Bull. Natl. Mus. Nat. Sci., Ser. B, 42(3), pp. 103–111, August 22, 2016

Taxonomic Notes on the Orchidaceae of Japan and Adjacent Regions

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(Received 27 May 2016; accepted 4 July 2016)

Abstract In accordance with recent reviews of Japanese Orchidaceae and results of molecular phylogenetic analyses, several new identifications, new combinations, and new synonyms are proposed here.

Key words: *Cephalanthera*, *Crepidium*, Eastern Asia, Japan, *Odontochilus*, Orchidaceae, taxonomy, *Thrixspermum*, *Yoania*

Recent reviews of Japanese Orchidaceae (Yukawa, 2015a, 2015b, in preparation) have revealed some misidentifications and unrecognised synonyms of the taxa in Japan and adjacent regions. Furthermore, results of molecular phylogenetic analyses demonstrated the non-monophyly of several orchid genera and new combinations are thus needed to recover the monophyly. Subsequent to Yukawa and Cribb (2014) and Tang *et al.* (2015), the necessary treatment in accordance with these findings is provided here.

Cephalanthera longifolia (L.) Fritsch.

Cephalanthera longifolia (L.) Fritsch. is a pan-Eurasian species widely distributed across subarctic and temperate regions in Europe, Asia and North Africa from Ireland and Morocco in the west to Korea in the east. Two species apparently related to this species, namely, *C. elegans* Schltr. and *C. shizuoi* F.Maek., were described from Japanese material. Taxonomic problems concerning the two species were reviewed and discussed by Yukawa *et al.* (2003) and Yukawa (2009).

Schlechter (1919) described *Cephalanthera elegans* on the basis of a specimen collected by K. Miyabe in Hakodate, southern part of Hokkaido Island in northern Japan. The holotype was deposited in Botanischer Garten und Botanisches Museum Berlin-Dahlem, Zentraleinrichtung der Freien Universität Berlin (B) but almost all of Schlechter's type collections in B were destroyed by fire in 1943. Yukawa and Ohba (1995) found that most of the duplicates of the type collections of Japanese orchid taxa described by Schlechter are deposited in the Herbarium, University of Tokyo (TI). However, they failed to locate any type material of *C. elegans* in TI and the Herbarium, Hokkaido University Museum (SAPA) where substantial parts of the Miyabe collection are housed. I therefore examined characters of *C. elegans* only on the basis of the protologue of the species and did not find any morphological differences from *C. longifolia*.

Cephalanthera shizuoi was described by Maekawa (1936) on the basis of material collected by S. Hattori in Kanagawa Prefecture, eastern part of Honshu, the largest island of Japan. The holotype deposited in TI and an illustration associated with the protologue perfectly match with *C. longifolia*.

I also investigated herbarium specimens and living plants referable to *Cephalanthera longifolia* from various regions of Japan. Although sizes of vegetative parts are variable among the individuals, characters of reproductive parts such as the shape and colour of the perianth segments and the morphology of the gynostemium are con-

sistent. A notable exception is the uniform dwarf habit in an isolated population around the summit of Mt. Tsurugi, Shikoku Island, western part of Japan. Even in this population, floral characters are identical to those of the other localities. Besides, Sugaya (1959) emphasized the papillose leaf, bract, and ovary of a specimen (*A. Kimura s.n.* collected on Mt. Moiwa, Hokkaido (TUS)) and suspected its conspecificity with *C. shizuoi* in which both vegetative and reproductive organs are glabrous except for the sparingly papillose inflorescence (Maekawa, 1936). However, this interpretation is due to the overlooking of the caducous nature of the papillae of *C. longifolia* including *C. shizuoi*. This character thus cannot be used as a diagnostic character of the species.

Further, comparisons with the Eurasian material of this species did not find any morphological differences (Yukawa *et al.*, 2003). The Eurasian material also showed great size variations in vegetative parts and the contrasting uniformity in reproductive parts. Consequently, it is reasonable to conclude that *Cephalanthera longifolia* is a variable species and distributed widely in Japan.

In Taiwan, Fukuyama (1938) described *Cephalanthera alpicola* Fukuy. from the Central Mountains of the island, and the type specimen and the protologue depict the characteristics of *C. longifolia*. I further observed herbarium specimens and living plants collected in Taiwan and concluded that these samples are identical to *C. longifolia*. *C. taiwaniana* S.S. Ying, the other Taiwanese *Cephalanthera* species, has been treated as a synonym of *C. alpicola* in recent floristic works such as Su (2000) and Chen *et al.* (2009). However, in the type material of *C. taiwaniana*, the foliage leaf is wider than *C. longifolia* and the sepals are shorter and wider than the petals (generally, sepals are longer and narrower than petals in *C. longifolia*), and the 5–7 lamellae on the epichile of the lip (3–5 in *C. longifolia*) are different. Further examinations of alpine populations of *C. longifolia* in Taiwan are needed to evaluate these variations.

Genetic diversity among Japanese, Taiwanese, and Eurasian samples identified as *C. longifolia* (including collections adjacent to type localities of *C. elegans*, *C. shizuoi*, *C. alpicola*, and *C. taiwaniana*) was very low and these samples formed a clade in relation to the other *Cephalanthera* species (M. Maki *et al.*, unpublished data). Consequently, both morphological and molecular evidence supported the view that the four entries, *C. elegans*, *C. shizuoi*, *C. alpicola*, and *C. taiwaniana* are synonymous with *C. longifolia*.

Cephalanthera elegans and *C. shizuoi* are sometimes considered conspecific with *C. erecta* (Thunb.) Blume as noted by Ohwi (1965) and Chen *et al.* (2009). However, *C. erecta* is distinct from *C. longifolia* by morphological and molecular characters.

Cephalanthera longifolia (L.) Fritsch, Oesterr. Bot. Z. 38: 81 (1888). [Fig. 1, A, B]

Basionym: *Serapias helleborine* var. *longifolia* L., Sp. Pl.: 950 (1753). Neotype: based on Oeder, Fl. Danica 3 (9): t. 506, f. media (1770).

Cephalanthera elegans Schltr., Repert. Spec. Nov. Regni Veg. Beih. 4: 58 (1919), **syn. nov.** Type: Japan, Hokkaido, Hakodate, *Miyabe s.n.* (holotype B, destroyed).

Cephalanthera shizuoi F.Maek., in Nakai, Iconogr. Pl. Asiae Orient. 1: 58 (1936). Type: Japan, Honshu, Kanagawa Pref., Kugenuma, *S.Hattori s.n.* (holotype TI!).

Cephalanthera alpicola Fukuy., Bot. Mag. (Tokyo) 52: 242 (1938), **syn. nov.** Type: Taiwan, Kwarenko, Mt. Gokwan-zan (Hohuan-shan), 16 June 1935, *K.Segawa s.n.*, Herb. Fukuyama 5915 (holotype TAI, not located). Taiwan, Kwarenko, Mt. Gokwan-zan, 16 June 1935, *K.Segawa s.n.* (lectotype KPM, here designated). Although the holotype is not located, a specimen with the identical collection data but without the collection number is deposited in KPM (Inoue *et al.*, 1998). This specimen (KPM-NA0105517) is appropriate for the lectotype of this species.

Specimens examined: Japan, Hokkaido: Asahikawa-shi, Asahiyama, alt. 240 m, 1960-6-11,

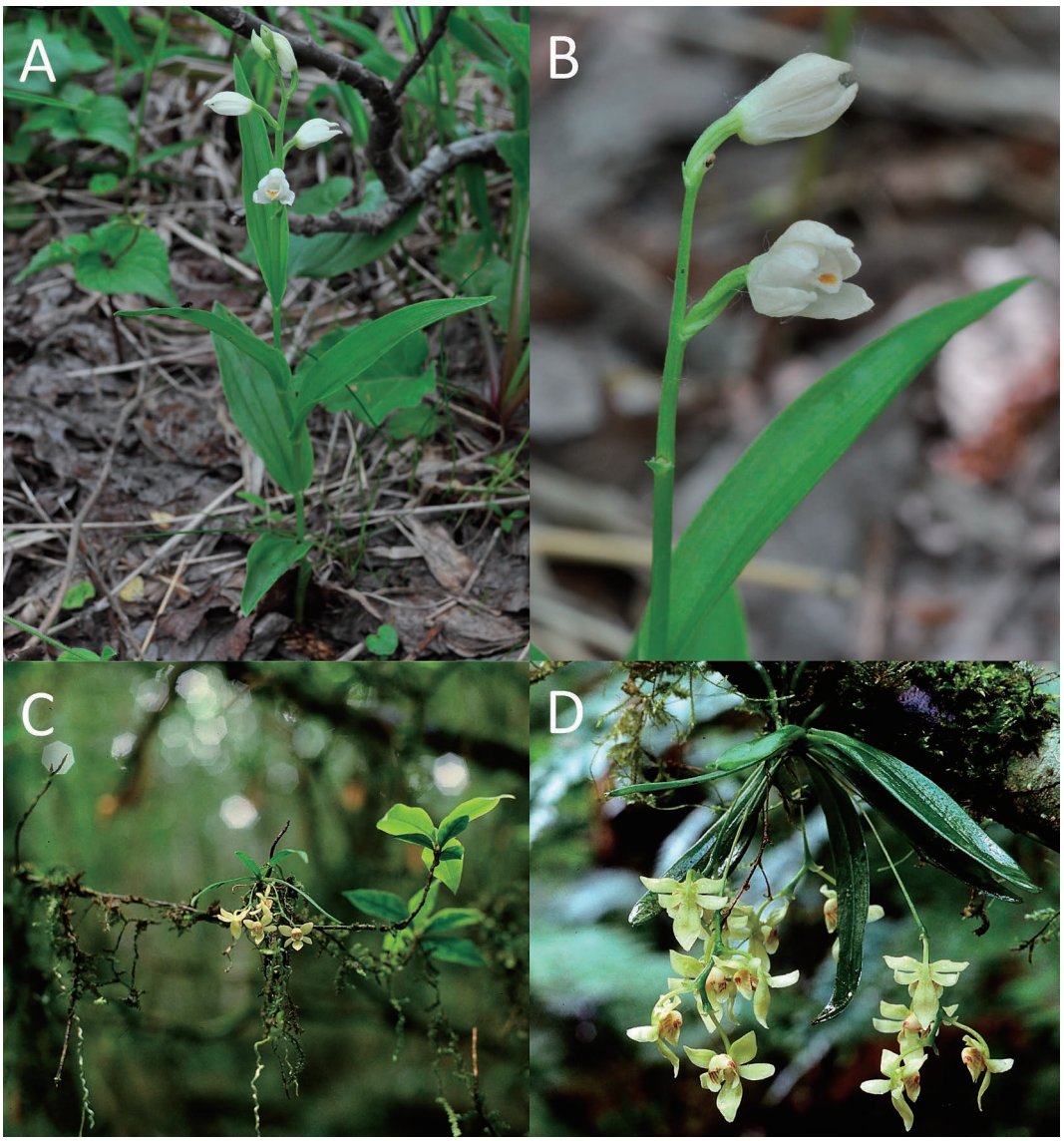

Fig. 1. *Cephalanthera longifolia* (L.) Fritsch from the habitat of Mt. Daisen, Tottori Pref., Honshu, Japan (A, B). A. Habit. B. Flowers. *Thrixspermum pygmaeum* (King & Pantl.) Holttum from the habitat of Amami Is., Kagoshima Pref., Ryukyu Isls., Japan (C, D). C. Habit. D. Flowers. (Photos A, B by T. Yagame; C, D by H. Yamashita)

Kanji Tokura 953 (TNS695747); Shari-cho, Shiretoko Peninsula, along Uwaebetsu River, alt. ca. 170 m, 2014-6-29, *Akitomo Uchida s.n.* (TNS8505657); Noboribetsu-shi, Washibesu-cho, on a hill, 1973-7-21, *Matsuji Hara s.n.* (TNS01013413); Noboribetsu-shi, Washibetsu-cho, 1974-6-12, *Matsuji Hara s.n.* (TNS01013414). Honshu: Aomori Pref. Higashidori-mura, alt. 10 m, 2010-6-8, *T. Kinoshita s.n.* (TNS8504905); Azumadake, *T. Numata s.n.* (TNS8504537); Misawa-shi, Sabishiro, on the beach of Ogawara-ko Lake, 1977-5-29, *Tatsuro Ohsawa s.n.* (TNS343232). Akita Pref. Akita-shi, Shimo-shinjo, 2008-5-21, *K. Miyoshi s.n.* (TNS8501244). Yamagata Pref. Mukaihara-Kanrin, 1930-6-2, *Haruki Okuyama s.n.* (TNS39611); Yamadera,

1931-6-14, *Haruki Okuyama 24138* (TNS 291933). Ibaraki Pref. Tsukuba-shi, University of Tsukuba, 2008-5-7, *Yuki Tsujita T08-4* (TNS8500539); Tsukuba-shi, Namiki, 2008-5-6, *Yuki Tsujita T08-3* (TNS 8500541); Tsukuba-shi, Amakubo, 2008-5-14, *Tomohisa Yukawa 08-2* (TNS8501231). Tokyo Metropolis. Nishitama-gun, Okutama-machi, Nippara, Ogawatani, 1971-5-27, *Midori Miyamoto 495* (TNS01086553). Chiba Pref. Chiba-shi, Mihama-ku, Saiwai-machi, 2005-4-28, *M. Saito s.n.* (TNS8501418). Kanagawa Pref. Tsukui-gun, Sagamiko-machi, near Sagami-ko Lake, alt. 200 m, 1969-5-6, *Tetsuya Kawasaki 6135* (TNS673113); Yokohama-shi, Aoba-ku, Nara-cho, Tamagawa University, 2002-5-7, *J. Yamazaki s.n.* (TNS8503114); Yokohama-shi, Aoba-ku, Nara-cho, Tamagawa University, 2003-5-7, *J. Yamazaki s.n.* (TNS8503107, 8503110); Yokohama-shi, Aoba-ku, Nara-cho, Tamagawa University, 2004-4-28, *J. Yamazaki s.n.* (TNS8503113); Fujisawa-shi, Hatori, 1992-4-30 (TNS8503981). KYUSHU: Fukuoka Pref. Kitakyushu-shi, Kokuraminami-ku, broad-leaved deciduous forest, alt. 520 m, *Kohji Tanaka s.n.* (TNS8500585).

Crepidium Blume

Results of phylogenetic analysis of tribe Malaxideae using macromolecular characters (Cameron, 2005) definitely showed the polyphyletic status of the genus *Malaxis s.l.* To restore the monophyly of the genus, it is necessary to recognise *Malaxis* section *Crepidium* as an independent genus, *Crepidium* Blume. The following endemic species of the Pacific islands have not been transferred to *Crepidium* yet.

Crepidium boninense (Koidz.) T.Yukawa, **comb. nov.**

Basionym: *Microstylis boninensis* Koidz., Bot. Mag. (Tokyo) 32: 137 (1918). Type: Japan, Bonin Isls., Insl. Chichishima, 30 September 1917, *S.Nishimura 107* (holotype TI).

Crepidium alamaganense (S.Kobay.) T.Yukawa, **comb. nov.**

Basionym: *Malaxis alamaganensis* S.Kobay., Nat. Hist. Res. (Chiba), Special Issue, 1: 71 (1994). Type: Northern Mariana Isls., Alamagan, ca. alt. 640 m, 9 June 1992, *T.Ohba CBM-BS-59238* (holotype CBM).

Odontochilus Blume

As pointed out by Ormerod (2002), the definition of *Odontochilus* Blume is problematic because it seems that otherwise critical generic characters in tribe Cranichideae subtribe Goodyerinae such as twisting of the column and connation of stigma lobes appear to be inconsistent or variable and thus have less value in generic circumscription. Moreover, results of molecular phylogenetic analysis of subtribe Goodyerinae revealed that *Evrardianthe* Rauschert, *Kuhlhasseltia* J.J.Sm., *Myrmechis* Blume, *Pristiglottis* Cretz. & J.J.Sm., and *Vexillabium* F.Maek. are nested within *Odontochilus* (T. Yukawa, unpublished). As a result, *Odontochilus* represents a polyphyletic entity, if *Evrardianthe*, *Kuhlhasseltia*, *Myrmechis*, *Pristiglottis*, and *Vexillabium* are treated as independent genera. Consequently, it is appropriate to circumscribe *Odontochilus* in a broad sense to recover the monophyletic status of this genus. The transfer of several species in *Kuhlhasseltia*, *Myrmechis*, *Pristiglottis*, and *Vexillabium* to *Odontochilus* is proposed here.

Odontochilus Blume, Fl. Javae Nov. Ser. 1: 66 (1858–1859). Type: *Odontochilus flavescens* (Blume) Blume.

Kuhlhasseltia J.J.Sm., Icon. Bogor. 4: t. 301 (1910). Type: *Kuhlhasseltia javanica* J.J.Sm., **syn. nov.**

Myrmechis Blume, Coll. Orchid.: 76 (1859). Type: *Myrmechis gracilis* (Blume) Blume, **syn. nov.**

Vexillabium F.Maek., J. Jap. Bot. 11: 457 (1935). Type: *Vexillabium nakaianum* F.Maek., **syn. nov.**

Odontochilus aureus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Tubilabium aureum* J.J.Sm., Bull. Jard. Bot. Buitenzorg, sér. 3, 9: 446 (1928).

Odontochilus bakhimensis (D.Maity, N.Pradhan & Maiti) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis bakhimensis* D.Maity, N.Pradhan & Maiti, Acta Phytotax. Sin. 45: 321 (2007).

Odontochilus bilobuliferus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Tubilabium bilobuliferum* J.J.Sm., Bull. Jard. Bot. Buitenzorg, sér. 3, 10: 6 (1928).

Odontochilus chalmersii (Schltr.) T.Yukawa, **comb. nov.**

Basionym: *Zeuxine chalmersii* Schltr., Bull. Herb. Boissier, sér. 2, 6: 297 (1906).

Odontochilus chinensis (Rolfe) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis chinensis* Rolfe, J. Linn. Soc., Bot. 36: 44 (1903).

Odontochilus coerulescens (Schltr.) T.Yukawa, **comb. nov.**

Basionym: *Cystopus coerulescens* Schltr., Repert. Spec. Nov. Regni Veg. Beih. 1: 68 (1911).

Odontochilus drymoglossifolius (Hayata) T. Yukawa, **comb. nov.**

Basionym: *Myrmechis drymoglossifolia* Hayata, Icon. Pl. Formosan. 6: 90 (1916).

Odontochilus elongatus (Blume) T.Yukawa, **comb. nov.**

Basionym: *Cystopus elongatus* Blume, Coll. Orchid.: 84 (1859).

Odontochilus fimbriatus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Cystopus fimbriatus* J.J.Sm., Bull. Dép. Agric. Indes Néerl. 10: 3 (1907).

Odontochilus fissus (F.Maek.) T.Yukawa, **comb. nov.**

Basionym: *Vexillabium fissum* F.Maek., J. Jap. Bot. 12: 91 (1936).

Odontochilus gilesii (Ormerod) T.Yukawa, **comb. nov.**

Basionym: *Kuhlhasseltia gilesii* Ormerod, Lindleyana 17: 207 (2002).

Odontochilus glaber (Blume) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis glabra* Blume, Coll. Orchid.: 76 (1859). This species is a later synonym of *Rhamphidia grandiflora* Lindl. (J. Proc. Linn. Soc., Bot. 1: 182 (1857)) but the transfer of *R. grandiflora* generates a homonym of *Odontochilus grandiflorus* (Lindl.) Hook.f.

Odontochilus gracilis (Blume) T.Yukawa, **comb. nov.**

Basionym: *Anoectochilus gracilis* Blume, Bijdr. Fl. Ned. Ind.: 413 (1825).

Odontochilus hatumetensis (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Cystopus hatumetensis* J.J.Sm., Bull. Jard. Bot. Buitenzorg, sér. 3, 10: 99 (1928).

Odontochilus integrus (Fukuy.) T.Yukawa, **comb. nov.**

Basionym: *Pristiglottis integra* Fukuy., Bot Mag. (Tokyo) 50: 20 (1936).

Odontochilus japonicus (Rchb.f.) T.Yukawa, **comb. nov.**

Basionym: *Rhamphidia japonica* Rchb.f., Bot. Zeitung (Berlin) 36: 75 (1878).

Odontochilus javanicus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Kuhlhasseltia javanica* J.J.Sm., Icon. Bogor. 4: t. 301 (1910).

Odontochilus kinabaluensis (Carr) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis kinabaluensis* Carr, Gard. Bull. Straits Settlem. 8: 188 (1935).

Odontochilus luzonensis (Ames) T.Yukawa, **comb. nov. et nom. nov.**

Basionym: *Cystopus philippinensis* Ames, Orchidaceae 5: 35 (1915). The binominal *O. philippinensis* cannot be used for this entity because this combination was used for another entity based on *Myrmechis philippinensis* Ames. The epithet “luzonensis” was derived from the type locality of the species.

Odontochilus mindanaensis (Ames) T.Yukawa, **comb. nov.**

Basionym: *Cystopus mindanaensis* Ames, Orchidaceae 5: 34 (1915).

Odontochilus montanus (Schltr.) T.Yukawa, **comb. nov.**

Basionym: *Anoectochilus montanus* Schltr., Bot. Jahrb. Syst. 39: 55 (1906).

Odontochilus muricatus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Cystopus muricatus* J.J.Sm., Orch. Ambon: 13 (1905).

Odontochilus nakaianus (F.Maek.) T.Yukawa, **comb. nov.**

Basionym: *Vexillabium nakaianum* F.Maek., J. Jap. Bot. 11: 458 (1935).

Odontochilus occultus (Blume) T.Yukawa, **comb. nov.**

Basionym: *Cystopus occultus* Blume, Coll. Orchid.: 85 (1859).

Odontochilus papuanus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Kuhlhasseltia papuana* J.J.Sm., Nova Guinea 12: 9 (1913).

Odontochilus pectiniferus (Schltr.) T.Yukawa, **comb. nov.**

Basionym: *Cystopus pectiniferus* Schltr., Repert. Spec. Nov. Regni Veg. Beih. 1: 69 (1911).

Odontochilus perpusillus (Ames) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis perpusilla* Ames, Schedul. Orchid. 6: 15 (1923).

Odontochilus philippinensis (Ames) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis philippinensis* Ames, Orchidaceae 2: 64 (1908).

Odontochilus puberulus (Schltr.) T.Yukawa, **comb. nov.**

Basionym: *Cystopus puberulus* Schltr., Repert. Spec. Nov. Regni Veg. Beih. 1: 70 (1911).

Odontochilus pubescens (Blume) T.Yukawa, **comb. nov.**

Basionym: *Anoectochilus pubescens* Blume, Bijdr. Fl. Ned. Ind.: 412 (1825).

Odontochilus quadrilobatus (Schltr.) T.Yukawa, **comb. nov.**

Basionym: *Cheirostylis quadrilobata* Schltr., Repert. Spec. Nov. Regni Veg. 10: 11 (1911).

Odontochilus rajanus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Kuhlhasseltia rajana* J.J.Sm., Mitt. Inst. Allg. Bot. Hamburg 7: 26 (1927).

Odontochilus seranicus (J.J.Sm.) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis seranica* J.J.Sm., Bull. Jard. Bot. Buitenzorg, sér. 3, 10: 95 (1928).

Odontochilus sibelae (Ormerod) T.Yukawa, **comb. nov.**

Basionym: *Kuhlhasseltia sibelae* Ormerod, Lindleyana 17: 209 (2002).

Odontochilus spicatus (Blume) T.Yukawa, **comb. nov.**

Basionym: *Cystopus spicatus* Blume, Coll. Orchid.: 84 (1859).

Odontochilus tsukusianus (Masam.) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis tsukusiana* Masam., Bot. Mag. (Tokyo) 43: 250 (1929).

Odontochilus urceolatus (Tang & K.Y.Lang) T.Yukawa, **comb. nov.**

Basionym: *Myrmechis urceolata* Tang & K.Y.Lang, Acta Phytotax. Sin. 34: 638 (1996).

Odontochilus whiteheadii (Rendle) T.Yukawa, **comb. nov.**

Basionym: *Zeuxine whiteheadii* Rendle, J. Bot. 34: 358 (1896).

Odontochilus yakushimensis (Yamam.) T. Yukawa, **comb. nov.**

Basionym: *Anoectochilus yakushimensis* Yamam., Bot. Mag. (Tokyo) 38: 131 (1924).

Thrixspermum pygmaeum (King & Pantl.) Holttum

A small *Thrixspermum* species was discovered in a few localities of subtropical evergreen broadleaf forests on Amami-oshima Island, Ryukyu Islands by Hiroshi Yamashita in 1980. This entity was first reported by Hatusima (1986) as *T. pricei* (Rolfe) Schltr. Subsequently, two more binominals, *T. formosanum* (Hayata) Schltr. and *T. saruwatarii* (Hayata) Schltr., have been applied to the Amami populations. Re-examination of the living material revealed that the plants should be referred to *T. pygmaeum* (King & Pantl.) Holttum rather than the three aforementioned species. *T. pygmaeum* is well demarcated from *T. saruwatarii* by the flower colour (cream

yellow in the former, white with purplish tints in the latter), an apical callus of the disc of the lip (absent in the former, present in the latter), and a longer disc of the lip (2 mm in the former, 3 mm in the latter). *T. formosanum* can be distinguished by a white flower, a well-developed, cylindric spur, and successive and ephemeral flowering. As correctly pointed out by Lin and Hsu (1977), *T. pricei* is a later synonym of *T. formosanum*.

Moreover, protologues of *Thrixspermum laurisilvaticum* (Fukuy.) Garay and *T. xanthanthum* Tuyama, both described on the basis of Taiwanese specimens, match well with *T. pygmaeum* and I treat them as synonyms of *T. pygmaeum*. Besides, specimens of *T. saruwatarii* from Arunachal Pradesh (Mao *et al.*, 2010) also likely represent *T. pygmaeum*. Since the identification of these *Thrixspermum* species is confusing, re-examination is necessary for the records of these species in East Asia.

So far, "Keitao-furan" has been used for the Japanese name of the Amami-oshima plants. However, this name corresponds to *Thrixspermum saruwatarii*. To emphasise the affinity of this species with *T. japonicum* (Miq.) Rchb.f., i. e. "Kayaran" in Japanese, I hereby propose a new Japanese name "Amami-kayaran" for this entity.

Thrixspermum pygmaeum (King & Pantl.) Holttum, Kew Bull. 14: 275 (1960). [Fig. 1, C, D]

Basionym: *Sarcochilus pygmaeus* King & Pantl., Ann. Roy. Bot. Gard. (Calcutta) 8: 207 (1898). Type: Sikkim, Pemiongtsi (Pemayangtse), *Pantling 472* (holotype CAL).

Sarcochilus laurisilvaticus Fukuy., Bot. Mag. (Tokyo) 52: 246 (1938), **syn. nov.** Type: Taiwan, Praef. Sintiku, alt. ca. 600 m, *N.Fukuyama s.n.*, Herb. Fukuyama 6106 (holotype, not located).

Thrixspermum laurisilvaticum (Fukuy.) Garay, Bot. Mus. Leafl. 23: 207 (1972).

Thrixspermum xanthanthum Tuyama, J. Jap. Bot. 16: 523 (1940), **syn. nov.** Type: Taiwan, Praef. Taihoku, Taiheizan, Kasinoki-daira, 2 April 1940, *Y.Kobayashi s.n.* (holotype TI!).

Thrixspermum pricei auct. non (Rolfe) Schltr., Hatusima, Fl. Kagoshima Rev. ed.: 236 (1986). Shimabuku, Check List Vascular Fl. Ryukyu Islands: 702 (1990). Hatusima & Amano, Fl. Ryukyu 2nd ed.: 345 (1994). Shimabuku, Check List Vascular Fl. Ryukyu Islands Rev. ed.: 797 (1997).

Thrixspermum formosanum auct. non (Hayata) Schltr., Hashimoto, Proc. 11 World Orch. Conf.: 124 (1987). Masamune, Native Orch. Nippon 7: 164 (1995).

Thrixspermum saruwatarii auct. non (Hayata) Schltr., Takahashi, Wild Orch. Jap. 3: 162 (1987). Hashimoto, Jap. Ind. Orch. Colour Rev. ed.: 251 (1991).

Specimens examined: Japan, Ryukyu Isls., Amami-oshima Is., Kinsakubaru, 15 June 2004, *H. Yamashita s.n.* ex hort. Tsukuba Bot. Gard. (TNS8500407); same locality, 24 February 1990, *T. Hashimoto s.n.* (TNS8503922, TNS9504630); same locality, 27 March 1993, *H. Yamashita s.n.* (TNS8504492); same locality, 1 April 1992, *H. Yamashita s.n.* (TNS8504748); Ryukyu Isls., Amami-oshima Is., along Sumiyo-gawa River, upper stream, alt. 194 m. March 2013, *Y. Maeda s.n.* ex hort. Tsukuba Bot. Gard. (TNS8505800).

Yoania **Maxim.**

A new genus *Yunorchis* and its sole species *Y. pingbianensis* were described by Z.J. Liu, G.Q. Zhang and M. He Li in Zhang *et al.* (2015). They emphasised that *Yunorchis* is morphologically different from the other genera in tribe Calypsoeae by a combination of the subumbellate inflorescence, the long pedicel, and the forward-hooked lip with reduced lateral lobes. Moreover, results of molecular phylogenetic analysis by them showed that the new taxon occupies a sister group position to *Dactylostalix* Rchb.f. and/or *Calypso* Salisb. However, morphological characters of *Yunorchis* fit well with *Yoania* Maxim. Molecular phylogenetic analysis incorporating more taxa of Calypsoeae revealed the monophyly of *Yunorchis* and *Yoania* with strong support (J. Freudenstein and T. Yukawa, unpublished). Consequently, it is appropriate to reduce *Yunorchis* as

a synonym of *Yoania*.

Yoania pingbianensis is closely related to *Y. prainii* King & Pantl., a species from Sikkim. The former has a more developed basal part of the lip and also exhibits purple-red in the abaxial surface of the sepals while the latter presents white flowers. Furthermore, a central papillate-pubescent callus of the lip and distant scales on the rhizome characterise *Y. pingbianensis*. In contrast, *Y. prainii* does not show a callus of the lip and has characteristic, densely clothed, imbricating scales on the rhizome.

Descriptions and illustrations of *Yoania prainii* from Ha Giang, Vietnam (Averyanov, 2011) show that these plants were misidentified and are actually referable to *Y. pingbianensis*, and that the distribution of the latter species extends into the northern part of Vietnam.

Yoania Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg, sér. 3, 18: 68 (1873). Type: *Yoania japonica* Maxim.

Yunorchis Z.J.Liu, G.Q.Zhang & M.He Li, PLoS ONE 10(4): e123382 (11) (2015), **syn. nov**. Type: *Yunorchis pingbianensis* Z.J.Liu, G.Q. Zhang & M.He Li

Yoania pingbianensis (Z.J. Liu, G.Q. Zhang & M. He Li) T.Yukawa & Freudenstein, **comb. nov.**

Basionym: *Yunorchis pingbianensis* Z.J.Liu, G.Q.Zhang & M.He Li, PLoS ONE 10(4): e123382 (11) (2015). Type: China, Yunnan, Pingbian, in a forest, alt. 2100 m, 31 May 2013, *Z. J. Liu 7103* (holotype NOCC).

Yoania prainii auct. non King & Pantl., Averyanov & Averyanova, Turczaninowia 3: 85 (2000). Averyanov, Turczaninowia 14: 15–100 (2011).

Acknowledgments

I would like to thank John Freudenstein, Teruo Katsuyama, Masayuki Maki, and Yumi Yamashita for sharing useful information, Yun-I Lee, Yoshiyuki Maeda and Hiroshi Yamashita for supplying the plant material, Takahiro Yagame and Hiroshi Yamashita for providing the photographs, and Hubert Kurzweil for critical reading of the manuscript. This study is partly supported by JSPS KAKENHI Grant Numbers JP15H04417 and JP15K14442 and a research grant from National Museum of Nature and Science.

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