NEW AND INTERESTING BRYOPHYTE RECORDS FOR TAIWAN

Alfons Schäfer-Verwimp[1], Gerhard Winter[2], Yu-Chwen Hsu[3], Shan-Hsiung Lin[4], Jia-Dong Yang[5], Kuei-Yu Yao[5]

[1] Mittlere Letten 11, D-88634 Herdwangen-Schönach, Germany; email: moos.alfons@kabelbw.de

[2] Senckenberg Research Institute, Senckenberganlage 25, D-60325 Frankfurt am Main, Germany

[3] National Taiwan Museum, No. 2, Xiangyang Road, Zhongzheng District, Taipei City, Taiwan 100, R.O.C.

[4] 2F-3, Building A, No. 136, Tunghai Rd, Neighborhood 18, Fu-en Li, Xitun District, Taichung City 40704, Taiwan, R.O.C.

[5] Endemic Species Research Institute, 1, Ming-Shen East Road, Jiji Township, Nantou 55244, Taiwan, R.O.C.

Abstract:

From recent fieldwork in Taiwan some 11 bryophytes, including 8 liverworts (*Cheilolejeunea krakakammae, Cephaloziella divaricata, Diplophyllum obtusatum, Douinia plicata, Geocalyx graveolens, Lejeunea micholitzii, Metzgeria crassipilis, Spruceanthus mamillilobulus*), and 3 mosses (*Daltonia marginata, Ulota intermedia* and *Zygodon reinwardtii*) are reported as new to the island. Several little known or rarely collected species are reported, too. Notes on the geographical distribution and habitats of the species are provided. *Frullania caduca* is considered to be a worthy of species recognition and is removed from synonymy of *F. amamiensis*.

Keywords: liverworts, mosses, Taiwan.

INTRODUCTION

With more than 900 species of mosses (Chiang *et al.* 2001; Redfearn *et al.* 1996), 531 species of hornworts and liverworts (Wang *et al.* 2011) and its size at only 35,980 km^2, Taiwan is one of the bryological hot spots in Southeast Asia. Though a very high number of bryophyte species is already known, additional discoveries are still possible.

A recent field trip to Taiwan in October 2016 in cooperation with the National Museum of Taiwan (NTM, hb TAIM) in Taipei and the Endemic Species Research Institute (TESRI, hb TAIE) in Jiji Township (Schäfer-Verwimp & Winter 2017; Shevock *et al.* 2017) yielded 11 bryophyte species so far not reported from Taiwan.

Original specimens will be deposited in TAIM or TAIE, duplicates in JE or FR and partly in further herbaria as indicated. All determinations by Schäfer-Verwimp (ASV) or otherwise as indicated.

List of species (in alphabetical order). Nomenclature of liverworts is following Söderström *et al*. (2016), of mosses Jia & He (2013), or more recent monographic treatments.
* = new to Taiwan

A. Liverworts

Anastrepta orcadensis (Hook.) Schiffn.

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.2' N, 121°18.7' E; only single plants creeping on *Scapania subnimbosa* Steph. over rock in partly filtered light, 16 Oct 2016, leg. A. Schäfer-Verwimp 37610/A, with Kuei-Yu Yao & James R. Shevock (only TAIE).

A bryogeographically highly interesting species because of its disjunct distribution: Europe, N. America, Aleutians, Hawaii, Yunnan, Himalayas, Taiwan, Japan (Honshu) (Kitagawa 1966); see also distribution map in Schuster (1984, fig. 21); from Taiwan first mentioned by Hattori (1951, without any data) and Horikawa (1951) from Mt. Hsüeh Shan. Kitagawa (1963) saw several specimens from Mt. Hsüeh Shan and reduced both *Lophozia decurrentia* Horik. and *L. rotundifolia* Horik. [types from Mt. Morrison (Yushan), Taiwan] to synonyms of *Anastrepta orcadensis*. *A. orcadensis* has also been reported by Lin (1991) from Yushan region, between Paiyun Lodge to Yushan Main Peak. Its occurrence in Taiwan seems to be rather restricted, and actual records are lacking.

During a visit of Yushan National Park (Chiayi and Nantou County) in Oct. 2018, *Anastrepta* was seen several times between Paiyun Lodge and Yushan West Peak at 3420-3450 m (leg. ASV 39084/B, 39096, 39125, with Kuei-Yu Yao, James R. Shevock and Gerhard Winter) and between Paiyun Lodge and Tataka entrance at 2980 m (leg. ASV 39154) and single plants admixed to *Scapania ciliatospinosa* Horik. at 2875 m (leg. ASV 39026/B).

Cheilolejeunea krakakammae (Lindenb.) R.M.Schust.

Taichung County: Hopin Township, Dasyueshan National Forest Recreation Area; 2275 m; 24°15.2' N, 121°00.4' E; surroundings of the Visitor Center, on bark of broad leaved tree at road side, half exposed to sunlight, c. per., 8 Oct 2016, leg. A. Schäfer-Verwimp DY-124, with Chao-Ling Kuo, Liang-Chi Wang, Kang-Yu Fan & Gerhard Winter, det. R.-L. Zhu (TAIE; TAIM; HSNU).

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.1' N, 121°18.6' E; on bark of broadleaved tree in partly filtered light, c. per., 16 Oct 2016, leg. A. Schäfer-Verwimp 37584, with Kuei-Yu Yao & James R. Shevock (TAIE).

Chiayi County: Alishan National Forest Recreation Area, along Tashan Trail up ridge near km marker 3.0; 2570 m; 23°32'04" N, 120°48'30" E; secondary conifer forest of *Cryptomeria japonica* (Thunb. ex L.f.) D.Don. and *Chamaecyparis obtusa* var. *formosana* (Hayata) Rehder, on bark of hardwood tree rather exposed to sunlight, c. per., 20 Oct 2016, leg. A. Schäfer-Verwimp 37857/A, with Jia-Dong Yang, Kuei-Yu Yao & James R. Shevock (TAIE).

A widespread paleotropical species known from Africa and Asia and reaching Australia and New Zealand (Zhu 2006); frequent in mainland China at higher altitudes and also known from Hainan, but so far not reported from Taiwan. However, a specimen from Mt. Ali in Chiayi County is deposited in HSNU (R.-L. Zhu in letter from 25 June 2018).

Cephaloziella divaricata (Sm.) Schiffn.

Nantou County: Taroko National Park, road side rocks along highway 8 between High Experimental Station / Visitor Center and Mt. Hehuan North & West Peak Trail; 2970-3000 m; 24°09.7-9' N, 121°17.3' E; on soil exposed to sunlight, 17 Oct 2016, leg. A. Schäfer-Verwimp 37663, with Kuei-Yu Yao and James R. Shevock, det. J. Váňa (TAIE, TAIM, PRC); - dito, 3030 m, 24°10.1' N, 121°17.3' E; on soil crevice at trail side, with *Solenostoma pyriflorum* Steph. and *Aongstroemia orientalis* Mitt., 17 Oct 2016, leg. A. Schäfer-Verwimp 37694/A, with Kuei-Yu Yao and James R. Shevock (TAIE).

A widespread holarctic species, scattered in the tropics; occurring throughout Europe, North, Central and South America, North Africa, Asia (incl. Turkey, Caucasus, Russia and China); new record to Taiwan, representing the southernmost locality in Asia.

Diplophyllum andrewsii A.Evans

Nantou County: Rueiyan River Major Wildlife Habitat, off of highway 14 between road markers 17-18 less than 0.5 km on Lixing Road at trail head of dirt road-trail, mixed hardwood forest with *Woodwardia* ferns on midslope; 2250 m; 24°06.6' N, 121°11.8' E; on soil of shady trail cut, c. per., 15 Oct 2016, leg. A. Schäfer-Verwimp 37519, conf. J. Váňa, 37521, with Kuei-Yu Yao and James R. Shevock (TAIE, PRC).

Chiayi County: Alishan National Forest Recreation Area, along the Mianyue section of the historic logging Alishan Railroad paralleling Tashan Trail between the 1 & 2 km marker; 2300 m; 23°31'15" N, 120°48'54" E; secondary conifer forest of *Cryptomeria japonica* and *Chamaecyparis formosana*, on rocky slope in filtered light, c. per., 20 Oct 2016, leg. A. Schäfer-Verwimp 37887, with Jia-Dong Yang, Kuei-Yu Yao & James R. Shevock (TAIE).

Disjunctly distributed in the Appalachians, Japan and Taiwan (distribution map in Schuster 1983: 518, fig. 22:2); firstly mentioned from Taiwan by Horikawa (1934, from Mt. Taiheizan, as *Diplophyllum obtusifolium*), and Inoue (1972) reported a second collection from near Mt. Morrison. It was consequently listed from Taiwan by Lai & Wang-Yang (1976), Piippo (1990, with reference to figures), Lin (2000) and Wang *et al.* (2011); seemingly so far known only from two collections from Taiwan.

Diplophyllum obtusatum (R.M.Schust.) R.M.Schust.

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.2' N, 121°18.7' E; on rock in partly filtered light, c. per. + numerous gemmae, 16 Oct 2016, leg. A. Schäfer-Verwimp 37609, with Kuei-Yu Yao and James R. Shevock, det. J. Váňa (TAIE, PRC).

Diplophyllum obtusatum is a rare Holarctic-Neotropical species, reported from scattered localities in North America with deep penetrations into the Neotropics from Costa Rica and the West Indies to Ecuador and Peru, Europe, South and East Siberia to Russian Far East and the Kuril Islands of northwestern Pacific (several reports since Konstantinova & Vasiljev 1994). It is reaching Taiwan and the tropics of South East Asia in (sub-)alpine environments comparable to those in the Neotropics (Gradstein & Váňa 1987, with distribution map, fig. 11); Konstantinova *et al.* 2002; Bakalin 2004, 2010; Schäfer-Verwimp & Pócs 2009; Sofronova 2017; Urmi 2017). New to Taiwan and China.

Douinia plicata (Lindb.) Konstant. & Vilnet [= *Macrodiplophyllum plicatum* (Lindb.) H.Perss.]

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.3' N, 121°18.8' E; on rock underhang, 16 Oct 2016, leg. A. Schäfer-Verwimp 37636, with Kuei-Yu Yao and James R. Shevock, conf. J. Váňa (TAIE, PRC).

A North Pacific Arc taxon, reported from Japan, Korea, Sakhalin, Siberia, Alaska, British Columbia, Oregon, Washington (Hong 1987, as *Diplophyllum plicatum*, with distribution map, fig. 13c); known also from mainland China (Piippo 1990, as *Macrodiplophyllum*) and figured in Gao *et al.* (2003, pl. 444: 1-8, as *Macrodiplophyllum*) and Choi *et al.* 2012 (fig. 49, 50, 52: 9, as *Macrodiplophyllum*); new generic record for Taiwan.

Frullania caduca S.Hatt.

Taipei County: New Taipei City, Manyueyuan National Forest Recreation Area; 400 m; 24°49.8'

N, 121°26.7' E; on metamorphic rock along road near entrance, half exposed to sunlight, 11 Oct 2016, leg. A. Schäfer-Verwimp TP-58, with Kang-Yu Fan, Yu-Chwen Hsu, Liang-Chi Wang & Gerhard Winter (TAIM; TAIE), - dito leg. A. Schäfer-Verwimp & Gerhard Winter TP-58B with Kang-Yu Fan, Yu-Chwen Hsu & Liang-Chi Wang (TAIM, FR).

The type specimen was collected by H. Inoue (no. 13924) in 1966 at Uri, Prov. Taipei [New Taipei City] at only 11.5 km distance, and described by Hattori (1980, fig. 1,a-y). In 1982, he added a specimen from Japan, Ryukyu Islands collected 1981 by Iwatsuki (no. 10823, fig 1,a-k) and assumes *Frullania caduca* to be "possibly conspecific with *Frullania amamiensis* Kamim. 1968". Yuzawa (2001) considered both as synonyms and the differences between both specimens "due to mutations caused by differences in environment conditions" [translated].

The examination of both collected specimens indicate that *Frullania caduca* can clearly be distinguished by (1) caducous leaves, (2) lateral teeth of underleaves ending with a rounded cell (ending with acute cells in *F. amamiensis*), (3) thin cell walls with small trigones and (4) entire perichaetial leaves, which were seen in the collected specimens for the first time. Therefore *Frullania caduca* should be considered a species worthy of recognition. In Yuzawa (2001) fig. 1 represents *Frullania amamiensis*, and fig. 2 *Frullania caduca*.

Frullania sphaerolobulata S.-H.Lin

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.2' N, 121°18.7' E; on liana in partly filtered light, c. per., 16 Oct 2016, leg. A. Schäfer-Verwimp 37617, with Kuei-Yu Yao and James R. Shevock, det. ASV & GW (TAIE, FR); - dito, 24°11.3' N, 121°18.8' E; on bark of broadleaved tree in partly filtered light, c. per., 16 Oct 2016, leg. A. Schäfer-Verwimp 37638/B, with Kuei-Yu Yao and James R. Shevock, det. GW (TAIE; FR).

A rather rare species so far known from the type specimen from Taitung County, Haiduan Hsiang, from bark of *Pinus taiwanensis* in forest at about 2800 m above sea level and a few further scattered localities (Lin & Chen 1997). It is further mentioned by Lin (2000) and Wang *et al.* (2011). This species seems to prefer growing epiphytically in light wooded areas at higher altitudes.

****Geocalyx graveolens*** (Schrad.) Nees

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.1' N, 121°18.6' E; on rock in partly filtered light, 16 Oct 2016, leg. A. Schäfer-Verwimp 37604, with Kuei-Yu Yao and James R. Shevock, conf. J. Váňa (TAIE, PRC).

Widespread in the northern hemisphere, predominantly of temperate climates, occurring in Europe, N. America, Russia, Caucasus, Siberia, and reaching the neotropics in the West Indies (Schäfer-Verwimp & Váňa 2011, with detailed distribution); from China it is known only from Jilin Province in the Northeast (Koponen *et al.* 1983; Gao & Cao 1983, cited after Söderström 2000); new

generic record for Taiwan.

Lejeunea micholitzii Mizutani

Taipei County: New Taipei City, Manyueyuan National Forest Recreation Area; 525 m; 24°49.18' N, 121°27.00' E; mixed hardwood-coniferous forest, on metamorphic rock in filtered light along trail near the river, 11 Oct 2016, leg. A. Schäfer-Verwimp TP-53, with Yu-Chwen Hsu & Gerhard Winter (TAIM; TAIE).

Widespread in Asia (Thailand, Vietnam, Pen. Malaysia, Borneo, Philippines, Indonesia, Papua New Guinea), New Caledonia, Vanuatu, Fiji, and Tonga (Lee *et al*. 2014); it is not mentioned in Piippo (1990) but listed in Jia & He (2013) from China.

Metzgeria crassipilis (Lindb.) A.Evans

Taichung County: Hopin Township, Dasyueshan National Forest Recreation Area; 2240-2275 m; 24°15.2' N, 121°00.4' E; road from Snow Mountain Guest House to the Visitor Center, on bark of road side tree near Guest House, half exposed to sunlight, 8 Oct 2016, leg. A. Schäfer-Verwimp DY-84, with Chao-Ling Kuo, Liang-Chi Wang, Kang-Yu Fan & Gerhard Winter (TAIM; TAIE).

Nearly worldwide in distribution, reported also from China, India, Japan, Indonesia and Sri Lanka (So 2003). Its occurrence in Taiwan therefore should be expected.

Sphenolobopsis pearsonii (Spruce) R.M.Schust.

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.2' N, 121°18.7' E; on bark of coniferous tree in partly filtered light, 16 Oct 2016, leg. A. Schäfer-Verwimp 37612/B, with Kuei-Yu Yao and James R. Shevock (TAIE); Taroko National Park, Mt. Hehuan North & West Peak Trail near below High Experimental Staion/Visitor Center off highway 8, open shrubby vegetation with single *Abies kawakamii* (Hayata) T.Itô, 3030 m, 24°10.1' N, 121°17.3' E, on bark of *Abies kawakamii*, 17 Oct 2016, leg. A. Schäfer-Verwimp 37692, with Kuei-Yu Yao and James R. Shevock (TAIE; FR).

Chiayi County: Alishan National Forest Recreation Area, along Tashan Trail up ridge between km marker 3.0 and 3.5, 2580 m; 23°32'05" N, 120°48'35" E; secondary conifer forest of *Cryptomeria japonica* and *Chamaecyparis formosana*, on bark of hardwood tree in partly filtered light, 20 Oct 2016, leg. A. Schäfer-Verwimp 37863, with Jia-Dong Yang, Kuei-Yu Yao & James R. Shevock (TAIM).

A northern oceanic, highly disjunctly distributed species, known from isolated areas in the Holarctic (North America, N and NW Europe), in Asia reported from Japan, Bhutan, Nepal, Malaysia (Mt. Kinabalu), Papua New Guinea (Váňa & Piippo 1989, with fig. 1g-i, k-l); and more recently from Tristan da Cunha (Schumacker & Váňa 2005), Korea (Choi *et al*. 2015), and from Russia Southern Far East (Bakalin 2013). All specimens recorded earlier from Russia belong to *Eremonotus myriocarpos* (Carr.) Lindb. & Kaal. (Konstantinova 2001).

The first record from Taiwan (Inoue 1966, as *Cephaloziopsis* sp.) is based on a specimen collected from Nantou County (Pa-Tung-Kuan Mt. Yu-Shan), ca. 3170 m, on bark of coniferous tree by S. Nakanishi (no. 13621), March 1963. Another one, collected by Yamaguchi (no. 32708) from Taichung County has been distributed in the exsiccata series "Bryophytes of Asia", Fasc. 17, no. 424 (Deguchi & Yamaguchi 2010).

A visit of Yushan National Park (Chiayi and Nantou County) in Oct. 2018 revealed that *Sphenolobopsis pearsonii* is rather abundant there and has been seen often between Tataka entrance and Paiyun Lodge as well as between Paiyun Lodge and Yushan Main Peak and Yushan West Peak on bark of *Abies*, *Juniperus* and *Pinus* between 2870 and 3555 m (leg. ASV 39029, 39066/A, 39085/A, 39111, 39128, with Kuei-Yu Yao, James R. Shevock and Gerhard Winter, and admixed to several further collections). *Sphenolobopsis* therefore may be widespread in Taiwan in natural forests at higher altitudes.

Spruceanthus mamillilobulus (Herzog) Verd.

Chiayi County: Alishan National Forest Recreation Area, along Tashan trail up ridge near summit region; 2580 m; 23°32' N, 120°48' E; secondary conifer forest of *Cryptomeria japonica* and *Chamaecyparis formosana*, on branch of shrub rather exposed to sunlight, 20 Oct 2016, leg. A. Schäfer-Verwimp 37872, with Jia-Dong Yang, Kuei-Yu Yao & James R. Shevock (TAIE).

Nantou County: Alishan Range, Lulinshan Major Wildlife Habitat Area, off of highway 18; 23°28'09" N, 120°50'47" E; 2325 m; mixed hardwood forest with planted *Cryptomeria japonica* and *Pinus armandii*, on bark of hardwood tree in filtered light, 21 Oct 2016, leg. A. Schäfer-Verwimp 37906, with Jia-Dong Yang, Kuei-Yu Yao & James R. Shevock (TAIE).

Spruceanthus mamillilobulus is known from mainland China (Guizhou, Guangdong and Guangxi provinces) and Vietnam (Wang *et al*. 2015, with figs. 1-2 and distribution map). The record from Taiwan means a considerable range extension to the east.

B. Mosses

Daltonia marginata Griff.

Nantou County: Rueiyan River Major Wildlife Habitat, off of highway 14 between road markers 17-18 less than 0.5 km on Lixing Road at trail head of dirt road-trail, mixed hardwood forest with *Woodwardia* ferns on midslope; 2250 m; 24°06.6' N, 121°11.8' E; epiphyte on bark of young tree, c. spor., partly mixed with *Daltonia splachnoides* (Sm.) Hook. & Taylor, 15 Oct 2016, leg. A. Schäfer-Verwimp 37515/B, with Kuei-Yu Yao and James R. Shevock (TAIE).

Daltonia marginata is one of the most widespread species of the genus and easily recognized by the contorted leaves when dry combined with the lenticular cells throughout the lamina with the exception of the most basal area (Majestyk 2011). Concluding from the long list of synonyms given by Majestik (2011) it is nearly pantropical in distribution, from Asia known from India and Nepal and under *Daltonia contorta* Müll. Hal. and its var. *humilis* M.Fleisch. (and *D. scaberula* Mitt.) it is reaching Sri Lanka, Malaysia, Java, and the Philippines (Mohamed & Robinson 1991, as *D. contora,* figs. 30-36). Fide Lin & Tan (2002: 12), the report of *D. angustifolia* var. *gemmiphylla* from Taiwan "appears to be close to *D. contorta* ... but the occurrence in China awaits its confirmation". New record for Taiwan and China.

Epipterygium tozeri (Grev.) Lindb.

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.2' N, 121°18.7' E; on humid rocky slope in partial shade, only a few plants between *Asterella leptophylla* (Mont.) Grolle, 16 Oct 2016, leg. A. Schäfer-Verwimp 37648/C, with Kuei-Yu Yao and James R. Shevock (TAIE only).

An interesting species characterized by dimorphic, distantly arranged leaves in a 2/5 phyllotaxy (Shaw 1984), lax leaf cells and costa ending well below leaf apex.

Widespread but scattered in temperate regions of the northern hemisphere, known from North America, Europe incl. Macaronesia, Africa, Lebanon, Iran, India, China, Korea, Japan, Philippines, Thailand, Malaysia, Indonesia (Printarakul *et al.* 2014), also known from the Caucasus (Chikovani & Svanidze 2004), and Bhutan (Long 1992); rarely collected in Taiwan and so far known only from few collections from Nantou County (Chuang 1973) and Chiayi County (Zhang *et al*. 2007).

Lewinskya taiwanensis (Lewinsky) F.Lara, Garilleti & Goffinet [= *Orthotrichum taiwanense* Lewinsky]

Nantou County: Taroko National Park, Mt. Hehuan North & West Peak Trail near below High Experimental Staion/Visitor Center off highway 8, open shrubby vegetation with single *Abies kawagamii* (Hayata) T.Itô; 3020 m; 24°10.1' N, 121°17.3' E; on branch of *Berberis* shrub, 17 Oct 2016, leg. A. Schäfer-Verwimp 37689, with Kuei-Yu Yao and James R. Shevock, det. R. Garilleti (TAIE).

A rare Chinese endemic species, from Taiwan known only from the type specimen, and from mainland China from Guizhou and Xizang provinces (Lewinsky 1992, with fig. 12; Jia *et al*. 2011).

Ulota intermedia Schimp.

Nantou County: Taroko National Park, Mt. Bilu Trail along rocky steep slope off of highway 8 between km marker 111 and 111.5 next to tunnel; 2600 m; 24°11.0-3' N, 121°18.5-8' E; on branch of broadleaved tree in partly filtered light, growing with *Lewinskya taiwanensis*, 16 Oct 2016, leg. A. Schäfer-Verwimp 37576, with Kuei-Yu Yao and James R. Shevock, det. R. Garilleti (TAIE only).

Caparrós *et al*. (2016) investigated the *Ulota crispa* complex and found *Ulota intermedia* to be a species worthy of recognition. It is widespread in western and eastern North America, northern Europe and southern European cordilleras, Altai, Russian Far and Japan and seems to prefer high elevational or altitudinal areas in the temperate zone (Caparrós *et al*. 2016, with distribution map); new to Taiwan and China.

Ulota morrisonensis Horik. & Noguchi

Nantou County: Rueiyan River Major Wildlife Habitat, off of highway 14 between road markers 17-18 less than 0.5 km on Lixing Road at trail head of dirt road-trail, mixed hardwood forest with *Woodwardia* ferns on midslope; 2250 m; 24°06.7' N, 121°11.8' E; epiphyte on hardwood tree, c. spor., 15 Oct 2016, leg. A. Schäfer-Verwimp 37540, with Kuei-Yu Yao and James R. Shevock, det. R. Garilleti (TAIE).

From Taiwan so far known only from the type and a second specimen from Mt. Notaka (Jia *et al*. 2011, with plate 286, figs. 1-15; Wang & Jia 2012). Recently reported also from Japan, Kyushu (Suzuki & Iwatsuki 2013, with fig. 4).

Zygodon reinwardtii (Hornsch.) Braun in Bruch, Schimper & Gümbel

Taichung County: Hopin Township, Dasyueshan National Forest Recreation Area; 2610 m; 24°16.8' N, 121°01.6' E; Trail from Siaoyueshan Visitor Center to Tianehih Lake, epiphyte on bark of solitary coniferous tree, c. spor., 7 Oct 2016, leg. A. Schäfer-Verwimp DY-36, with Chao-Ling Kuo, Liang-Chi Wang, Kan-Yu Fan & Gerhard Winter (TAIM).

Nantou County: Taroko National Park, Mt. Hehuan North & West Peak Trail near below High Experimental Station / Visitor Center off highway 8, open shrubby vegetation with single *Abies kawakamii* (Hayata) T.Itô; 3020 m; 24°10.1' N, 121°17.3' E; on bark of *Abies kawakamii*, 17 Oct 2016, leg. A. Schäfer-Verwimp 37687/A, with Kuei-Yu Yao and James R. Shevock (TAIE).

A very widespread species, known from China (Sichuan and Yunnan), Indonesia, western North America, Mexico, Central and South America, Africa and Australia (Jia *et al*. 2011, with plate 291, figs. 1-8). So far not reported from Taiwan.

Acknowledgements

Schäfer-Verwimp and Winter thank the Taiwan National Museum for sponsoring and organizing the first two weeks of the field trip, especially Liang-Chi Wang , Yu-Chwen Hsu, Chao-Ling Kuo and Kan-Yu Fan for guiding our field trips. (Schäfer-Verwimp & Winter 2017). For the third week of this field trip Schäfer-Verwimp thank Taiwan Endemic Species Research Institute for sponsoring and organizing, especially Jia-Dong Yang and Kuei-Yu Yao, and in addition James R. Shevock (USA) for accompanying him. (Shevock *et al.* 2016). Thanks also to the late Jiří Váňa (CSFR), Ricardo Garilleti (Spain) and Rui-Liang Zhu (China) for checking and commenting selected specimens.

Literature cited

Bakalin VA. 2004. Hepatics of Stanovoye Nagor'e Uplands (Eastern Siberia). *Arctoa* 13: 73-83 (in Russian, with English abstract and latin nomenclature).

Bakalin VA. 2010. Hepaticae of the Kuril Islands (nortwestern Pacific): a transoceanic route from circumboreal to East Asian flora. *Annales Botanici Fennici* 47: 81-105.

Bakalin VA. 2013. *Sphenolobopsis pearsonii* (Spruce) R.M.Schust., in Ellis LT *et al*., New national and regional bryophyte records, 36. *Journal of Bryology* 35(3): 235.

Caparrós R, Lara F, Draper I, Mazimpaka V & Garilleti R. 2016. Integrative taxonomy sheds light on an old problem: the *Ulota crispa* complex (Orthotrichaceae, Musci). *Botanical Journal of the Linnean Society* 180: 427-451.

Chiang T-Z, Hsu T-W, Moore S-J & Tan BC. 2001. An updated checklist of Taiwan Mosses. The Biological Society of China, Nantou.

Chikovani N & Svanidze T. 2004. Checklist of Bryophyte species of Georgia. *Braun-Blanquetia* 34: 97-116.

Choi SS, Bakalin VA & Yun B-Y. 2012. *Scapania* and *Macrodiplophyllum* in the Russian Far East. *Botanica Pacifica* 1: 31-95.

Choi SS, Bakalin VA, Park SJ & Sun B-Y. 2015. *Sphenolobopsis pearsonii* (Spruce) R.M.Schust., in Ellis LT *et al*., New national and regional bryophyte records, 42. *Journal of Bryology* 37(1): 79.

Chuang C-C. 1973. A Moss Flora of Taiwan exclusive of essentially pleurocarpous families. *Journal of the Hattori Botanical Laboratory* 37: 419-509.

Deguchi H & Yamaguchi T. 2010. Bryophytes of Asia. Fasc. 17 (2010). *Hikobia* 15(4): 529-530. Gao C & Cao T. 1983. A preliminary study on bryophytes of Changbai Mountain. *Research of Forest Ecosystems* 1983: 82-118.

Gao C, Lai M-J, Cao T, Li X-J, Chang K-C, Fu X, Bai X-L, So M-L, Wang Y-F & Zhu R-L. 2003. *Illustrations of Bryophytes of China*. Insitute of Applied Ecology, Chinese Academy of Sciences, Taiwan Development Institue, SMC Publishing Inc., Taipei. 1313 pp.

Gradstein SR & Váňa J. 1987. On the occurrence of Laurasian Liverworts in the Tropics. *Memoirs of*

The New York Botanical Garden 45: 388-425.

Hattori S. 1951. On the distribution of the Hepaticae of Shikoku and Kiushu (southern Japan). *The Bryologist* 54: 103-118.

Hattori S. 1980. Dr. H. Inoue's *Frullania* collection made in Formosa. *Bulletin of the National Science Museum* [Tokyo], *ser. B, Botany* 6(1): 33-40.

Hattori S. 1982. *Frullania caduca* from Amami Island. *The Journal of Japanese Botany* 57(11): 328-331.

Hong WS. 1987. The Distribution of Western North American Hepaticae. Endemic Taxa and Taxa with a North Pacific Arc Distribution. *The Bryologist* 90(4): 344-361.

Horikawa Y. 1934. Monographia Hepaticarum Australi-Japonicarum. *Journal of Science of the Hiroshima University*, series B, div. 2, 2: 101-325, pls. 11-21.

Horikawa Y. 1951. Symbolae Florae Bryophytae Orientali-Asiae et Micronesiae XII. *Hikobia* 1: 78-100.

Inoue H. 1966. New and noteworthy Liverworts from Formosa. *Bulletin of the National Science Museum Tokyo* 9(1): 37-41.

Inoue H. 1972. Studies on Formosan Hepaticae. 1. Introduction and Scapaniaceae. *Journal of Japanese Botany* 20: 311-327.

Jia Y, He S & Guo S. 2011. Orthotrichaceae, in *Moss Flora of China, English Version*, vol. 5: 22-117. Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Jia Y & He S. 2013. *Species Catalogue of China*. Vol. 1 Plants Bryophytes. Science Press [in Chinese, with latin nomenclature].

Kitagawa N. 1963. Lophoziaceae of Taiwan (Formosa). *Hikobia* 3(3): 169-176.

Kitagawa N. 1966. A revision of the family Lophoziaceae of Japan and its adjacent regions. II. *Journal of the Hattori Botanical Laboratory* 29: 101-149.

Konstantinova NA. 2001. *Eremonotus myriocarpus* (Carr.) Lindb. Kaal. – an addition to the hepatic flora of Russia. *Arctoa* 10: 115-120.

Konstantinova NA & Vasiljev AN. 1994. On the Hepatic Flora of Sayan Mountains (South Siberia). *Arctoa* 3: 123-132.

Konstantinova NA, Bakalin VA, Potemkin AD & Ignatov MS. 2002. Hepatic Flora of the Upper Bureya River (Russian Far East). *Arctoa* 11: 393-398.

Koponen T, Gao C, Lou J-S & Järvinen I. 1983. Bryophytes from Mt. Chang Bai, Jilin Province, Northeast China. *Annales Botanici Fennici* 20: 215-232.

Lai M-J & Wang-Yang J-R 1976. Index bryoflorae formosensis. *Taiwaniana* 21: 159-203.

Lee GE, Pócs T, Chantanaorrapint S, Damanhuri A & Latiff A. 2014. An account of the genus *Lejeunea* (Marchantiophyta: Lejeuneaceae) in Thailand, including seven newly recorded species. *Cryptogamie, Bryologie* 35(3): 247-259.

Lewinsky J. 1992. The genus *Orthotrichum* Hedw. (Orthotrichaceae, Musci) in Southeast Asia. A taxonomic revision. *Journal of the Hattori Botanical Laboratory* 72: 1-88.

Lin B & Tan BC. 2002. Hookeriaceae, in Moss Flora of China, English Version, vol. 6: 3-34. Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis.

Lin S-H. 1991. 玉山國家公園苔蘚植物調查(二)。內政部營建署玉山國家公園管理處委託之成果報告。南投縣：玉山國家公園管理處。

Lin S-H. 2000. The Liverwort Flora of Taiwan. The Council of Agriculture, The Executive Yuan, Taipei, Taiwan [in Chinese].

Lin S-H & Chen Y-Y. 1997. A Taxonomic Study of Frullaniaceae from Taiwan. Biological Bulletin 75: 79-125. Tunghai University, Taichung, Taiwan.

Long DG. 1992. Mosses of Bhutan. I. *Bryobrothera* 1: 119-125.

Majestyk P. 2011. A taxonomic treatment of *Daltonia* (Musci: Daltoniaceae) in the Americas. *Journal of the Botanical Research Institute of Texas* 5(2): 553-575.

Mohamed H & Robinson H. 1991. A taxonomic revision of the moss families Hookeriaceae and Hypopterygiaceae in Malaya. *Smithsonian Contributions to Botany* 80: 1-44.

Piippo S. 1990. Annotated catalogue of Chinese Hepaticae and Anthocerotae. *Journal of the Hattori Botanical Laboratory* 68: 1-192.

Printarakul N, Tan BC, Wongkuna-Thananoppakun K & Santanachote K. 2014. The Indian connection of the Thailand moss flora, with one new species, *Fissidens elizbrowniae*. *Telopea* 17: 195-215.

Redfearn PJ Jr., Tan BC & He S. 1996. A newly updated and annotated checklist of Chinese Mosses. *Journal of the Hattori Botanical Laboratory* 79: 163–357.

Schäfer-Verwimp A & Váňa J. 2011. *Geocalyx graveolens* (Schrad.) Nees. *In*: Ellis LT *et al*., New national and regional bryophyte records, 29. *Journal of Bryology* 33(4): 318-319.

Schäfer-Verwimp A & Winter G. 2017. Collecting bryophytes in Taiwan. *BryoString* 5: 25-30.

Schumacker R & Váňa J. 2005. Identification keys to the liverworts and hornworts of Europe and Macaronesia (distribution and status), 2nd ed. Poznan: Sorus.

Schuster RM. 1983. Phytogeography of the Bryophyta. *In* R.M. Schuster (ed.), New Manual of Bryology I: 463-626. The Hattori Botanical Laboratory, Nichinan, Japan.

Shaw J. 1984. Quantitative Taxonomic Study of Morphology in *Epipterygium*. *The Bryologist* 87(2): 132-142.

Shevock JR, Schäfer-Verwimp A & Yao K-Y. 2017. A Recent Bryological Expedition in Taiwan. *BryoString* 5: 21-24.

So ML. 2003. The genus *Metzgeria* (Hepaticae) in Asia. *Journal of the Hattori Botanical Laboratory* 94: 159-177.

Söderström L. 2000. Hepatics from Changbai Mountain, Jilin Province, China. *Lindbergia* 25: 41-47.

Söderström, Lars, Anders Hagborg, Matt von Konrat, Sharon Bartholomew-Began, David Bell, Laura Briscoe, Elizabeth Brown, D. Christine Cargill, Denise P. Costa, Barbara J. Crandall-Stotler, Endymion D. Cooper, Gregorio Dauphin, John J. Engel, Kathrin Feldberg, David Glenny, S. Robbert Gradstein, Xiaolan He, Jochen Heinrichs, Jörn Hentschel, Anna Luiza Ilkiu-Borges,

Tomoyuki Katagiri, Nadezhda A. Konstantinova, Juan Larraín, David G. Long, Martin Nebel, Tamás Pócs, Felisa Puche, Elena Reiner-Drehwald, Matt A. M. Renner, Andrea Sass-Gyarmati, Alfons Schäfer-Verwimp, José Gabriel Segarra Moragues, Raymond E. Stotler, Phiangphak Sukkharak, Barbara M. Thiers, Jaime Uribe, Jiří Váňa, Juan Carlos Villarreal, Martin Wigginton, Li Zhang, Rui-Liang Zhu. 2016. World checklist of hornworts and liverworts. *PhytoKeys* 59:1–828.

Sofronova EV. 2017. A contribution to the liverwort flora of Timpton River Basin (Aldan Upland, Southern Yakutia). *Arctoa* 26: 81-90.

Suzuki T & Iwatsuki Z. 2013. Notes on *Ulota* in Japan. *Hattoria* 4: 99-106.

Urmi E. 2017. Betreffend *Diplophyllum obtusatum* (R.M.Schust.) R.M.Schust. in der Schweiz. *Meylania* 60: 5-7.

Váňa J. & Piippo S. 1989. Bryophyte flora of the Huon Peninsula, Papua New Guinea. XXXI. Cephaloziaceae subfam. Alobielloideae, Cephaloziellaceae, Antheliaceae and Lophoziaceae (Hepaticae). *Annales Botanici Fennici* 26: 263-290.

Wang J, Lai M-J & Zhu R-L. 2011. Liverworts and hornworts of Taiwan: an updated checklist and floristic accounts. *Annales Botanici Fennici* 48: 369–395.

Wang Q-H & Jia Y. 2012. A taxonomic revision of the Asian species of *Ulota* Mohr (Orthotrichaceae). *The Bryologist* 115(3): 412-443.

Wang J, Gradstein SR, Shi X-Q, Zhu R-L & Do VT. 2015. On the occurrence of asymmetrical underleaves associated with left-right symmetry in *Spruceanthus mamillilobulus* (Herzog) Verd. (Lejeuneaceae), a little-known species from China and Vietnam. *Journal of Bryology* 37(1): 62-67.

Yuzawa Y. 2001. Species of the genus *Frullania* (Family Frullaniaceae, Hepaticae) in Japan II. [In Japanese]. *The Natural Environmental Science Research* 14: 1-47.

Zhang D-C, Li X-J & He S. 2007. Bryaceae. *In*: Li X-J, Crosby MR (eds)., *Moss Flora of China, English Version*, vol. 4: 3-92. Science Press, Beijing, New York and Missouri Botanical Garden Press, St. Louis.

Zhu R-L. 2006. Taxonomy and distribution of *Cheilolejeunea krakakammae* (Lejeuneaceae, Jungermanniopsida, Marchantiophyta), with a description and illustrations of *Cheilolejeunea laevicalyx* from Bolivia, Colombia and Ecuador. *Nova Hedwigia* 83: 187-198.

Fig. 1. *Frullania caduca*. a. inner bracts and bracteole, b. cells of dorsal leaf, c. underleaf.

臺灣新的及有趣的苔蘚植物紀錄

奧芬斯・舍費爾–沃文普[1]，葛哈德・溫特[2]，許毓純[3]，林善雄[4]，楊嘉棟[5]，姚奎宇[5]

[1] 德國黑爾德萬根–舍納，Mittlere Letten 11；e-mail: moos.alfons@kabelbw.de
[2] 德國法蘭克福申根研究所
[3] 臺灣博物館，10046 臺北市中正區襄陽路 2 號
[4] 臺中市西屯區福恩里 18 鄰東海路 136 號 A 棟 2 樓之 3
[5] 特有生物研究保育中心，55244 南投縣集集鎮民生東路 1 號

摘要：本文根據最近在臺灣的野外調查，報導 11 種臺灣新紀錄苔蘚植物，包含 8 種蘚類(*Cheilolejeunea krakakammae*, *Cephaloziella divaricata*, *Diplophyllum obtusatum*, *Douinia plicata*, *Geocalyx graveolens*, *Lejeunea micholitzii*, *Metzgeria crassipilis*, *Spruceanthus mamillilobulus*)及 3 種苔類(*Daltonia marginata*, *Ulota intermedia* and *Zygodon reinwardtii*)，本文同時也報導了幾種鮮為人知或稀有的物種，並提供地理分布與生育環境之資訊。文中將 *Frullania caduca* 視為一個種，而非 *F. amamiensis* 之同義名。

關鍵字：苔蘚植物、臺灣