

Confirmation of three species of pteridophytes in Taiwan

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(Manuscript received 24 October, 2001; accepted 28 November, 2001)

ABSTRACT: The distribution of *Huperzia serrata* (Thunb. ex Murray) Trevisan var. *serrata*, *Dryopteris lacera* (Thunb.) O. Ktze., and *Ophioglossum themale* Komarov in Taiwan are confirmed. Nomenclatural treatments, including two new combinations: *Huperzia serrata* var. *longipetiolata* (Spring) H.-M. Chang and *Huperzia serrata* var. *myriophyllifolia* (Hayata) H.-M. Chang, along with descriptions, taxonomic notes, and color photos are provided.

KEY WORDS: *Dryopteris lacera*, *Huperzia serrata* var. *serrata*, *Huperzia serrata* var. *longipetiolata*, *Huperzia serrata* var. *myriophyllifolia*, *Lycopodium*, *Ophioglossum themale*, pteridophytes, Taiwan.

INTRODUCTION

Since the publication of Flora of Taiwan (Li *et al.*, 1975, first edition), the ferns and fern allies of Taiwan have been thoroughly revised for three times, viz. Kuo (1985, 1997) and the second edition of Flora of Taiwan (Huang *et al.*, 1994). However, despite being previously reported, some species of ferns and fern allies in Taiwan were still questioned by local pteridologists. They were usually treated doubtfully because no specimen was available in Taiwan herbaria and/or no one re-collected them in the fields. During the past several years, the first author successively found some formerly uncertain species and confirmed their distribution in Taiwan. In this paper, we sustain their distribution in Taiwan and give nomenclatural treatments, descriptions, taxonomic notes, and color photos as follows.

TAXONOMIC TREATMENT

1. ***Huperzia serrata*** (Thunb. ex Murray) Trevisan, Atti Soc. Ital. Sci. Nat. 17: 248. 1875; Ching, Acta Bot. Yunnan. 3: 294. 1981; Øllgaard, Opera Bot. 92: 164. 1987; Nakaike, New Fl. Jap. Pterid. rev. & enlarg. 792. pl. 30. 1992; Iwatsuki in Iwatsuki *et al.*, Fl. Japan. 1: 5. 1995.

Terrestrial, bulbiferous plants. Stem actinostele, usually ascending at lower part, erect at upper part, 5-25 cm long, sparsely dichotomous branching. Microphylls chartaceous, variable (from linear to ovate-oblong) in shape, usually dentate at margin; trophophylls 7-20 mm long, 1-5 mm broad, sporophylls 3-10 mm long, 0.5-2 mm broad. Spororangia kidney-shaped, solitary at adaxial base of sporophyll, growing segmentally along upper part of persistent main stem, yellowish when mature. No distinct annual strobili.

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Distribution: Asia, Austro-Malaysian region, Hawaii, Mexico, and West Indies.

Most fern taxonomists in Taiwan adopted the broad concept that all members of Lycopodiaceae belonged to a single genus *Lycopodium* except Kuo (1997). Recent studies advocate that the genus *Lycopodium* (*sensu lato*) should be divided into four (Øllgaard, 1987, 1990; Nakaike, 1996; Kuo, 1997) or more genera (Wu & Ching, 1991; Zhang & Kung, 2000). This study follows the system of Øllgaard (1987).

Huperzia serrata is very variable and many infraspecific taxa have been proposed. In Taiwan, it was usually thought that there were only two varieties (or forma), var. *longipetiolata* and var. *myriophyllifolia* (DeVol, 1965, 1975; Kuo, 1997), except Shieh (1972). The former is a common taxon growing in the understory of mountain forests from low (400m) to middle (2500m) altitudes. The latter is a rather rare taxon, found only in one locality of mid-altitude. It is characterized by having narrower linear microphylls with the margin strongly crinkly and toothed. Previous taxonomists, such as Kuo (1985) and Tsai and Shieh (1994), thought that both of them belonged to the *Huperzia serrata* complex. However, the first author found that *H. serrata* var. *serrata* and *H. serrata* var. *longipetiolata* grew in separate populations at the same locality, Yuanyanghu Lake. We confirm that *H. serrata* var. *serrata* does occur in Taiwan. *Huperzia serrata* var. *serrata* can be easily distinguished from *H. serrata* var. *longipetiolata*, mainly by its narrowly oblanceolate microphylls. In addition, *H. serrata* var. *longipetiolata* has obvious petiole and its microphylls are broader (3-5 mm) than *H. serrata* var. *serrata* (1-2 mm). Sometimes, *H. serrata* var. *serrata* may have entire or few-toothed leaf margins.

From the record of the specimens in herbaria, we can confirm that *H. serrata* var. *serrata* is distributed in at least four localities of northern Taiwan (Fig. 1). Usually, it occupies habitats similar with *H. serrata* var. *longipetiolata*.

Key to varieties in Taiwan

1. Trophophyll oblong, 3-5mm broad, distinctly petiolate 1b. *H. serrata* var. *longipetiolata*
1. Trophophyll linear to oblanceolate, 1-2mm broad, sessile or narrowing to a broader base
 2. Trophophyll narrowly oblanceolate to oblanceolate, 1-2mm broad, margin more or less flat 1a. *H. serrata* var. *serrata*
 2. Trophophyll narrowly acicular or linear, 1-1.5mm broad, margin strongly crinkly 1c. *H. serrata* var. *myriophyllifolia*

1a. *Huperzia serrata* (Thunb. ex Murray) Trevisan var. *serrata* 千層塔 Figs. 2, A & B

Lycopodium serratum Thunb. ex Murray, Syst. Veg. (ed. 14) 944. 1784 (May-Jul.); Thunb., Fl. Jap. 341. t. 38. 1784 (Aug.); Hook. & Grev., Ic. Fil. 1: tab. 37. 1827; Ohwi, Fl. Jap. Pterid. 7. 1957; Ohwi, Fl. Jap. 23. 1965; Shieh, Quart. J. Chin. Forest. 6(1): 35. 1972; Kuo, Taiwania 30:12. 1985; Tsai & Shieh in Huang *et al.*, Fl. Taiwan, 2nd ed. 1: 42. 1994.

Plananthus serratus (Thunb. ex Murray) Beauv., Prod. Aethéog. 100-111. 1805.

Urostachys serratus (Thunb. ex Murray) Herter, Bot. Arch. 3: 13. 1923.

Huperzia selago subsp. *serrata* (Thunb. ex Murray) Löve & Löve, Univ. Colorado Stud. (Biol.) 17: 5. 1965.

Huperzia serrata (Thunb. ex Murray) Rothm., Feddes Repert. 54(1): 59. 1944; Dixit, Lycopod. India 55. f. 8A-B. 1988.

Microphylls chartaceous, yellowish green, narrowly oblanceolate to oblanceolate, acute at apex, sessile or gradually narrowing to a broader base, margin more or less flat; trophophylls 7-15 mm long, 1-2(3) mm broad, sporophylls 3-8 mm long, 0.5-1 mm broad.

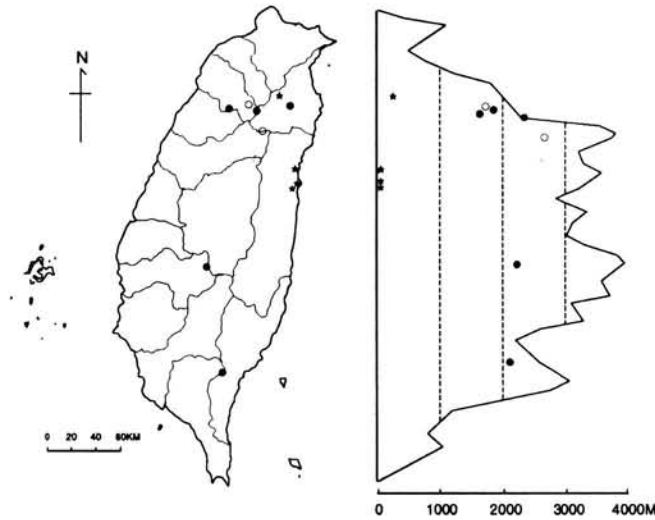


Fig. 1: Distribution of *Huerzia serrata* var. *serrata* (solid circle), *Ophioglossum themale* (star) and *Dryopteris lacera* (empty circle) in Taiwan.

Chromosome numbers: $n=68$ or 136 , $2n=204$, diploid, triploid or tetraploid (Takamiya & Kurita, 1983; Takamiya, 1984)

Distribution: Japan, Korea, China, India, and Malaysia. In Taiwan, growing at forest edge in mid-altitude mountains.

Specimens examined: **HSINCHU:** Chienshih, Yuanyanghu Lake, *Chang 3345* (TNU). **MIAOLI:** en route from Kuanwu to Kuaishan giant tree, *Peng 9458* (HAST). **CHIAYI:** Mt. Alishan, *Kuo 3237* (TAI). **PINGTUNG:** around the Hsiaokeihu Lake, *Yeh s.n.*, 1983 (TNU). **ILAN:** Taipingshan, *Kuo 14302* (HAST); Tsuifenghu Lake, *Chang 4042* (TNU).

1b. *Huperzia serrata* var. *longipetiolata* (Spring) H.-M. Chang, *comb. nov.* 長柄千層塔

Lycopodium serratum var. *longipetiolatum* Spring, Mém. Acad. Roy. Sci. Belgique 24: 18. 1849; et in Monogr. Lycop. 2: 18. 1850; Tagawa, Acta Phytotax. Geobot. 14: 137. 1952; DeVol, Taiwania 11: 49. pl. 2. f. 6. 1965; Shieh, Quart. J. Chin. Forest. 6(1): 36. 1972.; DeVol in Li *et al.*, Fl. Taiwan 1: 29. 1975; Kuo, Taiwania 30: 11. 1985.

Urostachys serratus var. *javanicus* forma *longipetiolatus* (Spring) Herter ex Nessel, Bärlappgewächse, 59. 1939.

Urostachys serratus var. *longipetiolatus* (Spring) Masamune, Sci. Rep. Kanazawa Univ. 1: 34. 1951.

Huperzia serrata forma *longipetiolata* (Spring) Ching, Acta Bot. Yunnan. 3(3): 294. 1981.

Lycopodium javanicum Sw., J. Bot. (Schrader) 1800 (2): 114. 1801.

Lycopodium serratum var. *javanicum* (Sw.) Makino, Bot. Mag. Tokyo 12 (131): 13. 1898; Takeda, Bot. Mag. Tokyo 23: 207. 1909; Takeo, Ill. Form. Pl. Suppl. 7. f. 7. 1928; Masamune, Short Fl. Form. 32. 1936.

Urostachys serratus var. *javanicus* (Sw.) Herter ex Nessel, Bärlappgewächse, 58. 1939.

Urostachys javanicus (Sw.) Herter, Ind. Lycop. 66. 1949.

Microphylls chartaceous, green to dark green, oblong to ovate-oblong, acute or acuminate at apex, notably petiolate; trophophylls 8-25 mm long, 3-5 mm broad, sporophylls 3-8 mm long, 1-2 mm broad.



Fig. 2. A & B: *Huperzia serrata* var. *serrata*. C & D: *Dryopteris lacera*. E & F: *Ophioglossum themale*.

Chromosome numbers: $n=136$, tetraploid (Tsai & Shieh, 1987).

Distribution: Sakhalin, Japan, China, the Philippines, and India. In Taiwan, growing in mountain forests at low to middle elevations.

Specimens examined: **TAIPEI:** Shengkeng, Mt. Pichiashan, *Chang 2023* (TAIF). **TAOYUAN:** Fuhsing, Mt. Tilushan, *Chang 3457* (TNU). **HSINCHU:** Chienshih, Yuanyanghu Lake, *Chen 853* (TNU). **MIAOLI:** Mt. Hsishuishan, *Kawakami & Mori s.n. 1908* (TAIF). **TAICHUNG:** Mt. Pahsienshan, *Wang et al. 11065* (TNU). **NANTOU:** Kwankao to Patungkwang, *Huang & Shieh 1725* (TNU). **CHIAYI:** Mt. Alishan, *Kanehira & Sasaki s.n. 1918* (TAIF). **KAOHSIUNG:** Taoyung, Tenhchih, Shihshan recreation area, *Wang 10390* (TNU). **PINGTUNG:** around the Hsiaoikeihu Lake, *Yeh 60* (TNU). **ILAN:** Nanao, Shenmihu Lake, *Chang 3857* (TNU). **HUALIEN:** Chohsi, Hsinkang, *Chang 2495* (TAIF). **TAITUNG:** Peinan, Lichia logging road, *Chang 3126* (TAIF).

1c. *Huperzia serrata* var. *myriophyllifolia* (Hayata) H.-M. Chang, *comb. nov.*

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Lycopodium serratum var. *myriophyllifolium* Hayata, *Icon. Pl. Form.* 4: 133. 1914; Masamune, *Short Fl. Form.* 32. 1936; DeVol, *Taiwania* 11: 49. *pl. 2. f. 5.* 1965; Shieh, *Quart. J. Chin. Forest.* 6(1): 36. 1972; DeVol in Li *et al.*, *Fl. Taiwan* 1: 30. 1975; Kuo, *Taiwania* 30: 11. 1985.
Urostachys serratus var. *myriophyllifolius* (Hayata) Herter ex Nessel, *Bärlappgewächse* 59. 1939.
Urostachys myriophyllifolius (Hayata) Herter, *Ind. Lycop.* 71. 1949.
Huperzia myriophyllifolia (Hayata) Holub, *Folia Geobot. Phytotax.* 20: 75. 1985.

Microphylls chartaceous, acicular or linear, attenuate at apex, sessile, margin sharp toothed and crispate; sporophylls similar to trophophylls, 13-20 mm long, 1-1.5 mm broad.

Chromosome numbers: no data.

Distribution: Endemic, growing in the forest of Mt. Alishan in central Taiwan.

Specimens examined: **CHIAYI:** Arisan, *Kawakami et Mori s.n. 1911* (Topotype: TAIF!); Alishan, Minyueh, *Kanehira et Sasaki s.n. 1918* (TAIF).

2. *Dryopteris lacera* (Thunb.) Ktze., *Reg. Gen. Pl.* 2: 813. 1891; C. Chr., *Ind. Fil.* 273. 1905; Nakai, *Bot. Mag. Tokyo* 28: 75. 1914; Ito, *Bot. Mag. Tokyo* 52: 587. 1938; Ching, *Bull. Fan. Mem. Inst. Biol. Bot.* 8: 439. 1938; Ohwi, *Fl. Jap.* 66. 1965; DeVol in Li *et al.*, *Fl. Taiwan* 6: 17. 1979; DeVol & Kuo, *Taiwania* 24: 107. 1979; Kuo, *Taiwania* 30: 30. 1985; Iwatsuki in Iwatsuki *et al.*, *Fl. Jap.* 1: 153. 1995; Hsieh *et al.*, *Fl. Reip. Pop. Sin.* 5(1): 156. 2000.

二型鱗毛蕨 Figs. 2, C & D

Polypodium lacera Thunb., *Fl. Jap.* 337. 1784.
Aspidium lacera (Thunb.) Sw., *J. Bot. (Schrader)* 1800(2): 39. 1801.
Polystichum lacera (Thunb.) Presl, *Epim. Bot.* 56. 1849.
Nephrodium lacera (Thunb.) Bak. in Hook. & Bak., *Syn. Fil.* 273. 1867; Yabe, *Bot. Mag. Tokyo* 17: 94. 1903.
Aspidium filix-mas Sw. var. *lacera* (Thunb.) Christ, *Farnkr. Erde* 257. 1897.

Evergreen fern, with partially dimorphic fertile frond. Rhizome stout, erect. Stipes tufted, 15-20 cm long, pale brown, densely scaly. Scales dimorphic, spreading, reddish brown, membranous, the larger scales ovate to broad lanceolate, 8-15 mm long and 3-8 mm broad on stipe, 2-8 mm long and 1-2 mm broad on rachis, ciliate on margins; the smaller scales linear to linear-lanceolate, 2-3 mm long and 0.5-1.5 mm broad on stipe, 0.5-2 mm long and less than 1 mm broad on rachis, ciliate to splited ciliate on margins. Laminae lanceolate to ovate,

bipinnate to tripinnatifid, 30-60 cm long, 20-30 cm broad, subcoriaceous, lower pinnae shorter; pinnae dimorphic, about 10-15 pairs, with short petiole; sterile pinnae 5-6 pairs, oblong-lanceolate, 10-15 cm long, 3-5 cm broad; fertile pinnae 8-10 pairs, strongly contracted and shortened, confined to upper 1/4 to 1/3 of the frond, less than 10 cm long, 1-3 cm broad, crimped and dry when sporangia mature. Sori round, indusia entire.

Chromosome numbers: $n=41$ or 82 , diploid or tetraploid (Weng, 1989; Iwatsuki, 1995).

Distribution: China and Japan. In Taiwan, only three distant populations are found, very rare.

Specimens examined: **HSINCHU:** Chienshih, Chenhsipao to Tulungtan pond, *Chang 3732* (TNU). **NANTOU:** Jenai, JihhsinKang, *Peng s.n. 2001* (TAIF). **ILAN:** Yunleng Hostel, *Chang 4086* (TNU).

In Taiwan, *Dryopteris lacera* was first recorded by Jeng (1978). His report was adopted by DeVol (1979), DeVol and Kuo (1979), and Kuo (1985) when they revised all Taiwanese pteridophytes. Nevertheless, this species was omitted in later studies, such as Tsai & Shieh (1994) and Kuo (1997). The first author collected this species in Hsinchu County in the summer of 2000, and found it again at Mt. Nanhutashan this year (Fig. 1). The most important character of *D. lacera* is its dimorphic pinnae. Other species of *Dryopteris* in Taiwan has wholly monomorphic pinnae, that is, all pinnae are potentially capable of forming sori. It has sharply contracted and distinguishable soriferous pinnae occupying only the apical part of the frond. When the sporangia mature, its pinnules of fertile pinnae are wholly crimped, not partially crimped as those of *D. squamiseta* (Hook.) Ktze.

Geographically, the distribution of *D. lacera* in Taiwan is almost on the southern limit of its range. We infer the three disjunctive populations in Taiwan could be relicts of an once large, widespread and continuous population, or alternatively, populations founded by long distance spore dispersal.

3. *Ophioglossum themale* Komarov, Feddes Repert. Spec. Nov. Regni Veg. 13: 85. 1914; Hara, Bot. Mag. Tokyo 48: 689-690. 1934; Tagawa, J. Jap. Bot. 33(7): 202. 1958; Nishida, J. Jap. Bot. 34(2): 43. 1959; Kato in Iwatsuki *et al.*, Fl. Jap. 1: 22. 1995.

狹葉瓶爾小草 Figs. 2, E & F

Ophioglossum vulgatum L. var. *themale* (Komarov) C. Chr. in Hultén, Fl. Kamt. 1: 45-46. 1927.

Ophioglossum littorale Makino, J. Jap. Bot. 6: 27. 1929.

Ophioglossum nipponicum var. *littorale* (Makino) Nishida ex Ohwi, Fl. Jap. Pter. 17. 1957.

Terrestrial, summer-green plants. Rhizome short, bearing 2-5 fronds simultaneously, gemma borne on slender creeping roots. Phyllomophore 1-3 cm long; trophophyll linear-lanceolate to linear, inward depressed, subsessile, 2-7 cm long, 0.5-1.5 cm broad, acute or obtuse at apex, attenuate at base; venation fine, areolae long, seldom with included free veinlets; sporophyll stipe 3-5 cm long, fertile spikes 2-3 cm long.

Chromosome numbers: $n=240$ or 480 , tetraploid or octoploid (Kurita, 1981; Kato, 1995).

Distribution: Siberia, Japan, China, and Micronesia. In Taiwan, growing in low-altitude fields of eastern part.

Specimens examined: **ILAN:** Tatung, Campus of Yingshih Primary School, *Chang 3211* (TAIF). **HUALIEN:** Sanchan, Estuary of Sanchanhsi, *Leong 756* (HAST); Hualien City, Campus of Hualien Normal College, *Chang s.n. 2001* (TAIF); Shoufong, Campus of National Tunghua University, *Chang s.n. 2000* (TAIF).

In general, the Taiwanese species of *Ophioglossum* are difficult to distinguish, but *O. themale* is easily detected by its narrow and inward depressed trophophylls. Besides, a short rhizome bearing 2-5 fronds simultaneously is another special character of this species. Although Tagawa (1958), Nishida (1959), Ohwi (1965), Shieh (1973), Yang (1973), Nakaike (1992), and Kato (1995) have recorded its distribution in Taiwan, they didn't mention where it grew, who collected it, and what its features were. For a long time, the local taxonomists couldn't be certain whether it grew in Taiwan or not. Last April, the first author found a large population of it in a schoolyard, beside a mountain, of Ilan County (Fig. 1). Then we examined specimens of the genus *Ophioglossum* in Taiwan's major herbaria and found that the species had been collected three times from another locality in eastern Taiwan. This distribution pattern of being confined in eastern Taiwan is just like other vascular plants, such as *Gentiana tenuissima* (Chen and Wang, 1999) having closed species in Japan of the same series. It seems interesting to seek why they just grow in eastern Taiwan, and why they are both phytogeographically close to those in Japan.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the reviewers for their critical comments on the manuscript. Grateful thanks from the authors are due to Dr. W.-L. Chiou of Taiwan Forestry Research Institute for his comments and for kindly providing literature. We are indebted to Messrs C.-T. Lu, S.-W. Chung, C.-W. Chen and P.-S. Li for their assistance in field collection. We also thank the herbaria HAST, TAI, TAIF and TNU for access to examine specimens.

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台灣產三種蕨類植物之確認

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(收稿日期：2001年10月24日；接受日期：2001年11月28日)

摘 要

本文確認千層塔 (*Huperzia serrata* var. *serrata*)、二型鱗毛蕨 (*Dryopteris lacera*) 及狹葉瓶爾小草 (*Ophioglossum themale*) 三種蕨類植物分布於台灣，並提供形態描述、分類註解、彩色照片與包括千層塔 (*Huperzia serrata*) 種下分類群的命名處理。

關鍵詞：二型鱗毛蕨，千層塔，長柄千層塔，阿里山千層塔，石松，狹葉瓶爾小草，蕨類，台灣。

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