

Lichen Flora of Western Part of Yunnan Province, China*

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Abstract: Lichenological expedition was organized by Korean Lichen Research Institute (KoLRI) to survey highland macrolichen at the western part of Yunnan province, China in 2005. The expedition was aimed to collect oversea lichen materials as a potential bioresource for further industrial use. More than 400 lichen specimens were collected and 86 species in 46 genera of lichens were identified from the survey area. Among them, 40 species have been reported in Korea peninsula. All the collected specimens are deposited in the herbarium of KoLRI at Suncheon National University in Korea and Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica in China.

Key words: bioresource; lichen; western part of Yunnan; China

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中国云南西部地衣区系

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摘要: 对中国云南西部高山地区的大型地衣进行了调查。采集地衣标本 400 余份, 鉴定为 46 属 86 种, 其中 40 种在朝鲜半岛有报道。所有采集的标本现保藏于顺天大学韩国地衣研究所和中国科学院昆明植物研究所隐花植物标本馆。

关键词: 生物资源; 地衣; 云南西部; 中国

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Yunnan province located in southwest China, between 22°—28° N and 97°—106° E, has attracted many botanists and collectors since the end of the 19th century. For lichens, Hue^[1-2] studied the collection made by Abbé Delavay, and Zahlbruckner^[3] enumerated many species mainly based on the collection made

by Handel-Mazzetti. Chinese lichenologists have made floristic and taxonomic studies on lichens in this area for the last decade^[4-7], but many genera and places still remain incompletely investigated.

More than 500 lichen species were reported in Korean Peninsula so far^[8]. However, lichen biodiversity

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Biography: WEI Xin-li (1978-), female, assistant professor, being engaged in systematics of lichen, and working as a postdoctoral fellow in Korea at present.

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of Korean peninsula is very limited compared to the neighboring countries such as China and Japan.

In June 2005, we had the 2nd lichenological expedition for the floristic survey of highland lichens in Yunnan province, China as a part of Bioresource Conservation Projects supported by Korean Ministry of Sciences & Technology. Here, we reported our highland lichen floristic survey at western part of Yunnan province.

1 Materials and Methods

1.1 Study area

The study area is located in northwest Yunnan, part of the eastern end of the Great "Sino-Himalayan" mountain chain between 25°05'—35°10' N and 85°10'—103°35' E. This area is well known for its rich flora of lichen species in the world. Characteristics of climate, geography and vegetations in the study area were previously described^[9].

This work is mainly based on collections made around Dali (大理) county (Fig. 1). Collecting localities are given below (Fig. 1).

(1) Mt. Cang (苍山): 20 km N of Dali. Forest of *Abies*, *Pinus*, and *Rhododendron*, alt. 2 850—3 490 m, 25°41'—25°42' N, 100°06' E.

(2) Jianchuan (剑川) plateau: 100 km NW of Dali. Shrubby forest of *Pinus*, *Quercus* and *Rhododendron*, alt. 3 040—3 080 m, 26°28'—26°31' N, 100°02'—100°05' E.

(3) Mt. Laojun (老君山): 120 km NW of Dali. Forest of *Abies*, *Pinus*, *Quercus*, *Rhododendron*, *Salix* and *Sorbus*, alt. 3 280—4 060 m, 26°37'—26°39' N, 99°43'—99°46' E.

(4) Alyuan (洱源): 70 km N of Dali, *Pinus* forest, alt. 2 950—3 320 m, 25°99'—26°01' N, 99°53' E.

(5) Mt. Bao (保山): 140 km SW of Dali, Forest of *Juniperus*, *Pinus*, and *Salix*, alt. 2 530—3 180 m, 25°42'—102°44' N, 99°03'—99°08' E.

(6) Mt. Jiaozi (轿子山): 130 km NE of Kunming (昆明), Forest of *Abies*, *Pinus*, *Populus* and *Rhododendron*, alt. 2 560—4 040 m, 25°40'—26°05' N, 102°44'—102°50' E.

1.2 Lichen collection and identification

Four hundred and three specimens were collected by Hur and Wang in middle June, 2005. The expedition for lichen collection was officially permitted by Yunnan Forest Administration through Kunming Institute of Botany. These collections are deposited in Korean Lichen Research Institute (KOLRI) at Suncheon National University in Korea and are duplicated to the lichen herbarium, Cryptogamic Herbarium, Kunming Institute of Botany, Academia Sinica (KUN - L) in China.

For this study, identification was mainly made by Mr. Wang at KUN - L. For confirmation of the identification, some type of specimens in the herbarium of KUN were used. The nomenclature follows IndexFungorum (<http://www.indexfungorum.org/Names>). Recent generic treatments are adopted for this study.

Thin-layer chromatography (TLC) was also performed to identify lichen chemical compounds with three developing solvent systems^[10-11]. In general, illustrations of some species are found in the following books: Yoshimura^[12], Wu^[13] and Lai^[14].

2 Results

Followings are the lichen species identified in this study. The lichen species reported during the first expedition in 2004 were previously illustrated^[9].

(1) *Anzia hypoleucoides* Müll. Arg. *

Thallus foliose, green to yellowish brown; lacini-ae mostly isodiametric dichotomously branched, lobe rounded near the apices; upper surface smooth to rugose; lower surface covered by continuous spongiostrom, the rhizinae stout, black, rather scattered; soredia and isidia absent. Apothecia reddish brown, up to 4 cm in diameter. Atranorin and lobaric acid contained.

Mt. Laojun, on trunk of *Abies*, 3 795 m (26°38' N, 99°44' E), CH - 05 - 224; Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH - 05 - 287; on trunk of *Pinus amandii*, 2 536 m (25°42' N, 99°08' E), CH - 05 - 317.

(2) *Baeomyces placophyllus* Ach. *

Thallus crustose, greenish white to pinkish gray,

brown in part, usually with small, rounded, loosely attached squamules on the surface; podetia up to 8 mm tall, at least partially covered with a smooth, vegetative thallus, each podetium topped with a large, brown, contorted apothecium, 1—4 mm in diameter. Stictic and norstictic acids contained.

Mt. Cang, on soil, 3 380 m (25 42 N, 100 06 E), CH - 05 - 019; Mt. Laojun, on soil, 3 800 m (26 38 N, 99 44 E), CH - 05 - 216.

(3) *Bryoria bicolor* (Ehrh.) Brodo & D. Hawksw.

Thallus erect, 5—7 cm tall, main branches 0.3—0.5 mm in diameter, blackish, olivaceous grey, to cervine brown; branches cylindrical, tapering, shiny; lateral spinules numerous in the middle and the base parts, soralia lacking, pseudocyphellae sparse to common, fissural, plane to slightly raised, elongate fusiform, 0.1 mm long, brown. Apothecia rare to common, subterminal; excipulum thallinum concolourous with thallus, eciliate, thalline margin pale, disc 2—4 (—5) mm, red brown to dark brown; pycnidia not seen. Fumarprotocetraric acid present, salazinic acid sometimes present.

Mt. Laojun, on trunk of *Abies*, 3 985 m (26 37 N, 99 43 E), CH - 05 - 188.

(4) *Bryoria confusa* (D. D. Awasthi) Brodo & D. Hawksw.

Thallus fruticose, usually 5—10 cm long, brown; branches cylindrical, tapering; lateral spinules numerous over the whole thallus; soralia and pseudocyphellae absent. Apothecia usually abundant, lateral, sessile; thalline margin concolourous with thallus, thin, cilia absent; disc 0.5—1.5 mm in diam., brown; pycnidia not seen. No lichen substance detected.

Mt. Cang, on trunk of *Abies*, 3 395 m (25 42 N, 100 06 E), CH - 05 - 021; Mt. Laojun, on trunk of *Rhododendron*, 4 030 m (26 37 N, 99 43 E), CH - 05 - 179; on trunk of *Abies*, 4 030 m (26 37 N, 99 43 E), CH - 05 - 187; Mt. Bao, on trunk of *salix*, 2 880 m (25 44 N, 99 04 E), CH - 05 - 297; Mt. Jiao Zi, on trunk of *Rhododendron*, 3 810 m (26 04 N, 102 50 E), CH - 05 - 364.

(5) *Bryoria divergescens* (Nyl.) Brodo & D.

Hawksw.

Thallus erect, usually 0.6—2.5 cm tall; main branches cylindrical; dense lateral spinules arising over the whole thallus; soralia and isidia absent, pseudocyphellae very rare, usually on lateral spinules. Apothecia common, subterminal, excipulum thallinum concolourous with thallus, ciliate; disc 2—5 mm in diam., red brown to dark brown; pycnidia not seen.

Fumarprotocetraric, lobaric, protocetraric, confumarprotocetraric acids contained.

Mt. Cang, on trunk of *Abies*, 3 395 m (25 42 N, 100 06 E), CH - 05 - 020; on trunk of *Abies*, 3 440 m (25 42 N, 100 06 E), CH - 05 - 027.

(6) *Bryoria hengduanensis* Li S. Wang & H. Harada

Thallus pendent, 3—5 cm (—15 cm) long, grey to pale brown, shiny; branches cylindrical; lateral spinulose branches common; pseudocyphellae sulcate, linear; soralia absent. Apothecia and pycnidia not seen. Fumarprotocetraric, usnic, protocetraric, confumarprotocetraric acids contained

Mt. Laojun, on trunk of *Abies*, 3 930 m (26 37 N, 99 43 E), CH - 05 - 146.

(7) *Bryoria himalayensis* (Motyka) Brodo & D. Hawksw.

Thallus pendent, 15—25 cm long, brown to black, dull; branches cylindrical; lateral spinules numerous over the whole thallus; pseudocyphellae sparse; soralia absent. Apothecia rare, lateral, thalline margin thin; disc 2.0—2.5 mm in diam., cervine brown to yellow brown to dark brown, shiny. Pycnidia not seen. Fumarprotocetraric and lobaric acids contained.

Mt. Laojun, on trunk of *Rhododendron*, 3 395 m (26 37 N, 99 43 E), CH - 05 - 159; Mt. Jiaozi, on trunk of *Taxus*, 3 660 m (26 04 N, 102 50 E), CH - 05 - 339; on trunk of *Taxus*, 3 810 m (26 04 N, 102 50 E), CH - 05365.

(8) *Bryoria lactinea* (Nyl.) Brodo & D. Hawksw.

Thallus pendent, 10—15 cm long, bony white to pale brown, dull; branches cylindrical; lateral spinules sparse to numerous; pseudocyphellae sparse; so-

ralia absent. Apothecia rare, lateral, thalline margin thin; disc 2—2.5 mm in diam., cervine brown to yellow brown or brown, shiny. Pycnidia not seen. Fumarprotocetraric acid contained.

Mt. Cang, on trunk of *Abies*, 3 430 m (25 42 N, 100 06 E), CH- 05 - 024.

(9) *Bryoria nitidula* (Th. Fr.) Brodo & D. Hawksw.

Thallus erect to decumbent, 4—7 cm tall; branches cylindrical; lateral spinules numerous in the base part, but sparse towards apices; pseudocyphellae sparse; soralia absent. Apothecia and pycnidia not seen. Fumarprotocetraric acid contained.

Mt. Jiaozhi, on rock (moss), 4 040 m (26 04 N, 102 51 E), CH- 05382.

(10) *Bryoria poeltii* (Bystrek) Brodo & D. Hawksw.

Thallus subpendent, 4—6 cm long; branches cylindrical; lateral spinules lacking; soralia abundant, round or ellipsoid; pseudocyphellae absent. Apothecia and pycnidia not seen. Fumarprotocetraric acid contained.

Mt. Laojun, on trunk of *Abies*, 3 890 m (26 37 N, 99 43 E), CH- 05 - 201.

(11) *Bryoria trichodes* subsp. *americana* (Motyka) Brodo & D. Hawksw. *

Thallus pendent, 5—10 (—15) cm long; branches cylindrical; lateral spinules lacking; soralia rarely, lateral, white; pseudocyphellae sparse to abundant. Apothecia and pycnidia not seen. Fumarprotocetraric acid present, usnic and lobaric acids sometimes present.

Mt. Laojun, on trunk of *Abies*, 3 980 m (26 37 N, 99 43 E), CH- 05 - 157.

(12) *Bunodophoron melanocarpum* (Sw.) Wedin
Thallus yellowish, granular, growing on wood; Apothecia like pinheads, stalks thick, unbranched; capitulum black, naked, non-pruinose.

Mt. Laojun, on moss (rock), 4 020 m (26 37 N, 99 43 E), CH- 05 - 163; CH- 05 - 147.

(13) *Calicium lenticulare* Körb.

Thallus yellowish white, granular to leprose,

growing on decaying wood; Apothecia like pinheads, stalks thick, unbranched; capitulum often white pruinose; ascospores dark brown, 2-celled, ellipsoid, loose in mazaedium.

Mt. Laojun, on trunk of *Abies*, 3 980 m (26 37 N, 99 43 E), CH- 05 - 147.

(14) *Candelaria concolor* (Dicks.) Stein *

Thallus foliose, 0.5—2.0 cm broad, thin, closely adnate, fusing into larger colonies, greenish lemon-yellow; lobes 0.1—0.5 mm wide, finely branched, crowded, margins ascending; upper surface sorediate on margins, soredia coarse and granular; lower surface corticated, white, sorediate marginally; rhizines short, simple, white, moderately distributed. Apothecia rare, c. 0.7 mm wide, margins sorediate and lobulate, disc dull yellow; spores tiny, numerous in each ascus. Pulvinic acid, calycin, and pulvinic dilactone contained.

Mt. Jiaozhi, on trunk of *Populus*, 2 560 m (25 40 N, 102 51 E), CH- 05 - 392.

(15) *Catolechia wahlenbergii* (Flot. ex Ach.) Körb.

Thallus foliose; lobes peltate, rigid, crowded, ridgy, deformed to gyrus-shaped; upper surface yellowish green, plane to slightly rugose, dull; soredia, isidia, and lobules absent; lower surface brown, rugose, dull. Apothecia and pycnidia not seen.

Mt. Jiaozhi, on rock, 3 940 m (26 04 N, 102 51 E), CH- 05 - 373.

(16) *Cetraria laevigata* Rass. *

Thallus fruticose, reddish brown; lobes narrow, 1—3 mm cross, with a smooth and shiny surface; rather broad, white, marginal pseudocyphellae forming a very conspicuous, almost unbroken line from lobe tip to base, with only rare and scattered laminal pseudocyphellae. Fumarprotocetraric, protolichesterinic, and lichesterinic acids contained.

Mt. Laojun, on moss, 4 060 m (26 37 N, 99 43 E), CH- 05 - 185; on moss, 3 790 m (26 38 N, 99 44 E), CH- 05 - 222; Mt. Jiaozhi, on moss, 3790 m (26 04 N, 102 50 E), CH- 05 - 362; on moss, 4 000 m (26 05 N, 102 51 E), CH- 05 - 379.

(17) *Cetrelia olivetorum* (Nyl.) W. L. Culb. &

C. F. Culb. *

Thallus foliose, about 10 cm wide, loosely adnate, tightly at center, grayish green; lobes 0.5—1.5 cm wide; upper surface with fine soredia along margin, pseudocyphellate, pores indistinct, very small; lower surface black, margins tan or brown, not punctuate; rhizines few, black; medulla white. Apothecia not seen. Atranorin, olivetoric and anziaic acids present.

Mt. Cang, on trunk of *Rhododendron*, 3 350 m (25°42' N, 100°06' E), CH-05-017; on trunk of *Pinus*, 2 940 m (25°41' N, 100°06' E), CH-05-070; on trunk of *Juniperus*, 2 950 m (25°41' N, 100°06' E), CH-05-076.

(18) *Cladia aggregata* (Sw.) Nyl. *

Thallus fruticose, shrubby; branches dispersed and loosely interweaved, dichotomously branched, tips acute, dirty green to pale brown, smooth, shiny, with cluster of pores; soredia and isidia absent. Apothecia and pycnidia not seen.

Mt. Cang, on soil, 3 250 m (25°42' N, 100°06' E), CH-05-007; on soil, 3 260 m (25°42' N, 100°06' E), CH-05-011; Alyuan (洱源), on soil, 2 850 m (25°59' N, 99°53' E), CH-05-256.

(19) *Cladonia macilenta* Hoffm. *

Thallus foliose, primary squamules small, less than 2 mm long or broad, thick, relatively undivided. Podetia grayish or greenish, slender, usually unbranched, 10—30 mm tall, often somewhat thicker at the tip, covered with fine soredia with relatively few podetial squamules, ending in blunt or pointed tips frequently with bright red apothecia, without cups. Barbatic acid present, squamatic acid sometimes present.

Mt. Laojun, on soil, 3 810 m (26°38' N, 99°44' E), CH-05-214.

(20) *Cladonia ceriosa* (Ach.) Spreng

Thallus fruticose, to 2 cm long; Podetia gray to pale brown, rugose, coarse, dull, covered with relatively few squamules, ending pointed tips frequently with reddish-brown apothecia, without cups.

Mt. Laojun, on moss, 3 810 m (26°38' N, 99°44' E), CH-05-218.

(21) *Cladonia cervicornis* (Ach.) Flot. *

Thallus fruticose, to 3.5 cm long; Podetia grayish-green, rugose, coarse, dull, with white spot; secondary podetia ending at the tip of cups. Apothecia around the cups, very small, lecanorine type, disc reddish-brown, less than 0.5 mm in diameter.

Alyuan, on soil, 2 850 m (26°00' N, 99°53' E), CH-05-254; Mt. Bao, on soil, 2 880 m (25°44' N, 99°04' E), CH-05-299.

(22) *Cladonia coccifera* (L.) Wild. *

Thallus fruticose, to 3 cm long; Podetia gray to grayish-green, coarse, dull, with relatively much squamules. Apothecia ending at the tip of podetia, lecidicine type, reddish, with cups.

Alyuan, on soil, 2 850 m (26°00' N, 99°53' E), CH-05-255.

(23) *Cladonia corymbescens* Nyl.

Thallus foliose; basal squamules persistent or evanescent, 2—3 mm long, 1—2 mm diam., lobed. Podetia growing from basal squamules, 10—25, rarely to 35 mm tall, 0.5—1.0 mm diam., simple at base, with subcymose or subcorymbose branching near apices, with axils open to centre of podetia, esorediate, escyphiferous, rarely squamulose; cortex smooth to subwarted. Apothecia terminal, 0.2—0.5 mm diam., convex, pale brown to dark brown. Atranorin, fumarprotocetraric and protocetraric acids contained.

Mt. Laojun, on soil, 3 810 m (26°38' N, 99°44' E), CH-05-208.

(24) *Cladonia gracilis* (L.) Willd. *

Thallus foliose; primary squamules disappearing. Podetia slender and usually unbranched, 3—8 cm tall, without cups; somewhat squamulose at the base and usually browned at the tips; base yellowish to brown, not blackened. Fumarprotocetraric acid contained.

Mt. Laojun, on moss, 4 010 m (26°37' N, 99°43' E), CH-05-161.

(25) *Cladonia pleurota* (Flörke) Schaer. *

Thallus pale yellowish green; primary squamules small or rather large, deeply lobed, nonsorediate. Podetia short (6—25 mm high), with broad cups covered with granular soredia; cup margins usually even. Bright red apothecia or pycnidia frequently produced

directly on the cup margins or on short proliferations. Usnic acid and zeorin contained.

Mt. Cang, on moss, 3 490 m (25°42' N, 100°06' E), CH-05-056.

(26) *Cladonia rangiferina* (L.) Weber ex F. H. Wigg. *

Thallus fruticose, shrubby; branches pale grayish-green, loosely interweaved, dichotomously to irregularly branched, tips pendent, acute, brown, surface coarse, dull, with white spot; soredia and isidia absent. Apothecia and pycnidia not seen.

Mt. Cang, on moss, 3 490 m (25°42' N, 100°06' E), CH-05-053; Mt. Laojun, on moss, 4 050 m (26°37' N, 99°43' E), CH-05-182; on moss, 4 060 m (26°37' N, 99°43' E), CH-05-184; on moss, 3 790 m (26°38' N, 99°44' E), CH-05-221.

(27) *Cladonia squamosa* (Scop.) Hoffm. *

Primary squamules abundant and persistent, very finely divided, nonsorediate. Podetia pale grayish green in the shade to rather browned in sunny sites, short and squat or rather tall and slender, abundantly scaly (the squamulose), the squamules sometimes extremely small and almost granular but with no true soredia; largely without a cortex between the squamules; tips of the podetia with narrow open cups or cupless and blunt, somewhat branched, with open axils. Brown apothecia sometimes seen. Thamnolic acid contained.

Mt. Cang, on soil, 3 460 m (25°42' N, 100°06' E), CH-05-046; Mt. Laojun, on moss, 4 050 m (26°37' N, 99°43' E), CH-05-180.

(28) *Cladonia yunnana* (Vain.) Abbayes

Thallus foliose; primary squamules present, but few. Podetia unbranched to dichotomously branched, 2—3 cm tall, without cups; somewhat squamulose at the surface of podetia. Apothecia ending at the podetia, lecidine type, disc bright red, protruding, c. 1 mm in diameter.

Xinwua, rotten bark, 3 080 m (26°31' N, 100°02' E), CH-05-136.

(29) *Coccocarpia erythroxyli* (Spreng.) Swinscow & Krog *

Thallus foliose, 2—6 cm broad, loosely attached, bluish-gray, turning darker when wet; lobes 2—9 mm wide, somewhat imbricate, apices very rounded, margins deflexed; upper surface glossy, slightly wrinkled along transverse concentric ridges, somewhat lobulate in older parts, epruinose, not isidiate; lower surface tan, sometimes with a bluish cast; rhizines arranged in transverse concentric lines, moderate, fasciculate, tan or with a blue cast; medulla white, very thin. Pycnidia and apothecia common; apothecia lecidine, sometimes forming irregular aggregates, 1—5 mm wide, adnate. No lichen substances detected.

Mt. Cang, on soil, 3 460 m (25°42' N, 100°06' E), CH-05-036; Mt. Laojun, on trunk of *Salix*, 3 880 m (26°37' N, 99°43' E), CH-05-193; on trunk of *Abies*, 3 790 m (26°38' N, 99°44' E), CH-05-225; Mt. Jiao Zi, on rock, 3 640 m (26°04' N, 102°50' E), CH-05-327.

(30) *Dermatocarpon miniatum* (L.) W. Mann *

Thallus foliose, 2—6 cm broad, plane, thick, often convoluted and crowded, pale brown to whitish-gray, not distinctly lobate, forming one large umbilicate sheet; upper surface slightly wrinkled in older part; lower surface naked, brown, somewhat wrinkled, holdfast present at centre; medulla white, thick. Perithecia abundant, seen as brown to black dots. No lichen substances detected.

Jianchuan, on rock (lime stone), 3 040 m (26°28' N, 100°05' E), CH-05-106.

(31) *Dibaeis baeomyces* A (L. f.) Rambold & Hertel *

A two-part lichen with a crustose primary thallus and fruticose apothecial stalks; primary thallus white, continuous, granular to verrucose, with more or less hollow granules or subspherical verrucae produced here and there. Turban-like pink apothecia, 1—4 mm across, produced at the summits of short, unbranched, solid stalks 2—6 mm tall. Baemycesic and squamatic acids contained.

Mt. Laojun, on rock, 3 900 m (26°38' N, 99°44' E), CH-05-203.

(32) *Erioderma tomentosum* Hue

Thallus foliose, loosely attached to the substrate; lobes crowded, like intact in habit, tips conspicuously upturn, margins with densely white hairs, squarrosely branched; soredia, isidia, and lobules absent; lower surface ecorticate, white, some part with densely hairs, white to dirty brown. Apothecia marginal, lecanorine type, thallus margin with hairs, disc reddish-brown, 1.0—3.5 mm in diameter.

Mt. Bao, on trunk of salix, 2 880 m (25 44 N, 99 04 E), CH- 05 - 294.

(33) *Evermia mesomorpha* Nyl. *

Thallus forming pendent or shrubby tufts (2—4—8 cm long composed of wrinkled and ridged branches 0.5—1.5 mm thick, irregularly but abundantly divided, with coarse soredia developing on the ridges. Divaricatic acid contained.

Jianchuan, on trunk of Pinus, 3 040 m (26 28 N, 100 05 E), CH- 05 - 102; Mt. Laojun, on rock, 4020 m (26 37 N, 99 43 E), CH- 05 - 175; on trunk of Abies, 3880 m (26 37 N, 99 43 E), CH- 05 - 195.

(34) *Evermiastrum cirrhatum* (Fr.) Hale ex Sipman *

Thallus fruticose, procumbent, c. 5 cm broad; branches dispersed, dichotomously branched, cilia along the margin, upturn downwards; upper surface gray, smooth to slightly rugose, dull; lower surface pale brown, rugose, tomentose. Pycnidia laminal, black, abundant. Apothecia not seen.

Mt. Cang, on soil, 2930 m (25 41 N, 100 06 E), CH- 05 - 065; Jianchuan, on trunk of Quercus, 3040 m (26 28 N, 100 05 E), CH- 05 - 116.

(35) *Evermiastrum nepalense* (Taylor) Hale ex Sipman

Thallus fruticose, procumbent, c. 5 cm broad; branches dispersed, isodiametric dichotomously branched, cilia along the margin, upturn downwards, tips acute; upper surface gray, smooth, shiny; lower surface pale brown to black, smooth, shiny, rhizines present, black, simple to simply branched. Pycnidia laminal, black, abundant. Apothecia rare, young, lecanorine type, less than 0.5 mm.

Mt. Cang, on trunk of Abies, 3 460 m (25 42 N, 100 06 E), CH- 05 - 040; on trunk of Pinus, 2 920 m (25 41 N, 100 06 E), CH- 05 - 062.

(36) *Flavopunctelia flaventior* (Stirt.) Hale

Thallus foliose, yellowish-green; lobes rounded, 4—8 mm across, sorediate at the margins and on the upper lobe surface; white pseudocyphellate; lower surface black, with a brown edge; rhizines black, very sparse. Usnic and lecanoric acids contained.

Jianchuan, on trunk of Quercus, 3 040 m (26 28 N, 100 05 E), CH- 05 - 110.

(37) *Gymnoderma* sp.

Thallus squamulose foliose, small, to 2.5 cm broad; lobes mostly erect, crowded, tips blunt; upper surface yellowish-brown, smooth, slightly shiny; soredia, isidia, and lobules absent; lower surface ecorticate, white. Apothecia and pycnidia not seen.

Mt. Jiao Zi, on rock, 3 940 m (26 04 N, 102 51 E), CH- 05 - 374.

(38) *Heterodermia boryi* (Fé) Hale *

Thallus subfiliform, loosely adnate; lobes discrete, subdichotomously branched, c. 0.5 mm wide, tips circinate, lateral sorediate, soredia forming round patches; upper surface pale yellowish brown, smooth, sometimes with soredia, also forming round patches; lower surface channelled, ecorticate, white, arachnoid; rhizines marginal, black, simple to squarrosely branched, above 5 mm long; medulla white. Pycnidia and apothecia not seen. Atranorin, zeorin, and other terpenes contained.

Mt. Cang, on trunk of Abies, 3 430 m (25 42 N, 100 06 E), CH- 05 - 028; on trunk of Pinus, 2 920 m (25 41 N, 100 06 E), CH- 05 - 081; Alyuan, on trunk of Pinus, 3320 m (26 01 N, 99 53 E), CH- 05 - 243; on trunk of Pinus, 2 950 m (25 59 N, 99 53 E), CH- 05 - 257; Mt. Bao, on trunk of Juniperus, 3 180 m (25 44 N, 99 03 E), CH- 05 - 270.

(39) *Heterodermia comosa* (Eschw.) Follman & Redón *

Thallus foliose, loosely attached to the substrate; lobes dispersed, tumefy, irregularly branched, tips

blunt, margins with abundant rhizines, concolor to thallus to pale brown, simple to squarrosely branched; upper surface pale, smooth, dull, with slight white spot; soredia, isidia, and lobules absent; lower surface ecorticate, white, naked. Apothecia abundant, lecanorine type, short stalked, thalline margin lobed, disc dark brown, densely white pruinose, 1—3 mm in diameter.

Mt. Laojun, on rock, 4020 m (26°37' N, 99°43' E), CH-05-176; Mt. Bao, on trunk of *Salix*, 2880 m (25°44' N, 99°04' E), CH-05-301.

(40) *Hypogymnia hengduanensis* J. C. Wei

Thallus foliose, 13—23 cm broad; lobes long, 1.0—2.5 mm wide, 5—20 mm long, abundantly branched, with black rim; upper surface brown, isidiate, isidia global to coralloid; lower surface black except tips brown, rugose, shiny, with holes, 0.2—1.5 mm diam.; medulla hollow, ceiling of medulla white to brown, floor dark to black. Apothecia and pycnidia not seen. Atranorin, diffractaic and barbatic acids contained.

Mt. Cang, on trunk of *Pinus*, 2920 m (25°41' N, 100°06' E), CH-05-100; Mt. Jiaozi, on trunk of *Taxus*, 3660 m (26°04' N, 102°50' E), CH-05-346.

(41) *Hypogymnia flavida* McCune & Obermayer*
= *Hypogymnia hypotrypella* (Asahina) Rassad.

Thallus foliose, to 20 cm broad; lobes inflated, 4—8 mm wide, 1.0—1.5 cm long; upper surface yellowish-green, smooth; soredia, isidia, and lobules absent; lower surface black, near tips brown, rugose, shiny, with big holes, to 2 mm in diam.; medulla hollow, ceiling and floor of medulla dark brown to black except tips white. Apothecia common, lecanorine type, jar-shaped stalk; disc brown to reddish-brown, 1.0—1.5 mm in diameter. Usnic, physodalic, protocetraric acids present, conphysodic acid occasionally present.

Mt. Cang, on trunk of *Abies*, 3390 m (25°42' N, 100°06' E), CH-05-023; on trunk of *Pinus*, 3490 m (25°41' N, 100°06' E), CH-05-057; Jianchuan, on trunk of *Quercus*, 3040 m (26°28' N, 100°05' E), CH-05-109; Mt. Laojun, on trunk of *Abies*, 3830 m (26°37' N, 99°43' E),

CH-05-140; Mt. Jiao Zi, on trunk of *Taxus*, 3780 m (26°04' N, 102°50' E), CH-05-357.

(42) *Hypogymnia subarticulata* (J. D. Zhao, L. W. Hsu & Z. M. Sun) J. C. Wei & Y. M. Jiang

Thallus foliose, 3—4 cm broad; lobes inflated, 1—2 mm wide, 5—6 mm long, tips with labriform; upper surface yellowish-brown, smooth; lower surface black, near tips brown, rugose, slightly shiny, with holes, 0.2—1.0 mm in diam.; medulla hollow, ceiling of medulla white, floor dark to black. Apothecia not seen. Atranorin, physodalic, physodic, and protocetraric acids contained.

Mt. Cang, on trunk of *Abies*, 3430 m (25°42' N, 100°06' E), CH-05-026; Jianchuan, on trunk of *Pinus*, 3040 m (26°28' N, 100°05' E), CH-05-113; Mt. Jiao Zi, on trunk of *Taxus*, 3660 m (26°04' N, 102°50' E), CH-05-341.

(43) *Hypogymnia taiwanalpina* M. J. Lai

Thallus foliose, 3—5 cm broad; lobes above 10 mm long, 1—2 mm wide; upper surface pale yellow, papillate, dull; soredia and isidia absent, lobules present; lower surface black, rugose, dull, with holes, 1.0—1.5 mm in diam.; medulla hollow, ceiling of medulla white, floor dark to black. Apothecia common, lecanorine type, short stalked; disc yellowish brown, over 10 mm in diameter. Pycnidia not seen. Atranorin, physodalic, physodic, and protocetraric acids present, conphysodic acid sometimes present.

Mt. Laojun, on trunk of *Abies*, 3830 m (26°37' N, 99°43' E), CH-05-141; on trunk of *Abies*, 3970 m (26°37' N, 99°43' E), CH-05-150.

(44) *Icmadophila ericetorum* (L.) Zahlbr.

Thallus crustose, pale green to blue green, continuous, fairly thick, smooth to granular, covered with small, spherical, often hollow warts. Apothecia abundant, 1.5—4.0 mm in diameter, biatorine, slightly raised on short stalks; discs flat to slightly convex, pink or pinkish orange. Thamnic and perlatolic acids.

Mt. Jiao Zi, on rotten trunk, 3900 m (25°05' N, 102°08' E), CH-05-403.

(45) *Lasallia daliensis* J. C. Wei

Thallus umbilicate foliose, attached with the substrate at central umbilicus; lobes intact, margins upturn and black tomentum; upper surface gray, dull, postulate; soredia, isidia, and lobules absent; lower surface brown to black, holes present, coarse, dull. Apothecia laminal, sessile, disc black, with gyrus, c. 2 mm in diameter.

Mt. Cang, on rock, 3 460 m (25°42' N, 100°06' E), CH - 05 - 034.

(46) *Lasallia sinorientalis* J. C. Wei *

Thallus umbilicate foliose, attached with the substrate at central umbilicus; lobes intact, margins upturn and black tomentum; upper surface gray, dull, postulate; soredia, isidia, and lobules absent; lower surface dark gray to black, holes present, coarse, dull. Apothecia and pycnidia not seen.

Mt. Cang, on rock, 3 490 m (25°42' N, 100°06' E), CH - 05 - 052.

(47) *Lethariella cladonioides* (Nyl.) Krog

Thallus fruticose, shrubby; branches loosely interleaved, dichotomously branched, orange-yellow, rugose, dull; isidia, soredia, and lobules absent. Apothecia and pycnidia not seen.

Mt. Laojun, on rock, 4 020 m (26°37' N, 99°43' E), CH - 05 - 166; on rock, 4 060 m (26°37' N, 99°43' E), CH - 05 - 183.

(48) *Lichenomphalia hudsoniana* (H. S. Jenn.)

Redhead, Lutzoni, Moncalvo & Vilgalys

Thallus squamulose foliose; squamules intact and dispersed, margins upturn, tips round; upper surface green, with white rim, plane, dull; lower surface ecorticate, white. Apothecia marginal, very small, sessile, lecanorine type, disc green, less than 1 mm.

Mt. Laojun, on soil, 3 960 m (26°37' N, 99°43' E), CH - 05 - 149; on rotten bark, 3 990 m (26°37' N, 99°43' E), CH - 05 - 160.

(49) *Lobaria discolor* (Bory) Hue *

Thallus coriaceous, loosely adnate centrally, free at the margins, 8—20 cm wide; lobes sublinear, 1.0—1.5 mm wide; upper surface grayish green to olive-brown; isidia, soredia, and phyllidia absent; lower surface pale tan, almost glabrous, sparsely tomentose and rhizinate only in the older central areas;

rhizines simple or squarrosely branched, brown to dark brown. Apothecia subpedicellate, 4—5 mm wide; Pycnidia immersed. Gyrophoric and lecanoric acids contained.

Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH - 05 - 284.

(50) *Lobaria isidiophora* Yoshim. *

Thallus adnate centrally, 10—15 cm wide; lobes sublinear, 4—10 mm wide; upper surface brown, dull, with conspicuous interconnecting ridges; isidia sparse to moderately dense, erect, cylindrical, mainly on ridges; lower surface pale brown with bullate glabrous areas separated by a network of dark brown tomentum, sparsely to densely rhizinate centrally, rhizines simple or squarrosely branched, dark brown; Apothecia rare on ridges of lobes, 3—5 mm wide; Pycnidia not seen. Gyrophoric, stictic, constictic, norstictic, and cryptostictic acids contained.

Mt. Laojun, on trunk of *Abies*, 4 050 m (26°37' N, 99°43' E), CH - 05 - 186; on trunk of *Abies*, 3 790 m (26°38' N, 99°44' E), CH - 05 - 226; Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH - 05 - 276.

(51) *Lobaria isidiosa* (M. Ü. Arg.) Vain. *

Thallus medium sized to large, 10—15 cm wide; lobes antler-like, isidiate on ridges; dorsal surface of thalli brown, reticulately ridged, densely isidiate on ridges; ventral surface light yellowish-orange, the grooves densely tomentose and rhizinate. Apothecia located on ridges of the dorsal surface of lobes, lecanorine type, disc brown, 2—4 mm wide; pycnidia immersed in thalli. Norstictic acid and triterpenoids contained.

Mt. Laojun, on trunk of *Abies*, 3 880 m (26°37' N, 99°43' E), CH - 05 - 198; Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH - 05 - 275; Mt. Jiao Zi, on trunk of *Taxus*, 3 780 m (26°04' N, 102°50' E), CH - 05 - 358.

(52) *Lobaria kurokawae* Yoshim. *

Thallus foliose, to 20 cm broad; dorsal surface reticulately ridged; ventral surface tomentose. Apothecia located marginally, absence of algae in the excipulum thallinum, disc 2—3 mm wide; pycnidia im-

mersed in thalli. Triterpenoids contained.

Mt. Laojun, on trunk of *Abies*, 3 830 m (26°37' N, 99°43' E), CH - 05 - 139; on moss, 3 970 m (26°37' N, 99°43' E), CH - 05 - 156; on moss, 4 020 m (26°37' N, 99°43' E), CH - 05 - 177; on trunk of *Abies*, 3 790 m (26°38' N, 99°44' E), CH - 05 - 220; Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH - 05 - 289.

(53) *Lobaria orientalis* (Asahina) Yoshim. *

Thallus large, 10—20 (—30) cm wide; dorsal surface olive-ochre, reticulately ridged; ventral surface pale brown, densely tomentose and rhizinate in the grooves, rhizines and tomenta brown. Inner cephalodia often present. Apothecia located on ridges of the dorsal surface of lobes, lecanorine type, disc reddish brown, 1—3 mm in diameter; pycnidia immersed along ridged portion of thalli. Gyrophoric and norstictic acids contained.

Mt. Bao, on trunk of *Salix*, 2 880 m (25°44' N, 99°04' E), CH - 05 - 295.

(54) *Lobaria retigera* (Bory) Trevis. *

Thallus medium sized to large, up to 25 cm wide; lobes reticulately ridged on dorsal surface, mostly isidiate in ridged portion, isidia cylindrical, often lobulate; ventral surface of thalli rhizinate and thickly tomentose at portions of swelling nude. Apothecia located mostly on ridges, sessile, disc brown, 2—4 mm in diameter; Pycnidia not seen. Triterpenoids and telephoric acid contained.

Mt. Cang, on soil, 3 460 m (25°42' N, 100°06' E), CH - 05 - 037; on trunk of *Pinus*, 2 920 m (25°41' N, 100°06' E), CH - 05 - 084; Mt. Laojun, on trunk of *Abies*, 3 970 m (26°37' N, 99°43' E), CH - 05 - 151; Mt. Bao, on soil, 2 660 m (25°45' N, 99°05' E), CH - 05 - 312; Mt. Jiao Zi, on trunk of *Taxus*, 3 660 m (26°04' N, 102°50' E), CH - 05 - 349.

(55) *Lobaria yunnanensis* Yoshim.

Thallus foliose, moderate, 10—15 cm wide; lobes reticulately ridged on dorsal surface, soredia and isidia absent; ventral surface rhizinate and tomentose. Cephalodia in thallus. Apothecia located mostly marginally, substipitate, disc 2—4 mm in diameter;

Pycnidia immersed in thallus. Triterpenoids contained.

Mt. Laojun, on trunk of *Salix*, 3 286 m (26°39' N, 99°46' E), CH - 05 - 231.

(56) *Menegazzia subsimilis* (H. Magn.) R. Sant.

Thallus foliose, nearly round, margins intact; lobes flush-like, irregularly branched, conglutinated; upper surface grayish-brown, with black rim, smooth, shiny, holes present, rising soralia present, sometimes holes present in the middle of soralia; lower surface black, obviously rugose. Apothecia and pycnidia not seen.

Mt. Cang, on soil, 3 460 m (25°42' N, 100°06' E), CH - 05 - 035.

(57) *Nephroma helveticum* Ach. *

Thallus 2—6 cm broad, loosely to closely attached, brown to dark reddish-brown; lobes 2—10 mm wide, lobulate; upper surface somewhat cracked, with laminal isidioid lobules; lower surface dark brown to black, tomentose, hairs short; medulla white. Apothecia marginal, to 1 cm wide, disc brown, exciple lobulate. Some unknown terpenes contained.

Mt. Cang, on trunk of *Rhododendron*, 3 460 m (25°42' N, 100°06' E), CH - 05 - 032.

(58) *Nephromopsis pallescens* (Schaer.) Y. S. Park *

Thallus 5—9 cm broad, partially adnate, yellowish olive-green; lobes 2—15 mm wide, with secondary lobes; upper surface not pseudocyphellate; lower surface wrinkled, creamy to light-brown; medulla white. Pycnidia present along secondary lobe margins, flat and fused. Apothecia only along margin, very small. Protolichestic and lichestic acids contained.

Mt. Cang, on trunk of *Pinus*, 2 920 m (25°41' N, 100°06' E), CH - 05 - 078; Alyuan, on trunk of *Pinus*, 3 320 m (26°01' N, 99°53' E), CH - 05 - 242; Mt. Bao, on trunk of *Salix* soil, 2 880 m (25°44' N, 99°04' E), CH - 05 - 296.

(59) *Nephromopsis stracheyi* (C. Bab.) M Üll. Arg.

Thallus about 7 cm broad, thick, somewhat wrinkled, adnate, olive-green; lobes 1 cm broad, entire, margins crenate; upper surface somewhat wrinkled, not pseudocyphellate; lower surface corticate, somewhat

wrinkled, papillate, pseudocyphellate, pores large, to 1 mm; rhizines short and simple; medulla white. Apothecia along margin, small. Pycnidia indistinct along margin. Caperatic acid contained.

Mt. Cang, on trunk of *Abies*, 3 490 m (25°42' N, 100°06' E), CH-05-058; Mt. Bao, on trunk of *Juniperus*, 3180 m (25°44' N, 99°03' E), CH-05-286.

(60) *Ophioparma lapponica* (Räsänen) Hafellner & R. W. Rogers

Thallus crustose, granular; upper surface grass-green, coarse, dull; lower surface ecorticate, white. Apothecia laminal, lecanorine type, disc reddish-brown, plane to protruding, to 2 mm in diameter.

Mt. Laojun, on rock, 4 020 m (26°37' N, 99°43' E), CH-05-165.

(61) *Oropogon orientalis* (Gyeln.) Essl.

Thallus fruticose, filiform, to 7 cm broad; branches loosely interleaved to dispersed, dichotomously branched, small branches present at margins, tips acute, pale to brown, smooth, shiny. Apothecia and pycnidia not seen.

Mt. Laojun, on trunk of *Abies*, 3 830 m (26°37' N, 99°43' E), CH-05-144.

(62) *Parmeliella stylophora* (Vain.) P. M. Jørg

Thallus squamulose foliose, closely adnate to the substrate; squamules small, crowded, some deformed to globose, margins of lobe tips white pruinose; upper surface yellowish-brown, smooth, dull; soredia and isidia absent, lobules present, almost globose; lower surface densely tomentose, black. Apothecia abundant, lecanorine type, excipulum thallinum with small cracks, white pruinose between cracks, disc slightly protruding, yellowish-brown, c. 2 mm in diameter.

Mt. Laojun, on trunk of *Salix*, 3 830 m (26°37' N, 99°43' E), CH-05-144.

(63) *Peltigera canina* (L.) Willd. *

Thallus brown or brownish gray, with a fuzzy tomentum on the upper surface, especially close to lobe margins; lower surface white, or brownish toward the center; veins conspicuous, flat to rounded and raised, mostly white; rhizines tufted and fibrous or brushlike, sometimes running together. No lichen substances de-

tected.

Mt. Cang, on soil, 2 850 m (25°42' N, 100°06' E), CH-05-002.

(64) *Platismatia erosa* W. L. Culb. & C. F. Culb.

Thallus foliose, large, c. 6 cm broad; lobes 0.5 - 1.5 cm wide, margins upturned and with soredia; upper surface pale olive-green, rugose, veined, dull; lower surface near tips dark brown, others sides black, smooth, shiny, pseudocyphellate, pores slightly protruding, white. Apothecia and pycnidia not seen.

Mt. Cang, on trunk of *Abies*, 3 460 m (25°42' N, 100°06' E), CH-05-045; Mt. Jiao Zi, on trunk of *Taxus*, 3 640 m (26°04' N, 102°50' E), CH-05-331; on trunk of *Taxus*, 3 810 m (26°04' N, 102°50' E), CH-05-386.

(65) *Pleopsidium chlorophanum* (Wahlenb.) Zopf

Thallus crustose, closely adnate to the substrate, granular to slightly foliose, lobes parallel; upper surface yellow, smooth, dull; soredia, isidia, and lobules absent; lower surface ecorticate, white. Apothecia and pycnidia not seen.

Mt. Jiaozhi, on rock, 3 830 m (26°05' N, 102°50' E), CH-05-383.

(66) *Psora decipiens* (Hedw.) Hoffm.

Squamules bright, brick-red to orange brown, sometimes pinkish, usually at least partially pruinose on the upper surface and margins, 1 - 6 mm in diameter. Apothecia hemispherical, black, 0.7 - 2.0 mm in diameter, along the margins of some squamules. No lichen substances detected.

Jianchuan, on rock (lime stone), 3 040 m (26°28' N, 100°05' E), CH-05-107.

(67) *Pyxine sorediata* (Ach.) Mont. *

Thallus 2 - 6 cm broad, thick, closely appressed, margins ascending, whitish to greenish-gray; lobes 1.0 - 1.5 mm wide; upper surface shiny, pruinose at tips, pseudocyphellate, sorediate laterally and marginally, soredia granular; lower surface black, shiny; rhizines moderate to dense, black, simple to somewhat fasciculate; medulla deep-yellow. Apothecia not seen. Atranorin and terpenes contained.

Alyuan, on trunk of *Pinus*, 3 320 m (26°01' N,

99 53 E), CH - 05 - 251.

(68) *Ramalina conduplicans* Vain. *

Thallus fruticose, shrubby, attached to the substrate with central part; branches band-like, rugose, dull, perforated in main stems, margins pseudocyphellate and with lobules, lobules branched, elongate, tips acute; soredia and isidia absent. Apothecia abundant, lecanorine type, short stalked, disc densely pruinose, c. 1 mm in diameter.

Mt. Cang, on trunk of *Abies*, 3 460 m (25 42 N, 100 06 E), CH - 05 - 038; Jianchuan, on trunk of *Quercus*, 3 040 m (26°28 N, 100 05 E), CH - 05 - 120; Alyuan, on trunk of *Pinus*, 3 320 m (26 01 N, 99 53 E), CH - 05 - 247; Mt. Jiao Zi, on trunk of *Populus*, 2 560 m (25 40 N, 102 51 E), CH - 05 - 390.

(69) *Ramalina inflata* subsp. *australis* G. N. Stevens

Thallus fruticose, shrubby, attached to the substrate with central part; branches band-like, rugose, dull; soredia and isidia absent, lobules present, branched, elongate, tips acute; Apothecia and pycnidia not seen.

Mt. Cang, on trunk of *Pinus*, 3 250 m (25 42 N, 100 06 E), CH - 05 - 006; on trunk of *Pinus*, 2 920 m (25 41 N, 100 06 E), CH - 05 - 064, CH - 05 - 088.

(70) *Ramalina roesleri* (Hochst. ex Schaer.) Hue *

Thallus small, shrubby, 1—4 cm long, with delicate, perforated main stems, 0.1—1.0 (—2.0) mm wide; lobe tips almost round in cross section, much branched, curled and disintegrating into granules and coarse soredia. Apothecia absent. Sekikaic acid complex contained.

Jianchuan, on trunk of *Quercus*, 3 040 m (26 28 N, 100 05 E), CH - 05 - 118; Mt. Laojun, on trunk of *Abies*, 3 820 m (26 38 N, 99 44 E), CH - 05 - 205.

(71) *Ramalina sinensis* Jatta *

Thallus fruticose, tufted, olive- to brownish-green; lobes very flattened and broad, 2—4 cm long, 7—10 mm wide, irregularly branched; upper surface

strongly striate, perforate; pseudocyphellate, pores elongated along ridges; medulla white. Apothecia common, terminal, occasionally lateral, to 10 mm wide, disc light brown, perforate. Usnic acid present, salazinic and norstictic (or variolaric) acids rarely present.

Mt. Cang, on trunk of *Pinus*, 2 920 m (25 41 N, 100 06 E), CH - 05 - 061; Jianchuan, on trunk of *Quercus*, 3 080 m (26 31 N, 100 02 E), CH - 05 - 130; Alyuan, on trunk of *Pinus*, 2 850 m (26 00 N, 99 53 E), CH - 05 - 253.

(72) *Squamarina* sp.

Thallus foliose, small; lobes peltate, rigid, crowded; upper surface dirty green to pale brown, plane, dull, pruinose; soredia, isidia, and lobules absent; lower surface black, rugose, dull. Apothecia and pycnidia not seen.

Mt. Jiaozi, on rock, 3 590 m (26°04 N, 102 50 E), CH - 05 - 324; on rock, 3 640 m (26 04 N, 102 50 E), CH - 05 - 338.

(73) *Sticta nylanderiana* Zahlbr. *

Thallus 7—15 cm broad, loosely attached, thick, light greenish- to dull-brown; lobes 0.7—2.0 cm wide, irregularly branched, margins continuous; upper surface shiny, plane; lower surface dark-brown with tan or yellowish-brown marginal zone, shiny, fragile, cyphellate, pores rather irregular in size, laminal, abundant, tomentose, hairs rather dense, short, dark brown; medulla white. Pycnidia common, protruding, with distinct ostioles. Apothecia not seen. Atranorin, gyrophoric and 4-O-methylgyrophoric acids contained.

Mt. Laojun, on trunk of *Rhododendron*, 3 880 m (26 37 N, 99 43 E), CH - 05 - 200; Mt. Bao, on trunk of *Juniperus*, 3 180 m (25 44 N, 99 03 E), CH - 05 - 277.

(74) *Sticta platyphylloides* Nyl.

Thallus foliose, large, c. 10 cm broad, loosely attached; lobes 0.6—2.0 cm wide, irregularly branched, margins continuous; upper surface plane to slightly rugose; lower surface pale to brown, tomentose, and with rhizines, rhizines concolor with lower surface, cyphellate, pores rather irregular in size. Apothecia near marginal, lecanorine type, short-

stalked, disc yellowish-brown, to 5 mm in diameter.

Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH-05-283.

(75) *Sulcaria sulcata* (L. ex Fr.) Bystrek ex Brodo & D. Hawksw. *

Thallus fruticose, erect to pendent, subdichotomously to irregularly branched, branches to 2 mm thick; cortex smooth, pseudocyphellate longitudinally, forming linear furrows, soredia and isidia absent; medulla white; Apothecia lateral, to 5 mm wide, exciple spinulate, disc reddish-brown, pruinose. Atranorin and psoromic acid contained.

Mt. Cang, on trunk of *Pinus*, 2 920 m (25°41' N, 100°06' E), CH-05-082; Jianchuan, on trunk of *Quercus*, 3 080 m (26°31' N, 100°02' E), CH-05-127; Mt. Laojun, on trunk of *Abies*, 3 900 m (26°38' N, 99°44' E), CH-05-202; on trunk of *Rhododendron*, 3 500 m (26°38' N, 99°46' E), CH-05-227; Mt. Bao, on trunk of *Juniperus*, 3 180 m (25°44' N, 99°03' E), CH-05-288.

(76) *Sulcaria virens* (Taylor) Bystrek ex Brodo & D. Hawksw.

Thallus fruticose, pendent, to 15 cm long, subdichotomously to irregularly branched; cortex smooth, yellow, forming linear furrows, soredia and isidia absent; medulla white; branch tips black. Apothecia and pycnidia not seen.

Mt. Laojun, on trunk of *Abies*, 3 470 m (26°37' N, 99°43' E), CH-05-138; on trunk of *Rhododendron*, 3 830 m (26°37' N, 99°43' E), CH-05-142.

(77) *Thamnia vermicularis* subsp. *vermicularis* (Sw.) Ach. ex Schaer.

Thallus fruticose, with prostrate or erect, ivory-white, hollow stalks, unbranched or with few branches, 2—7 cm long, 1.0—2.5 mm in diameter; soredia, isidia, and fruiting bodies absent. Thamnic acid present, or baemycesic and squamatic acids present.

Mt. Cang, on moss, 3 840 m (25°41' N, 100°06' E), CH-05-051; Mt. Laojun, on moss (rock), 4 020 m (26°37' N, 99°43' E), CH-05-172.

(78) *Tuckermannopsis gilva* (Asahina) M. J. Lai

Thallus foliose; lobes wide, margins obviously upturn, with soredia and black isidia; upper surface pale green, plane, dull, with slightly white spot; lower surface pale to white, rugose, dull, pseudocyphellate. Apothecia and pycnidia not seen.

Mt. Jiaozi, on trunk, 2 160 m (25°19' N, 102°44' E), CH-05-400.

(79) *Tuckneraria ahtii* Randlane & Saag

Thallus foliose, attached to the substrate with central part, to 5 cm broad; lobes wide, to 1.5 cm long, c. 5 mm wide, discrete, margins upturned, black cilia, isidia, and white soredia along the margin of lobes; upper surface pale olive-green to olive-yellow, rugose, dull, isidia and cuff-shaped soralia laminar; lower surface white to pale brown, pseudocyphellate. Apothecia and pycnidia not seen.

Jianchuan, on trunk of *Pinus*, 3 040 m (26°28' N, 100°05' E), CH-05-115; Mt. Laojun, on trunk of *Abies*, 3 940 m (26°37' N, 99°43' E), CH-05-145; Mt. Jiaozi, on trunk of *Taxus*, 3 780 m (26°04' N, 102°50' E), CH-05-357.

(80) *Tuckneraria pseudocomplicata* (Asahina) Randlane & Saag *

Thallus foliose, closely adnate to the substrate, large, to 7 cm broad; lobes dispersed, flat, margins slightly upturn, with black cilia, tips blunt; upper surface grayish-green to brown, rugose, dull; isidia and soredia absent, lobules present; lower surface brown, smooth, shiny. Apothecia and pycnidia not seen.

Mt. Laojun, on trunk of *Abies*, 3 970 m (26°37' N, 99°43' E), CH-05-155; Mt. Jiaozi, on trunk of *Taxus*, 3 750 m (26°04' N, 102°50' E), CH-05-353.

(81) *Umbilicaria indica* Frey

Thallus umbilicate foliose, large, to 5 cm broad, attached to substrate at central umbilicus; lobes plane to rugose, brown, dull; lower surface densely tomentose, tomentum black. Apothecia abundant, laminar, black, disc with homocentric loop, 1—2 mm in diameter, exciple with black tomentum.

Mt. Cang, on rock, 3 460 m (25°41' N,

100 06 E), CH - 05 - 044; Mt. Jiaozi, on rock, 3 590 m (26 04 N, 102 50 E), CH - 05 - 325; on rock, 4 040 m (26 05 N, 102 51 E), CH - 05 - 381.

(82) *Umbilicaria* sp.

Thallus umbilicate foliose, large, to 6 cm broad, attached to substrate at central umbilicus; lobes plane to rugose, central part with radicalized wrinkle, gray, dull; variable lobules laminal, erect; lower surface central part around the umbilicate black, other sites gray, naked, smooth. Apothecia laminal, black, disc with homocentric loop, c. 1 mm in diameter.

Mt. Laojun, on rock, 4 020 m (26 037 N, 99 43 E), CH - 05 - 164, CH - 05 - 174.

(83) *Umbilicaria squamosa* J. C. Wei & Y. M. Jiang

Thallus umbilicate foliose, small to moderate, 1.0—2.5 cm broad, attached to substrate at central umbilicus, composed of many small lobes; lobes crowded; upper surface rough, dull, pale brown; soredia, isidia absent, lobules present, laminal, erect; lower surface black, tomentose, black. Apothecia laminal, black, disc with homocentric loop, less than 1 mm in diameter.

Mt. Jiaozi, on rock, 3 990 m (26 04 N, 102 51 E), CH - 05 - 377.

(84) *Umbilicaria thamnodes* Hue

Thallus umbilicate foliose, small to moderate, 1—3 cm broad, attached to substrate at central umbilicus, composed of many squamulose lobes; squamules crowded, slightly erect; upper surface rough, dull, black; soredia, isidia, and lobules absent; lower surface black, densely tomentose, black. Apothecia laminal, black, disc with homocentric loop, c. 1 mm in diameter.

Mt. Cang, on rock, 3 460 m (25 41 N, 100 06 E), CH - 05 - 033; Mt. Laojun, on rock, 4 020 m (26 37 N, 99 43 E), CH - 05 - 163; on rock, 3 810 m (26 38 N, 99 44 E), CH - 05 - 215.

(85) *Umbilicaria yunnana* (Nyl.) Hue

Thallus umbilicate foliose, c. 3.5 cm broad, intact, only un conspicuous lobed at margins, flat; upper surface slightly rough, dull, gray to pale brown, dull;

soredia, isidia and lobules absent; lower surface black, densely tomentose, black. Apothecia laminal, black, immersed, labriform, less than 1 mm in diameter.

Mt. Cang, on trunk of *Pinus*, 3 250 m (25 42 N, 100 06 E), CH - 05 - 004; on trunk of *Pinus*, 2 920 m (25 41 N, 100 06 E), CH - 05 - 097; Alyuan, on trunk of *Pinus*, 3 310 m (26 01 N, 99 53 E), CH - 05 - 250; Mt. Bao, on rock, 2 880 m (25 44 N, 99 04 E), CH - 05 - 303.

(86) *Usnea longissima* Ach. *

Thallus pendent, extremely long (up to 3 m), consisting of slender, almost undivided main branches with many perpendicular side branches and fibrils of about equal length, round to angular in section, often with circular cracks; cortex smooth, but disintegrating on the main stems, leaving rough patches of white medulla over the pinkish to brown central cord; soralia or isidia occasionally form on the side branches. Evernic, barbatic, and diffractaic acids contained.

Jianchuan, on trunk of *Pinus*, 3 080 m (26 31 N, 100 02 E), CH - 05 - 132; Mt. Laojun, on trunk of *Abies*, 3 960 m (26 37 N, 99 43 E), CH - 05 - 148; on trunk of *Soburs*, 3 970 m (26 37 N, 99 43 E), CH - 05 - 154.

This is the first floristic report on lichen flora in the visited areas. 86 species in 46 genera were identified among the 403 specimens collected. Among them, 40 species have also been reported in Korean peninsula^[8] and 59 species were newly added to the collection of the first KOLRI lichenological expedition in Yunnan in 2004^[9]. More than 800 lichen specimens of 115 species have been collected from northwestern Yunnan, China and deposited at KOLRI so far. Screening of their biological activity is still under progress. Some lichen species exhibited very strong biological activity such as antimicrobial, immuno-modulating, antioxidant and cytotoxic activity. Isolation of lichen-forming fungi from the ascospore or thalli of these lichen specimens is also under going to obtain cultural bioresource in large scale for commercialization of lichen substances.

Note: “*” represents the lichen species reported in Korean peninsula as well.

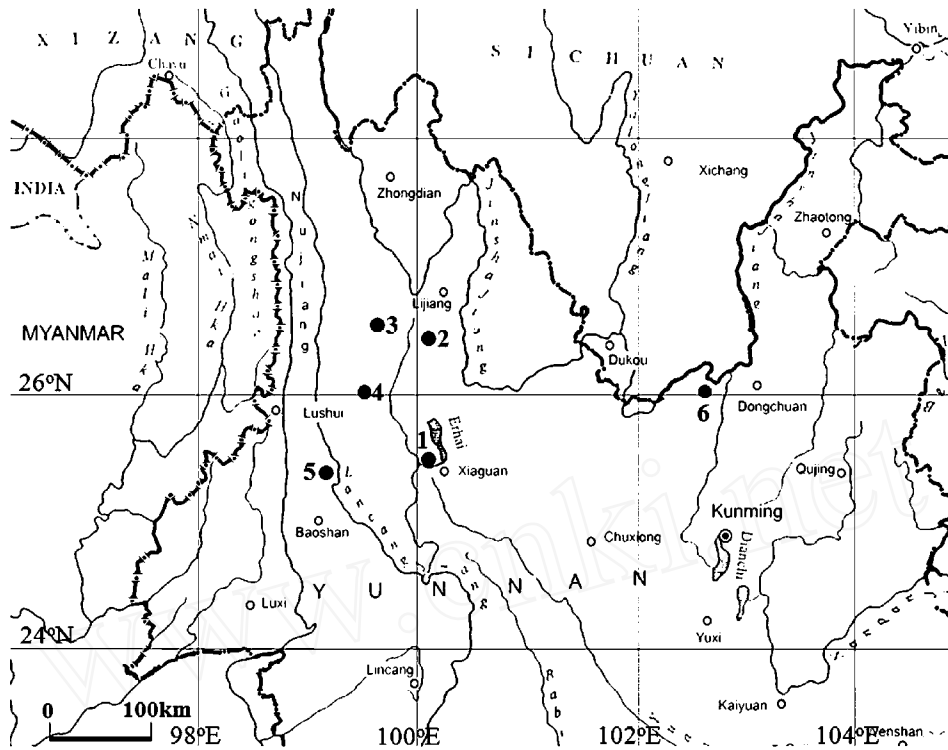


Fig. 1. The study areas and collecting localities

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