hsu, T. C., Y. F. Huang and Y. S. Chao. 2019c. Systematics of *Hymenophyllum* subgenus *Mecodium* (Hymenophyllaceae) in Taiwan. *Systematic Botany* 44(4):753–767.
- IUCN, 2017. Guidelines for using the IUCN red list categories and criteria. version 13. Standards and Petitions Subcommittee, Gland, Switzerland and Cambridge, UK.
- Knapp, R. 2011. Ferns and fern allies of Taiwan. KBCC Press and Yuan-Liou Publishing, Taipei, Taiwan.
- Knapp, R. 2013. Ferns and fern allies of Taiwan — supplement. KBCC Press, Pintung, Taiwan.
- Knapp, R. and T. C. Hsu. 2017. Ferns and fern allies of Taiwan — second supplement. KBCC Press, Pintung, Taiwan.
- Li, C. F., M. Chytrý, D. Zelený, M. Y. Chen, T. Y. Chen, C. R. Chiou, Y. J. Hsia, H. Y. Liu, S. Z. Yang, C. L. Yeh, J. C. Wang, C. F. Yu, Y. J. Lai, W. C. Chao and C. F. Hsieh. 2013. Classification of Taiwan forest vegetation. *Applied Vegetation Science* 16(4): 698–719.
- Lin, Y. X., J. Prado and M. G. Gilbert. 2013. *Adiantum*. pp. 238–250. *In*: Z. Y. Wu, P. H. Raven and D. Y. Hong (eds.), *Flora of China*, Vol. 2–3 (Pteridophytes). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis, USA.
- Lu, N. T., X. M. Zhou, L. Zhang, R. Knapp, C. X. Li, X. P. Fan, L. Zhou, H. J. Wei, J. M. Lu, B. Xu, Y. L. Peng, X. F. Gao and L. B. Zhang. 2019. A global plastid phylogeny of the cliff fern family Woodsiaceae and a two-genus classification of Woodsiaceae with the description of *Woodsimatium* nothogen. nov. *Taxon* 68(6): 1149–1172.
- Miller, A. G. 1996. Pteridophyta. pp. 33–69, 497–503. *In*: Miller, A. G. and T. Cope (eds.), *Flora of the Arabian Peninsula and Socotra*, Vol. 1. Edinburgh University Press, Edinburgh, Scotland.
- Moore, S. J., C. M. Chen and J. C. Wang. 2010. *Hymenophyllum pilosissimum* C. Chr. (Hymenophyllaceae), a new recorded fern from Taiwan. *American Fern Journal* 100(3): 180–183.
- Prado, J., E. Schuettpelz, R. Y. Hirai and A. R. Smith. 2013. *Pellaea flavescens*, a Brazilian endemic, is a synonym of Old World *Pellaea viridis*. *American Fern Journal* 103: 21–36.
- Roux, J. P., 2009. Synopsis of the Lycopodiophyta and Pteridophyta of Africa, Madagascar and neighboring islands. *Strelitzia* 23: 1–296.
- Schuettpelz, E., H. Schneider, L. Huiet, M. D. Windham and K. M. Pryer. 2007. A molecular phylogeny of the fern family Pteridaceae: assessing overall relationships and the affinities of previously unsampled genera.

- Molecular Phylogenetics and Evolution 44(3): 1172–1185.
- Shieh W. C., C. E. De Vol and C. M. Kuo; *Polystichum* by Wang, J. C. and W. C. Shieh. 1994. Dryopteridaceae. pp.333–351. In: Editorial Committee of Flora of Taiwan (eds.). Flora of Taiwan (2nd ed.) Vol. 1. Editorial Committee of the Flora of Taiwan, 2nd Edition, Taipei, Taiwan.
- TPG. 2019. Updating Taiwanesepteridophyte checklist: a new phylogenetic classification. *Taiwania* 64(4): 367–395.
- TPG. 2021. Taiwan Pteridophyte Checklist v2021.1. <https://groups.google.com/forum/#!forum/taiwan-pteridophyte-group> [accessed 31 August 2021]
- Walters, S. M. 1986. The European Garden Flora. Vol. I. Pteridophyta; Gymnospermae; Angiospermae — Alismataceae to Iridaceae. Cambridge University Press, Cambridge, UK.
- Webb, C. J., W. R. Sykes, P. J. Garnock-Jones and P. J. Brownsey. 1995. Checklist of dicotyledons, gymnosperms, and pteridophytes naturalised or casual in New Zealand: additional records 1988–1993. *New Zealand Journal of Botany* 33(2): 151–182.
- Yatskievych, G. 2020. The status of the non-native fern *Cheilanthes viridis* (Pteridaceae) in the United States. *Lundellia* 23: 19–27.
- Zhang, G., X. Zhang, Z. Chen, H. Liu and W. Yang. 2007. First insights in the phylogeny of Asian cheilanthoid ferns based on sequences of two chloroplast markers. *Taxon* 56: 369–378.
- Zhang, L. B. and D. S. Barrington. 2013. *Polystichum*. pp. 629–713. In: Z. Y. Wu, P. H. Raven, and D. Y. Hong (eds.). Flora of China, Vol. 2–3 (Pteridophytes). Science Press, Beijing, China, and Missouri Botanical Garden Press, St. Louis, USA.