Cetrarioid lichen genera and species in NE China

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Twenty-five species in ten cetrarioid lichen genera belonging to the family Parmeliaceae are reported for the lichen flora of NE China. Keys to the genera and species as well as short descriptions are given. Cetraria japonica, Tuckermannopsis americana and T. ulophylloides are reported as new to China. Seven additional species are new to NE China. Nephromopsis endocrocea is excluded from the lichen flora of China.

Key words: Asia, biodiversity, floristics, lichenized Ascomycetes

Professor Ming-Jou Lai, the first author of the present article, sadly passed away soon after submitting the manuscript to Annales Botanici Fennici. From the hospital in Taipei in April 2007 he wrote to the author TA, under whom Lai prepared his Ph.D. thesis, asking him to complete editing of his manuscript. Now it has been done, although regrettably with some delay.

The first reports of the cetrarioid lichens in Parmeliaceae from NE China were made by Asahina (1952) and Sato (1952). Five species were known by that time: Cetraria crispa var. japonica, C. cucullata, C. delisei, C. nivalis and C. chrysantha. X. L. Chen et al. (1981) listed nine cetrarioid species among the 195 species for the lichen flora of NE China. C. B. Chen (1986) reported five species of the genus Cetraria for the present area, viz., C. braunsiana, C. cetrarioides, C. chicitae, C. olivetorum and C. pseudolivetorum. Wei (1991) recognized 22 species of cetrarioid lichens for NE China.

Geographically NE China comprises the eastern part of Neimenggu (Inner Mongolia) Autonomous Region, Liaoning, Jilin and Heilongjiang Provinces. The whole broad area is connected to Siberia and northern Eurasia in the north, adjacent to Russian Far East and North America in the east, neighbouring Korea and North China in the south, and also linked to Mongolian steppe in the west.

Located in the northern temperate climatic zone, the present area is predominantly temperate in its floristic features, with 88.5% of seed plants, 89.1% ferns, and over 90% bryophytes are fundamentally temperate species (Fu et al. 1995, Zhou & Zu 1997). Floristically, NE China is located in a transitional region where the floras of the Changbai Floristic Region, the Northern China Floristic Region, the Daxinganling Floristic Region and the Mongolia Steppe Floristic Region intermix.
The present study is based on ca. 500 specimens of cetrarioid lichens kept at the herbarium of the Institute of Applied Ecology (formerly the Institute of Forestry and Pedology, IFP), Chinese Academy of Sciences, Shenyang. The lichen collections were extensively made by the second author and his colleagues from various localities in NE China during the past fifty years. Some collections deposited in Botanical Museum, University of Helsinki, Finland (H) were added by T. Ahti. Ming-Jou Lai was invited as a visiting scholar to Shenyang in the summer of 2002 by Academia Sinica and was offered the opportunity to study the lichen collections in the nice herbarium facilities with all kinds of assistance during his stay.

We are using the present-day taxonomy of the cetrarioid lichens primarily based on morphological and chemical characters. However, recent phylogenetic studies of cetrarioid lichens with molecular methods have shown that some of the genera appear to be non-monophyletic and some species need nomenclatural recombinations (Thell et al. 2002, 2004, 2005, 2008). The taxonomic changes will be published in the near future. Most changes are not expected to concern the species-level taxonomy. Lai et al. (2007) also made some new proposals, e.g. describing the new genus Usnocetraria, but unfortunately many new combinations were published invalidly.

Key to the cetrarioid genera in NE China

1. Upper cortex contains usnic acid ................................. 2
2. Medulla bright yellow (contains pinastric and vulpinic acids) .................................................. Valpicida
3. Lobes usually narrow, 2–8(10) mm wide, elongate. Pseudocyphellae indistinct on the lower surface, or completely lacking. Pycnoconidia bifusiform (5–6 × 1 µm). Mainly terricolous .......................... Flavocetraria
4. Usnic acid and atranorin present in the upper cortex. Pseudocyphellae present on the ridges of upper surface; lower surface without rhizines. Terricolous ... Asahinea

5. Pseudocyphellae present on both surfaces; medulla Pd+ red (contain fumarprotoprotocetraric and protocetraric acids) ................................................................. Cetrellopsis
6. Lobe margins ciliate; ascospores globose (7–10 µm in diameter) to subglobose (6–8 × 5–7 µm); thallus margins sorediate ................................. Tuckneraria
7. Thallus erect, fruticose; lobes distinctly canaliculate, dorsiventral; lower surface without rhizines. Terricolous ................................................................. 8
8. Ascii normally widely clavate; pycnoconidia oblong-ellipticform ............................................ Cetraria
9. Upper surface pale to dark brown, with or without scattered pseudocyphellae; lobe margins ciliate or eciliate ........................ Tuckernanopsis

7. Thallus adnate, wide or narrow, foliose; lobes not canaliculate; lower surface normally with rhizines. Mainly corticolous ......................................................... 9
8. Asci normally widely clavate; pycnoconidia sublageniform ................................................. Cetrariella
9. Upper surface ashy white or tan, distinctly pseudocyphellate; lobe margins eciliate ................ Cetrelia

Asahinea W.L. Culb. & C.F. Culb.


Thallus foliose, large, loosely attached to the substrate; lobes thin, wrinkled, with or without pseudocyphellae; lower surface black, shiny, rhizines lacking. Apothecia rare, marginal to laminal, imperforate; ascospores ellipsoid. Pycnidia laminal; pycnoconidia bifusiform. Key references: Culberson and Culberson (1965), Trass et al. (1985), Randlane and Saag (1989), Gao (1991).

Asahinea chrysantha (Tuck.) W.L. Culb. & C.F. Culb.


Thallus yellow to pale greyish brown, lobes rounded, broad, 10–30 mm wide, usually with a network of ridges and depressions on the upper surface; pseudocyphellae located mainly on the ridges; soredia and isidia lacking; rhizines
entirely lacking. Apothecia not found. Pycnidia laminal, emergent, in scattered black patches; pycnoconidia bifusiform, 3–5 × 1–1.5 µm.

CHEMISTRY: usnic acid (±) and atranorin contained in the cortex; alectoronic acid in the medulla; medulla Pd−, K−, KC+ red, C−.

Pycnoconidia of *Asahinea* were described by Thell (1995) as bacillariform, but indicated with a question mark. We have examined a number of specimens of *A. chrysantha* and found that they are clearly bifusiform (Daxinganling, Zhao 1101).

**Distribution:** China (Heilongjiang, Jilin, Neimenggu, Taiwan), Mongolia, Korea, Japan, Russia, Scandinavia, North America. This species was reported from Daxinganling, Neimenggu by Sato (1952). We have found it also in Heilongjiang and Jilin.

**Specimens examined.** *Neimenggu:* Daxinganling, Eergunazuoqi, Aokeludishan, alt. 1530 m, Zhao C. F. 2967;Alongshan, alt. 1460 m, Wang Z. 1925. **Heilongjiang:** Daxinganling, Huzhong District, Dabaishan, alt. 1100–1400 m, Zhao C. F. 1101, 1125-4; Ding T. Y. 8502, 8506: Nan Y. H. 97825. **Jilin:** Antu, Changbaishan south slope, Xie Z. X. 5985.

**Cetraria Ach.**

Meth. Lich. 292. 1803.

Thallus fruticose, subfruticose or erect foliose, yellowish to reddish brown or olive-brown; lobes ± canaliculate, flattened or cylindrical, normally with conspicuous, marginal or laminal pseudocyphellae on the lower surface; margins with branched or unbranched cilia. Apothecia lecanorine, marginal or subterminal; ascospores ellipsoid. Pycnidia black, located in conspicuous marginal projections; pycnoconidia usually oblong-citriform. All species contain fatty acids, and many have fumarprotocetraric acid as well.

Anatomy of the thallus with 2-layered cortex and asci with small axial body and a distinctive amyloid ring structure are the most important characters of these 16 brown species group (including also four species that were transferred from the formerly recognized genus *Coelocaulon*). Key references: Kärnefelt (1979, 1986), Kärnefelt *et al.* (1993).

**Key to the species**

1. Thallus foliose, lobes narrow, ± concave; Pd+ yellow ...
   ................................................................. *C. hepatizon*

1. Thallus fruticose, branches cylindrical; Pd+ red ........
   ................................................................. *C. laevigata*

**Cetraria hepatizon** (Ach.) Vain.


Thallus foliose, up to 20 cm in diameter, loosely adnate; lobes 1–2 mm wide, ± concave; upper surface greenish brown to black, glossy; lower surface black, ± pale near the margins; soredia and isidia lacking; pseudocyphellae occur on the upper surface, marginal and laminal. Apothecia marginal or submarginal; ascospores ellipsoid. Pycnidia marginal or laminal, pycnoconidia bifusiform.

CHEMISTRY: norstictic and stictic acids; medulla K+ yellow, C−, KC−, Pd+ yellow.

This species has been transferred to *Tuckermannopsis* (Kurokawa 1991) and *Melanelia* (Thell 1995), but the generic status is still disputed (Blanco *et al.* 2004). In size and colour of thalli, species of *Tuckermannopsis* resemble *Melanelia*, but species of *Melanelia* are normally more closely appressed, have laminal apothecia, often have conspicuous pseudocyphellae, ascospores are ellipsoid and pycnoconidia are bifusiform, upper cortex thick, paraplectenchymatous.

**Distribution:** Widely distributed in arctic-alpine regions. First reported by Sato (1939) from Heilongjiang. The records of *C. islandica* and *C. ericetorum* from Jilin (Chen *et al.* 1981) must also belong here. However, the similar *C. islandica* subsp. *orientalis* may also occur in the area, because it is known from Korea (Kärnefelt 1959).

**Specimens examined.** *Heilongjiang:* Daxinganling, Huzhong District, Dabaishan north slope, Zhao C. F. 1274; Dahailin, Laotudingzishan, Zhang G. C. & Gao Q. 9159. **Jilin:** Antu, Changbaishan north slope, Wenquan, East mountain, Chen X. L. 4702.
**Cetraria laevigata** Rass.


Lobes of thallus narrow, 1–3 mm wide, upper surface smooth, shiny; pseudocyphellae marginal, forming a distinct continuous line along the lobe margins from lobe tip to base, rather broad, white, scattered laminal pseudocyphellae very few. Apothecia marginal or submarginal; ascospores ellipsoid. Pycnidia on marginal projections, pycnoconidia oblong.

**CHEMISTRY:** fumarprotocetraric acid, lichesterinic-protolichesterinic type fatty acids. Medulla Pd+ red, K–, KC–, C–. Sometimes Pd– individuals may be found.

**DISTRIBUTION:** An arctic-alpine and boreal species, NE, SW China, Taiwan, Japan, Korea, North America, Siberia, Kamchatka, Sakhalin, NW India, Nepal. First reported by Sato (1939, as *C. crispa* var. *japonica*) from Heilongjiang. The records of *C. islandica* and *C. ericetorum* from Jilin (Chen *et al.* 1981) must also belong here. However, the similar *C. islandica* subsp. *orientalis* is expected to reach the area, because it is known from the neighbouring areas of Korea (Kärnefelt 1979).

**SPECIMENS EXAMINED. Neimenggu:** Daxinganling, Ganhe, Liu S. E. 8880; Yingjilishan, alt. 1480 m, Wang Z. 1937; Mangue, alt. 900 m, Chen X. L. 3144, 3146-4; Eergunzuauqi, Aluguya, Ewenke Country, alt. 700 m, Zhao C. F. 3038; Mangui, alt. 860 m, Zhao C. F. 3065, 311; Xiguituqi, Tulhe, alt. 750 m, Zhao C. F. 3161; Aokeliduishan, alt. 1530 m, Zhao C. F. 2942, 2975; Aoluguya Country, alt. 800 m, Gao D. E. 0117; Gulan, Wei 3263 (Lich. Sin. Exs., fasc. 1: 23.).

**Heilongjiang:** Daxinganling, Huzhong District, Xiongguan forest station, Chen X. L. 7470; Dabaishan north slope, alt. 1200–1400 m, Zhao C. F. 1115, 1116, 1117; Huyuan forest station, alt. 1400 m, Ding T. Y. 8512; Nan Y. H. 97825; Xiaoxinganling, Hongsing, Tang Hong Ling, Ding T. Y. 820038; Mudanjiang, north gully of Laoyeling, alt. 500 m, Gao C. et al. 1043-1; Shangzhi County, Daguokuishan, Li Q. T. 101. **Jilin:** Antu, Changbaishan, from the way from Tizihe to Motianyu, alt. 2500 m, Liu S. E. 1549; 7.5 km from Wenquan, alt. 1200 m, Liu S. E. 4064, 5097, 4219; Fusong, Neidaoli to Wenquan, alt. 1700 m, Wang S. G. & Li S. X. 437; Hengshan forest station, along the Yalujiang, alt. 1800 m, Chen X. L. 2068, 2070, 2080, 2081, 2102; Changbaishan south slope, alt. 2100 m, Chen X. L. 2249, 2250; Changbaishan north slope, Bingchang, East mountain, alt. 2200 m, *Chen X. L. 4680, 4713, 4721-4*; Changbaishan north slope, Xiaotianchi, alt. 1750 m, *Chen X. L. 4925*; Changbaishan, Wenquan, roadside, alt. 1700 m, *Hou J. L. 78157, 78267; 78294-2, 78300, 78302, 78329*; Xiaotianchi, alt. 1750 m, *Hou J. L. 78348, 78349*; Changbaishan, tundra, alt. 2100 m, *Zhao C. F. 21, 200, 3549, 4182*; Changbaishan north slope, 2 km to Baishan station, alt. 1190 m, *Zhao C. F. 0426*; below waterfall, the bridge, *Zhao C. F. 3508*; Tianshi, meteorological station, alt. 2620 m, *Zhao C. F. 3328*; Wenquan, alt. 1800 m, *Zhao C. F. 3347, 3385*; Changbaishan, crater rim of Tianshi, tundra, alt. 2150 m, *Zhao C. F. 3457-1, 3468, 3481*; Xiaotianchi, alt. 1800 m, *Zhao C. F. 3591-1, 3631, 3680-1*; Changbaishan, *Betula ermannii* forest, *Cao T. 90-61*; *Huang R. H. 90-61*; Changbaishan, alt. 2000 m, *Zhao S. D. 006*; Changbaishan, tundra, alt. 2000 m, *Qian H. 3-10*; Changbaishan, valley of river Erdo Baihu, alt. 1900 m, *Koponen T. 36816 (H), alt. 2200 m, Koponen T. 36667b, 36671 (H).*

**Cetrariella Kärnefelt & A. Thell**


Thallus erect-foliose, dark to pale brown; lobes ± canaliculated or almost subtubular, sometimes becoming expanded toward apical portions, pseudocyphellae marginal or laminal on the lower surface; cortex paraplectenchymatous, composed of 1–3 layers of pachydermatous and rather large cells. Apothecia terminal on lobe tips; asci broadly clavate; ascospores ellipsoidoidal. Pycnidia developed on tips of marginal projections; pycnoconidia sublageniform. Key references: Kärnefelt (1979), Kärnefelt *et al.* (1993).

**Cetrariella delisei** (Bory *ex* Schaer.)

Kärnefelt & A. Thell


Thallus lobes 1–5 mm wide, pale yellowish brown, mottled with darker brown, tips branched and dissected, ± concave, not strongly curled, with few marginal projections; pseudocyphellae laminal and marginal. Apothecia marginal, at lobe ends; ascospores ellipsoidial. Pycnidia at ends of marginal projections, pycnoconidia sublageniform.


**Cetrelia W.L. Culb. & C.F. Culb.**


Thallus foliose, broad-lobed; upper surface greenish grey or ashy white, often uniformly brown or tan in old herbarium specimens, pseudocyphellate, often sorediate or isidiate, lobe margins lack cilia; lower surface black, punctate in some species, rhizines sparse; upper cortex prosoplectenchymatous; medulla white. Apothecia lecanorine, submarginal, usually perforate; ascospores ellipsoid. Pycnidial marginal; pycnocnidia rod-shaped. Key references: Culberson and Culberson (1968), Chen (1986), Randlane and Saag (1991a), Lai (2001), Obermayer and Mayrhofer (2007).

### Key to the species

1. Thallus sorediate or isidiate ........................................... 2
2. Thallus neither sorediate nor isidiate ........................... 6
3. Medulla C+ pink or pinkish orange, contain olivetoric acid ................................. *C. olivetorum*
4. Medulla C–, olivetoric acid lacking .............................. 4
5. Medulla KC–, contain imbricaric acid .......................... 8
6. Medulla KC–, contain imbricaric acid .......................... 9

#### Chemistry

medulla contain gyrophoric acid; medulla Pd–, K–, KC+ red, C+ pink.

#### Distribution

Widespread in temperate and arctic regions of the northern hemisphere, and in cold temperate regions in the southern hemisphere. First reported by Sato (1952) from Neimenggu.

**Specimen examined.** Neimenggu: Mangui, Morgan, alt. 800 m, *Wei J. C.* 3370 (Lich. Sinic. Exs., no. 22).

**Cetrelia braunsiana** (Müll. Arg.) W.L. Culb. & C.F. Culb.


Thallus large, 15–25 cm broad; lobes 0.5–1.8 cm. wide, the margins ± ascending; upper surface grey or ashy-white, isidiate, isidia often coralloid, the tips pruinose, pseudocyphellae small, irregular to punctiform; lower surface black, the margins brown or greyish, not punctate, rhizines black. Apothecia submarginal, perforate, ca. 0.5 cm in diameter. Pycnidia marginal, black; pycnoconidia rod-shaped, 1 × 4–6 µm.

**Chemistry:** atranorin in the cortex; elecorotic and α-collatolic acids in the medulla; medulla K–, C–, KC+ pink, Pd–, UV+ blue-white.

Specimens of this species with poorly developed isidia may resemble *C. nuda*, but they have very small pseudocyphellae, while *C. nuda* has large aggregate pseudocyphellae.

**Distribution:** Japan, China (Yunnan, Taiwan), Philippines, Himalayas. New to NE China.

**Specimens examined.** Neimenggu: Daxinganling, Ganhe, Westsouth Mountain, alt. 700 m, *Chen X.* 3272, 3277, 3282. Heilongjiang: Dedu County, Wudaliangchi, Longmenshan, alt. 300 m, *Chen X.* 3533-J; Xiaoxinganling, Dailing, alt. 350 m, *Liu S.* 1357, 1363; Dailing, Liangshiguou, alt. 350 m, *Chen X.* 3652, 3689, 3695, 3697, 3829, 3847, 3864, 3916, 3922, 3937, 3963-J, 3989, 4022, 4086; Xiaoxinganling, Wuying, 40th Branch District, alt. 462 m, *Chen X.* 5149, 5176, 5221, 5240, 5486; Wuying Town, *Chen B.* et al. 503; Xiaoxinganling, Wuminghe, Anquan, *Chen X.* 5322, 5333, 5360, 5416-1; Raobei County, Qiyuan forest station, alt. 250 m, *Zhao C.* 728, 733, 755, 775; Ningan County, Xiaobeihu forest station, alt. 800 m, *Zhao C.* F. 982, 998; Hengdaofei, *Beishilazi*, *Gao C.* et al. 6103, 6113; Muling County, Sanxinhuan, alt. 600 m, *Chen X.* 4200, 4201, 4258; Dongjiangcheng, nearby power plant station, *Chen X.* 4404. Jilin: Changbaishan, Fusong County, Donggang to shenyuan, alt. 780 m, *Liu S.* 1298; Changbaishan, the Natural Reserves Administration, upper reaches of the power station, alt. 780, *Hou J.* 78085, 78086;
Dunhua Forest Administration, Dapuchai forest station, 8th branch line, alt. 650 m, Zhao C. F. 4116, 4114; 10 km west-south of Antu Town, alt. 550 m, Gao C. 1364. Liaoning: Benxi County, Heshangmao, alt. 150–250 m, Chen X. L. et al. 6011; 6217; Kuandian County, on the way from Xiangshuangou to Gaoligou, alt. 780 m, Chen X. L. et al. 6909; Futanggou, alt. 570–720 m, Chen X. L. et al. 6937.

**Cetrelia cetrarioides** (Delise ex Duby) W.L. Culb. & C.F. Culb.


Thallus medium to large, 7–16 cm wide; lobes 1–1.5 cm wide, the margins finely and densely sorediate; upper surface tan or pale, pseudocyphellae small, not exceeding 0.5 mm in size; lower surface jet-black, the margin brown, punctate, rhizines sparse, black. Apothecia extremely rare.

**CHEMISTRY:** atranorin in the cortex; perlatolic and α-collatolic acids in the medulla; medulla K–, C–, KC– or KC+ pinkish, Pd–.

This species is the only *Cetrelia* spotted with larger white pseudocyphellae on both surfaces. It is the most widely ranging species in the genus, with some internal chemical variation (Culberson & Culberson 1968, Randlane & Saag 1991a).

**DISTRIBUTION:** Eastern North America, western Europe, Japan, Philippines, Sabah, Java, China (SW, E, NE, Taiwan), Siberia, Europe.

**SPECIMENS EXAMINED.** **Heilongjiang:** Daxinganling, Tahe District, Xiluoluling, alt. 920 m, Zhao C. F. 1370; Xiaoxinganling, Wuminhe, Anquan, Chen X. L. 5320; Dailing, Liangshuihoug, *Chen S. L. 4021*; Wandashan, Raohe County, Bukaishan, alt. 820 m, *Zhao C. F. 797, 830*; Yichun County, 26 km NNW of Tailang, Liang Shui, alt. 400 m, Hämét-Ahti L. 3240 (H). **Jilin:** Changbaishan, nearby Tizihe Wenquan, alt. 1710 m, *Liu S. E. 1524*; Changbai County, Hengshang, along the Yulujiang, alt. 1450 m, *Chen X. L. 2041, 2060, 2110, 2194, 2332-1*; Antu County, Changbaishan, Hepingyingzi, west main line, alt. 1100 m, *Chen X. L. 4640*; 1 km west-north of Bingchang, alt. 1700 m, *Hou J. L. 78245-1*; nearby Bingchang, alt. 1720 m, *Zhao C. F. 0064, 0219*; Antu County, Heping forest station, alt. 1080 m, *Zhao C. F. 3244*; Changbaishan, Xiaotianchi, alt. 1800 m, *Zhao C. F. 3640, 3650, 3688, 3702*; Changbaishan, No. 2 sample field, *Huang Y. H. 9062-1*. **Liaoning:** Kuandian County, Baishilazi to Heigou, alt. 500 m, *Chen X. L. 7408*.

**Cetrelia chicitae** (W.L. Culb.) W.L. Culb. & C.F. Culb.


Thallus medium to large, 10–15 cm wide, lobes 1.0–2.0 cm wide, ascending, the margins erupting with fine soredia, pseudocyphellae small, white, irregular, mostly 0.15–0.6 mm in size; upper surface light grey or ash, smooth, often pruinose at the tips; lower surface jet-black, the margins brown or concolorous with the upper surface, rhizines sparse, black. Apothecia rare.

**CHEMISTRY:** atranorin in the cortex; electroronic and α-collatolic acids in the medulla; medulla K–, C–, KC+ pinkish, Pd–, UV+ blue-white.

This species is often indistinguishable morphologically from *C. cetrarioides*. Pseudocyphellae are often larger and abundant in this species, while small and inconspicuous in *C. cetrarioides*. For their morphological distinction see also Obermayer and Mayrhofer (2007).

**DISTRIBUTION:** North America, Sakhalin, Japan, Philippines, Sabah, Java, China (SW, E, NE, Taiwan), Siberia, Europe.

**SPECIMENS EXAMINED.** **Heilongjiang:** Daxinganling, Huzhong District, Dabaishan, alt. 1000 m, *Zhao C. F. 1107, 1111*; Tahe District, Xiluoluling, alt. 920 m, *Zhao C. F. 1367-1*; Xiaoxinganling, Yichun, *Zhang Y. L. 1467*; Xiaoxinganling, Dailing, Liangshui, alt. 350 m, *Chen X. L. 3922, 3941-1, 3945, 3963*; Wuying, alt. 462 m, *Chen X. L. 5200, 5271*; Wuminhe Forest Administration, Anquan, *Chen X. L. 5291, 5326*; Wandashan, Roahe County, Bukaishan, alt. 825 m, *Zhao C. F. 853, 854, 871*. **Jilin:** Changbaishan south slope, Sizhuangfang, alt. 1870 m, *Chen X. L. 2140*; Changbai County, 15th Daogou to Xigangding, alt. 1650 m, *Chen X. L. 2163, 2276*; Antu County, Changbaishan, Bingchang, alt. 1700 m, *Chen X. L. 4455, 5043*; Changbaishan, 14 km south of Baishan Station, alt. 1270 m, *Zhao C. F. 106, 487*; Changbaishan, nearby Tianchi, alt. 2150 m, *Zhao C. F. 3479*; Xiaotianchi, alt. 1800 m, *Zhao C. F. 3613*; Helong County, Zhenfengshan, alt. 1360 m, *Zhao C. F. 3836, 3857*; Dunha County Dapuchai forest station, 7th branch line, alt. 700 m, *Zhao C. F. 4005*.

**Cetrelia collata** (Nyl.) W.L. Culb. & C.F. Culb.

Thallus medium, to 15 cm wide, lobes 0.6–2.5 cm wide, smooth, pseudocyphellae large, sometimes becoming confluent and exceeding 1 mm in size; upper surface whitish grey; lower surface jet-black, ± punctate, the margins dark brown or concolorous with the upper surface, rhizines sparse. Apothecia 0.8–2.0 cm in diameter, perforate or entire, the thalline exciple pseudocyphellate; ascospores ellipsoid, 15–20 × 8–12 µm. Pycnidia marginal; pycnoconidia rod-shaped, the ends ± inflated.

Chemistry: atranorin in the cortex; imbricaric acid in the medulla; K–, C–, KC– or KC+ pinkish, Pd–.

Distribution: Nepal, China (SW). New to NE China.

Specimen examined: Jilin: Changbaishan, tundra, alt. 2000–2300 m, Qian H. 69-15.

*Cetrelia japonica* (Zahlbr.) W.L. Culb. & C.F. Culb.


Thallus medium to very large, 10–25 cm wide; lobes 0.5–1.5 cm wide, the margins densely fringed with tiny branched lobulae or dorsiventral isidia; upper surface greyish-white or ashy-white, smooth, pseudocyphellae punctiform to elongate, small, ca. 1 mm in size; lower surface jet-black, the margins brown to whitish, not punctate, rhizines black. Apothecia not found.

Chemistry: atranorin in the cortex; microphyllinic acid in the medulla; medulla K–, C–, KC+ pink, Pd–, UV+ blue-white.

This species is distinctive in the well developed tiny branched lobulae along the lobe margins, and in containing the rare lichen substance microphyllinic acid.

Distribution: Japan, South Korea, Borneo, Java, Taiwan. New to NE China.

Specimens examined: Jilin: Changbaishan, nearby Huapeizi, Wenquan, alt. 1710 m, Liu S. 1524; Antu, Changbaishan, Wenquan, East Mountain, alt. 2200 m, Chen X. L. 4722. Liaoning: Huanren County, Laotudingzi, Xiangbizigou, alt. 1000 m, Chen X. L. 6607; Kuandian County, Baishilazi, Futanggou, alt. 900 m, Chen X. L. 7078.

*Cetrelia nuda* (Hue) W.L. Culb. & C.F. Culb.


Thallus large, 15–24 cm broad, lobes 0.5–1.8 cm wide; upper surface greyish or ashy-white, smooth, pseudocyphellae with large pores, conspicuous, irregular, confluent, the largest aggregates could be more than 1 mm in size; lower surface black, punctate, the margins of some lobes concolorous with the upper surface. Apothecia common, submarginal to laminal, perforate, 1.2–1.5 cm in diameter. Pycnidia large, often pruinose, marginal or laminal; pycnoconidia rod-shaped, the ends slightly inflated, 5.7 × 1 µm.

Chemistry: atranorin in the cortex; allectoronic and α-collatolic acids in the medulla; medulla K–, C–, KC+ pink, Pd–, UV+ blue-white.

This species is often conspicuous with large thalli, lobes broad and often with large aggregate pseudocyphellae.

Distribution: Japan, China (Yunnan, Taiwan). New to NE China.

Specimens examined: Jilin: Changbaishan, nearby Huapeizi, Wenquan, alt. 1710 m, Liu S. E. 1524; Antu, Changbaishan, Wenquan, East Mountain, alt. 2200 m, Chen X. L. 4722. Liaoning: Huanren County, Laotudingzi, Xiangbizigou, alt. 1000 m, Chen X. L. 6607; Kuandian County, Baishilazi, Futanggou, alt. 900 m, Chen X. L. 7078.

*Cetrelia olivetorum* (Nyl.) W.L. Culb. & C.F. Culb.


Thallus small to medium-sized, 6–15 cm wide, lobes 0.5–1.8 cm wide, the margins densely sorediate; upper surface light tan or brownish, pseudocyphellae abundant, very small, less than 0.3 mm in size; lower sur-
face black, the margins brown or concolorous with the upper surface, rarely punctate, rhizines sparse, black. Apothecia not found.

Chemistry: atranorin in the cortex; olivetoric acid in the medulla; medulla K–, KC+ red, C+ pink or red, Pd–.

This species resembles *C. cetrarioides* and *C. chicitae*, but is recognized by its slightly convex lobes, abundant but extremely minute pseudocyphellae, the distinctly fine marginal soredia, and the total absence of laminal soredia. Only this species gives a positive reaction with C due to the presence of olivetoric acid.

**Distribution:** North America, Europe, Japan, Nepal and China (SW, NE, Taiwan).

**Specimens Examined.** **Heilongjiang:** Daxinganling, Tahe District, Xiluoqiling, alt. 920 m, Zhao C. F. 1366, 1368, 1369, 1371, 1373, 1379-2, 1418; Wandashan, Ningan County, Xiaobeihu forest station, west-north 30 km, alt. 800 m, Zhao C. F. 980, 995; Dedi County, Wudalianchi, Laosheshan, alt. 300 m, Chen X. L. 3462; Muling, Sanxinshan forest station, alt. 600 m, Chen X. L. 4199, 4297. **Jilin:** Fusong County, Daoli, Sipingjie, alt. 1700 m, Zhang Y. L. et al. 581; Changbaishan, Heigou, west line, alt. 1100 m, Chen X. L. 4598, 4599; Changbaishan, nearby Bingchang, alt. 1750 m, Chen X. L. 4982; nearby Bingchang, alt. 1700 m, Hou J. L. 78139; Changbaishan, 14 km south of Baishan station , Zhao C. F. 135; nearby Wengan, alt. 1800 m, Zhao C. F. 3386, 3662, 3683; on the way from Tianchi to the waterfall, alt. 2080 m, Zhao C. F. 3505; Helong County, Xujuadong forest station, alt. 920 m, Zhao C. F. 3747, 3798; Helong County, Zhenfengshan, alt. 1400 m, Zhao C. F. 3857; Duhua County, Dapuchai forest station, alt. 650 m, Zhao C. F. 4064; Changbaishan north slope, alt. 2450 m, Zhao C. F. 4181. **Liaoning:** Huanren County, Laotudingzi, nearby the Natural Reserves Administration, alt. 600 m, Chen X. L. 6808; Xiangshuigou, alt. 900 m, Chen X. L. 6906; Gaoliougou, alt. 780 m, Chen X. L. 6911-1; Heigou, alt. 650 m, Chen X. L. 7457.

**Cetreria pseudolivetorum** (Asahina) W.L. Culb. & C.F. Culb.


Thallus very large, 18–25 cm wide, lobes 1–2 cm wide, the margins densely fringed with palmately divided lobulae, sometimes isidioidal or broadly expanded into lobelike, so dense that the thallii become cristate; upper surface light brown (greyish white when fresh), smooth, pseudocyphellae punctiform or elongate, small, ca. 0.5 mm. in size; lower surface jet-black, margins concolorous with the upper surface, not punctate, rhizines black. Apothecia not found. Pycnidia black, produced at lobulae margins; pycenoconidia rod-shaped, 6 × 1.5 μm.

Chemistry: atranorin in the cortex; imbricaric acid in the medulla; medulla K–, C–, KC–, Pd–.

**Distribution:** China (Yunnan, Taiwan). New to NE China.

The only distinction of this species from *C. japonica* is in the chemistry.

**Specimens Examined.** **Jilin:** Changbai County, Changbaishan south slope, alt. 1440 m, Chen X. L. 2276-1. **Liaoning:**
Cetreliopsis M.J. Lai

Thallus broad foliose, large; lobes rotund, upper surface yellowish grey or straw-yellow, shiny, sorediate along the margins or lacking, pseudocyphellate; upper cortex prosoplectenchymatous; medulla white; lower surface black, pseudocyphellate, with sparse rhizines. Apothecia nephromoid, produced along the lobe margins, disc pale brown, almost perpendicular to the thallus; ascospores ellipsoid. Pycnidia marginal; pycnoconidia bifusiform.

The genus is morphologically close to Cetrelia but is distinguished by containing usnic acid in the upper cortex and fumarprotocetraric and protocetraric acids in the medulla (Pd+ red). Moreover, Cetrelia usually has submarginal and perforate apothecia. Key references: Lai (1980), Randlane et al. (1995), Lai and Elix (2002).

Cetreliopsis asahinae (Sato) Randlane & A. Thell

Thallus foliose, up to 10 cm in size; lobes 8–15 mm, with ascending margins; upper surface yellowish green; lower surface black near central parts, margins pale brown; pseudocyphellae occur on both surfaces, on upper surface surrounded with a black rim and bearing black emergent projections, on lower surface less conspicuous, in the form of white patches situated on ridges; cortex 3–4 layers; medulla white. Apothecia marginal or submarginal, 10–15 mm in diameter; disc brown; exciple 2-layered; ascospores ellipsoid, 8–10 × 4–7 µm. Pycnidia laminal or marginal, on emergent projections; pycnoconidia bifusiform, ca. 4 × 1 µm.

Flavocetraria Kärnefelt & A. Thell

Thallus subfoliose, small to medium-sized, erect, main lobe once to twice dichotomously branched; lobes canaliculate, subtubular or sometimes flat; upper surface yellow, smooth and glossy, marginal projections lacking, marginal projections lacking, lower surface smooth, the same colour as the upper surface, with sparse white pseudocyphellae along the margins, rhizines lacking; cortical layers paraplectenchymatous, composed of 2–3 layers of pachydermatous cells of different size; medulla white. Apothecia brown, produced along the margins at lobe ends; ascospores ellipsoidal. Pycnidia black, marginal, pycnoconidia ± bifusiform. Key reference: Kärnefelt et al. (1994).

Key to the species

1. Lobes flat with a network of depressions and sharp ridges, or wrinkled...............................F. nivalis
1. Lobes curled inward, canaliculate, smooth, or undulate and crisped at the margins .....................F. cucullata

Flavocetraria cucullata (Bellardi) Kärnefelt & A. Thell
Thallus subfoliose, erect, 2.5–6 cm high, main lobe once to twice dichotomously branched, lobes 5 mm wide, ruffled at the margins, distinctly canaliculate, or strongly curled inward and almost becoming subtubular; upper surface yellow, smooth, glossy, old basal parts becoming red-violet; lower surface pale yellow, smooth, sparsely pseudocyphellate along the margins, pseudocyphellae round or linear. Apothecia brown, marginal, produced at lobe ends, 1–2 mm wide, exciple 2-layered; ascospores ellipsoidal, 5–10 × 3–5 µm. Pycnidia black, marginal; pycnoconidia ± bifusiform, 5 × 1 µm.

**Chemistry**: usnic acid in cortex, no medullary substances.

**Distribution**: Widely distributed in arctic-boreal areas in the northern hemisphere, and in cold temperate regions in southernmost South America.

**Specimens examined.** Neimenggu: Eergunazuoqi, Aokeli dui shan, alt. 1530 m, Zhao C. F. 2941. Heilongjiang: Daxinganling north slope, Huzhong District, Dabaishan, alt. 1200–1400 m, Zhao C. F. 1120, 1125-2; Huyuan forest station, alt. 1400 m, Ding T. Y. 8517.

**Flavocetraria nivalis** (L.) Kärnefelt & A. Thell


Thallus subfoliose, 3–6 cm high, lobes divided dichotomously, 1.5–6 mm wide, erect or prostrate, ± flat with depressions and ridges; upper surface yellow, smooth, glossy, basal parts becoming yellow-orange; lower surface pale yellow, foveolate, pseudocyphellae round, slightly convex. Apothecia rare, marginal, produced at lobe ends, disc brown; exciple 2-layered; ascospores ellipsoidal. Pycnidia black, located on or close to the lobe margins, slightly raised but not on projections; pycnoconidia ± bifusiform, 5–6 × 1.5 µm.

**Chemistry**: usnic acid in cortex, no medullary substances.

**Distribution**: Widely distributed in arctic-boreal areas in the northern hemisphere, and in cold temperate regions in southernmost South America.

**Specimens examined.** Neimenggu: Eergunazuoqi, Aokeliushan, alt. 1530 m, Zhao C. F. 2940. Heilongjiang: Daxinganling, Huzhong District, Dabaishan, alt. 1200–1400 m, Zhao C. F. 1118, 1120, 1125-2; Huyuan forest station, alt. 1400 m, Ding T. Y. 8517.

**Nephromopsis Müll. Arg.**

Flora 74: 374. 1891.

Thallus foliose, large-sized, up to 20 cm in diameter, sometimes distinctly rugose or reticulated; upper surface greenish yellow, lobe margins lacking isidia, soredia and cilia, but often with numerous black, laminal and marginal, emergent projections bearing pycnidia at their tops; lower surface light to dark brown or even black, pseudocyphellae occur either in the form of small white dots or larger regular patches, plain, concave or convex, often produced on the ridges or on the special plug-like outgrowths, rhizines sparse or numerous; cortical layers para-plectenchymatous; medulla white or in some species pale yellow or orange. Apothecia marginal, produced on the lower surface but the disc often turns upwards; disc brown, rounded or reniform, ± stalked; exciples usually distinctly 3-layered; ascospores ellipsoid. Pycnoconidia bifusiform. Distributed in Himalayan to East Asian regions. Key references: Randlane and Saag (1991b, 1992, 1998), Randlane et al. (1995, 2001), Thell et al. (2005).

**Key to the species**

1. Medulla pale yellow ........................................... *N. ornata*
2. Medulla white .................................................... 2
2. Thallus strongly rugose, with concentric rings; epilithic .................................................. *N. komarovi*
2. Thallus smooth; epiphytic ................................... *N. lai*
**Nephromopsis komarovii** (Elenkin) J.C. Wei


Thallus foliose, large, up to 15 cm in diameter, lobes rounded, 1–2 cm wide; upper surface yellow to yellowish green, distinctly rugose in a ± concentric pattern; lower surface brown, smooth or ± rugose, with laminal white pseudocyphellae, rhizines scattered; medulla white. Apothecia marginal, rarely laminal, rounded or reniform, up to 15 mm in diameter, marginal juvenile apothecia frequent; disc brown, facing upwards; exciple 3-layered; ascospores oblong. Pycnidia (Obermayer 2004) submarginal, on short thallus projections; pycnosporites dumbbell-shaped, (6–)7–8(–10) µm.

**Chemistry:** usnic acid in the cortex; fumarprotocetraric (Huneck et al. 1984), stictic, constictic acids (Randlane & Saag 1998), lichesterinic and protolichesterinic-type fatty acids, and unknowns (Obermayer 2004).

**Distribution:** Russia (eastern Siberia and Far East), Mongolia, China.

**Specimens examined.** Neimenggu: Daxinganling, Ganhe, West-south mountain, alt. 700 m, Chen X. L. 3270. Heilongjiang: Daxinganling Huzhong District, Dabaishan north slope, alt. 1200–1400 m, Zhao C. F. 1236. Jilin: Antu, Changbaishan, 7.5 km from Wenquan, alt. 1200 m, Liu S. E. 4018; Tiansan, waterfall, alt. 1500 m, Liu S. E. 4118; Changbaishan, Bingchang, alt. 1700 m, Chen X. L. 4458; Bingchang, east slope, alt. 2200 m, Chen X. L. 4684; Xiaotianchi, alt. 1750 m, Chen X. L. 4757; Wenquan, roadside, alt. 1700 m, Hou J. L. 78130, alt. 1900 m, Wei J. C. 2902 (H).

**Nephromopsis laii** (A. Thell & Randlane) Saag & A. Thell


Thallus foliose, up to 8 cm in diameter, lobes 8–15 mm, often with secondary marginal lobules; upper surface yellowish grey, ± rugose; lower surface pale brown to brown and pale whitish at the margins, distinctly reticulated, with white, small, rounded pseudocyphellae developed on the ridges; rhizines sparse, brown; medulla white. Apothecia marginal, numerous, often juvenile only, sometimes situated on the secondary marginal lobules, up to 5 mm in diameter; disc brown, oblong or reniform; exciple 2-layered; ascospores oblong.

**Chemistry:** usnic acid in the cortex; alcetroneic and/or lichenerinic and protolichesterinic-type fatty acids in the medulla.

This species is characterized by the rugose upper surface and reticulated lower surface with pseudocyphellae situated on the ridges, and presence of secondary marginal lobules forming a fringe along the margins of lobes in many specimens.

**Distribution:** Russian Far East, China (SW, Taiwan), India, Japan and Vietnam. New to NE China.

**Specimens examined.** Heilongjiang: Xiaoqinganling, Daling, south of Lianshuigou, alt. 350 m, Chen X. L. 3378, 3739, 3988, 4067, 4111; Wuyin, alt. 462 m, Chen X. L. 5178: Wandashan, Ningan County, Dahalin Forest Administration, Qifeng forest station, Gao C. et al. 6876. Jilin: Changbai County, Hengshan, along the Yalujiang alt. 1450 m, Chen X. L. 2039, 2321, 2331; Antu County, Changbaishan, Baishan station, alt. 1270 m, Zhao C. F. 100, 305, 351; 1 km northwest of Bingchang, alt. 1700 m, Hou J. L. 78244-1. Liaoning: Kuandian County, Baishilazi, Futanggou, alt. 570–720 m, Chen X. L. 6942.

**Nephromopsis ornata** (Müll. Arg.) Hue


Thallus foliose, large, up to 16 cm in diameter, lobes ascending, 1–1.5 cm wide; upper surface yellowish grey, smooth or slightly wrinkled; lower surface brown or dark brown to
almost black, reticulated; pseudocyphellae white, on ridges or at marginal part on the lower surface; rhizines sparsely scattered; medulla pale yellow. Apothecia rounded or reniform, ca. 20 mm in diameter, produced along the margins of the lower surface; disc brown, facing upwards; exciple 3-layered; asci sporangia oblong, 7–8 × 4–5 µm; pycnidial marginal and laminal, produced on the black emergent projections; pycnococonidia bifusiform, 5 × 1 µm.

Chemistry: usnic acid in the cortex, fumar-protocetraric acid and secalonic acids A or C, trace of endocrocin and some fatty acids in the medulla; medulla K+ deep yellow.

This species is closely related to *N. endocrocea*, but differs by containing secalonic acid A or C, trace of endocrocin and some fatty acids in the medulla; medulla K+ deep yellow.

This species must be excluded from the lichen flora of China (Wei 1991).

**Distribution**: China, Japan, Russian Far East, South Korea.

**Specimens Examined.** **Jilin**: Antu County, Changhaishan, Hengshan, along by the Yalujiang, alt. 1450 m, Chen X. L. 2016, 2275, 2297, 2337; Changhaishan north slope, Hepingyinzhi, west main line, alt. 1100 m, Chen X. L. 4600, 4651; nearby Bingchang, alt. 1700 m, Hou J. L. 78202, 78244.

**Tuckermannopsis Gyeln.**


Thallus subfoliose or almost fruticose, lobes narrow, weakly canaliculate, with or without cilia along the margin; upper surface brown to olive, weakly wrinkled, pseudocyphellae sparse or lacking; soredia present or lacking; isidia lacking; upper cortex paraplectenchymatous; lower surface pale brown, with sparse rhizines; medulla white. Apothecia lecanorine, produced on the underside of reflexed lobe margins, or submarginal; ascospores subglobose to globose. Pycnidia on the lobe margins; pycnococonidia bifusiform. Distributed in North America and East Asiatic temperate regions. Key references: Lai (1980), Thell (1998), Kärnefelt and Thell (2001). — Ought to be spelled Tuckermannopsis rather than ‘Tuckermanopsis’, as proposed by some recent authors; see Ahti (2007).

**Key to the species**

1. Thallus sorediate along the lobe margins
   1. Thallus esorediate

**Tuckermannopsis americana** (Spreng.) Hale


Thallus foliose, lobes 1–4 mm wide, with scattered cilia along the margins; upper surface pale brown to greenish, ± wrinkled; soredia lacking; pseudocyphellae scattered. Ascospores globose, 4–5 µm in diameter; pycnococonidia bifusiform, 5 × 1 µm.

Chemistry: atranorin (inconstant) in the cortex; aleoloric and (usually) α-collatolic acids in medulla; medulla C-, KC+ pink or red, UV+ blue-white.

The identity of *Cetraria ciliaris* reported by Chen *et al.* (1981) from Neimenggu must be *Tuckermannopsis americana*.

**Distribution**: North America, Europe, from S Finland east through northern Asia to Kamchatka, China and Japan. New to China.

**Specimens Examined.** **Neimenggu**: Eergunzaowoqi, Mangui, alt. 800 m, Gao D. E. 100; Alongshan, alt. 800 m, Gao D. E. 177; Morgan, alt. 800 m, Wei 3379-2 (Lich. Sin. Exs., fasc. 1: 26, as *Cetraria microphylla*); Xingan league, Keyouqianqi, Yiershi Town, Tagebin, Chen X. L. 1747. **Heilongjiang**: Daxinganling, Xinlin, West mountain, alt. 590 m, Chen X. L. 3360; Huzhong District, Dabaishan north slope, alt. 100 m, Zhao C. F. 1285-2, 1287, 1343; Tahe District, Xiluoqiling, alt. 920 m, Zhao C. F. 1379-1, 1392, 1413; Xilinjir District, Gulion Country, alt. 600 m, Zhao C. F. 1460; 42 km from Xilinjir to Mohe, Zhao C. F. 1510, 1512.
**Tuckermannopsis ulophylloides** (Asahina) M.J. Lai


Thallus foliose, lobes 3–5 mm wide, branched, ciliate and sorediate along the margins; pseudocyphellae lacking; upper surface olive or brown, smooth; lower surface pale, ± rugose, rhizines sparse. Apothecia not found.

**CHEMISTRY:** protolichesterinic acid in the medulla.

**DISTRIBUTION:** Japan. New to China.

**SPECIMENS EXAMINED.** **Heilongjiang:** Xiaoxinganlin, Daoling, Liangshuigou, alt. 340 m, Chen X. L. 4043. **Liaoning:** Kuandian, summit of Baishelazi, alt. 1230 m, Nan Y. H. 6319-l.

**Tuckneraria** Randlane & A. Thell


Thallus foliose, medium-sized, upper surface smooth or slightly rugose, light yellow, yellowish-green or yellowish-grey; lobes elongate or rounded, normally with marginal cilia; with or without marginal soredia; lower surface pale, light to dark brown or black, pseudocyphellae, rhizines sparse; both cortices paraplectenchymatous; cortical hyphae strongly gelatinized. Apothecia marginal, rounded or reniform; disc brown; exciples 2-layered; ascospores globose-subglobose. Pycnidia on marginal (or occasionally laminal) emergent projections; pycnoconidia bifusiform. Five species so far known, mainly in eastern and southeastern Asia. Key references: Randlane *et al.* (1994, 2001), Thell *et al.* (1995). Thell *et al.* (2005) included Tuckneraria again in the genus *Nephromopsis*, but we still want to keep it separate.

**Key to the species**

1. Lobe margins isidiate ........................................ *T. togashii*

1. Lobe margins sorediate ........................................ *T. laureri*
**Vulpicida juniperina** (L.) J.-E. Mattsson & M.J. Lai


Thallus dorsiventral, bright yellow to greenish yellow on both surfaces, medulla bright yellow. Soredia lacking. Apothecia usually abundant. Pycnidia abundant, on marginal projections: pycnoconidia sublageniform, 6–8 × 2 μm.

**Key to the species**

1. Soredia present on the lobe margins; pycnidia sparse or very inconspicuous .......................... *V. pinastri*
   1. Soredia lacking; pycnidia abundant and conspicuous ............................................. *V. juniperina*

**Vulpicida pinastri** (Scop.) J.-E. Mattsson & M.J. Lai


Thallus forming appressed or ascending rosettes, upper surface greenish yellow to bright yellow; lobes 1.5–5 mm wide, the margins ± divided or ruffled, dissolving into bright yellow, farinose soredia; lower surface pale yellow to white, pseudocyphellae lacking, rhizines almost absent to sparse; medulla yellow. Apothecia very rare (not found); pycnidia rare, on projections.

**Chemistry**: usnic acid in the cortex; vulpinic and pinastric acids as well as zeorin and other triterpenes in the medulla.

**Distribution**: Arctic-boreal-temperate regions of the northern hemisphere.

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**Specimens examined**: **Heilongjiang**: Xiaoxinganling, Dailing, Liangshuigou forest station, alt. 350 m, Chen X. L. 3915, 3982. **Jilin**: Dunhua Forest Administration, Dapuchai forest station, 7th branch line, alt. 750 m, Zhao C. F. 4025. **Liaoning**: Zhuanghe, Buyunshan, north gully, alt. 270 m, Gao C. 5731.

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**Vulpicida J.-E. Mattsson & M.J. Lai**


Thallus foliose to almost fruticose, small to medium-sized, bright golden yellow to dark yellowish green; lobes flat, dorsiventral, appressed to ascending or erect; upper surface usually distinctly ridged, pseudocyphellae lacking; medulla bright yellow to orange. Apothecia lecanorine, borne close to the lobe margins, disc shiny, red-brown, often with crenulate margin; ascospores broadly ellipsoid. Pycnidia marginal or laminal, black, on projections, raised or immersed; pycnoconidia citriform (lemon-sharped) or sublageniform. The main diagnostic character of the genus is the presence of pinastric and vulpinic acids in the medulla. Ascomatal and pycnidial characters differ among the six species. Distributed in the arctic-boreal-temperate regions of the northern hemisphere. Key references Mattsson (1993), Mattsson and Lai (1993).

**Key to the species**

1. Soredia present on the lobe margins; pycnidia sparse or very inconspicuous .......................... *V. pinastri*
   1. Soredia lacking; pycnidia abundant and conspicuous ............................................. *V. juniperina*
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