Comparison and assessment of three East-Asian species of the genus *Scapania* (Hepaticae: Scapaniaceae)

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Abstract  Three East-Asian species of the hepatic genus *Scapania*, namely, *S. parvidens* Steph., *S. parvitexta* Steph., and *S. glaucoviridis* Horik., which were recently treated as one species (*S. parvidens*) by Potemkin, are described and typified. Examination and comparison of the types as well as representative specimens showed that these three should be treated as separate species. Descriptions with figures for each species are presented and differences among the three species are discussed in detail.

Key words  Hepaticae, Scapaniaceae, *Scapania*, *Scapania parvidens*, *Scapania parvitexta*, *Scapania glaucoviridis*, East-Asia, assessment.

*Scapania* (Dumort.) Dumort. is the largest genus of the hepatic family Scapaniaceae, and is distributed mainly in temperate regions and on high mountain areas in tropical and subtropical regions. About 230 species have been described in the world (Müller, 1905; Long, 1990) and more than 110 species were recognized by Potemkin in 1998. Later in 2002, Potemkin put forward a phylogeny and classification of the genus *Scapania* and recognized 87 recent and one fossil species in the genus. He also proposed a number of new synonyms in the genus. Among them, there are three East-Asian species, namely, *S. parvidens* Steph. and *S. glaucoviridis* Horik. in Japan, China and Himalayas. Potemkin (2002) treated *S. parvidens* and *S. glaucoviridis* as new synonyms of *S. parvitexta* because of considerable overlap in variability and some unstable characters among them.

During our study of Chinese *Scapania*, we examined the types and other specimens from China and Japan of these three species. After examination and comparison of types and some additional specimens, we concluded that the three are different and should be treated as separate species. Comparison and assessment of these species are presented here.

1. *Scapania parvitexta* Steph., Bull. Herb. Bossier 5: 107. 1897. Type: “Kattasan, Towada, Hakodate”, Faurie 151123 (paratype, G!), 14262 (paratype, G).  Fig. 1

Plants median in size, 0.5–1.2 cm long, 0.6–1.9 mm wide with leaves, yellow-green. Stems ascending above, unbranched or rarely forked, in transverse section cortical cells in 3–5 layers, small, thick-walled, interior cells large, thin-walled. Rhizoids scattered on stems, long, colorless. Leaves densely imbricate, unequally divided 2/5–3/5 their lengths. Keel 0.3–0.6 the length of the ventral lobe, slightly concave dorsally, in cross section 2–4 cells thick, wing wanting. Ventral lobe nearly transversely inserted on the stem, oval to obovate, distinctly convex backwards, more or less decurrent at base, apex rounded to obtuse, sometimes subacute with a point, margins densely ciliate-dentate to dentate, teeth often acute at tip, 1–4
Fig. 1. *Scapania parvitexta* Steph. A–D, leaves; E, F, leaf margin teeth; G, leaf cells near basal margin; H, median leaf cells; I, basal leaf cells; J, perianth; K, perianth mouth pattern; L, cells of perianth mouth; M, gemmae; N, cross section of leaf; O, cross section of leaf keel; P, cross section of stem; Q, part of plants with perianths, dorsal view; R, leaf insertion pattern, dorsal view; S, leaf insertion pattern, ventral view. Drawn by B. R. Zuo from *Faurie 151123*, paratype of *Scapania parvitexta* Steph.

Line scales: 150 µm for A–D, J, R, S; 100 µm for K; 75 µm for Q; 50 µm for E, F, L, P; 25 µm for G–I, M–O.
cells long, 1–3 cells wide. Dorsal lobe transversely inserted and appressed to the stem, arching beyond the farther edge of the stem, not decurrent at base, rectangular to obovate, 0.5–0.7 the ventral lobe in size, apex rounded to obtuse, rarely with a point, margins irregularly dentate to ciliate-dentate, teeth similar to those of dorsal lobe. Wings absent. Leaf cells along margin 8–10 μm, median cells 12–15 μm wide × 17–20 μm long, basal cells 12–15 μm wide × 20–34 μm long, walls usually equally thickened, trigones moderately large to small. Cuticle coarsely verrucose, sometimes with distinct papillae. Dioicous. Perianth terminal, oblong, truncate, dorsiventrally compressed, the upper part often bent towards the ventral side, mouth with numerous lobes, lobe with irregular teeth. Gemmae ellipsoid, green to reddish, 1-celled.

Habitat: On granite or in shaded habitats on soil-covered surfaces of rock, and sometimes on bark of trees or rotten wood.

Distribution: China, Japan.

Stephani (1897) described S. parvitexta based on Japanese specimens. Later, this species was recorded from Japan by Müller (1905), Stephani (1910), Hattori (1944), Amakawa & Hattori (1954), etc. It was reported from Anhui (Chen & Wu, 1965; Guo et al., 1988; Piippo, 1990; Zhang et al., 1993; Hu & Liang, 1996; Gao & Cao, 2000), Jiangxi (Zhang et al., 1993; Fang et al., 1998), Yunnan (Gao & Cao, 2000) and Zhejiang (Liu, 1985; Zhang et al., 1993; Wang & Hu, 1995; Zhu et al., 1998) provinces in China before the present study. It seems that S. parvitexta is one of the most common species of Scapania in China. According to the present study, it is distributed in East China (Anhui, Fujian, Zhejiang, and Jiangxi), South China (Guangxi), Southwest China (Guizhou, Yunnan, and Xizang (Tibet)), Northeast China (Liaoning), and Taiwan.

S. parvitexta is sometimes confused with S. parvidens. But comparison of types and additional specimens from China and Japan showed that these two species differ in size of the dorsal lobe and leaf margin teeth, as well as in plant size. S. parvitexta has dorsal lobes distinctly smaller than the ventral lobes; margin teeth large, consisting of numerous cells; and plants about 1–3 cm long, while S. parvidens has dorsal lobes nearly equal to the ventral lobes in size; margin teeth small, mostly 1-celled, sometimes 2-celled; and plants about 0.5–1 cm long.

S. parvitexta differs from S. glaucoviridis in having smaller dorsal lobes, about 0.7–0.8 of the ventral lobes in size, and shorter keels without wings, while S. glaucoviridis has dorsal lobes nearly equal to the ventral lobes and long, straight keels with distinct wings.

Specimens examined.


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L. Liu (刘仲苓) 1484, 249a, 573 (IFSBH).

**Japan. Hakodate**: Yezo, Faurie March 1899 (BM); Nagasaki, Mt. Tarudake, Faurie 10 June 1899 (BM); Kittasan, Faurie 14098 (M); Sanze, Tsuruoka-shi, Yamagata, S. Ono Nov. 5, 1978 (NY); Kuman Oto, Mt. Ichifusa, K. Mayebara (NY); S. Hattori (NY); Fuka-yabakei, Ooita Prefecture, A. Noguchi, July 13, 1950 as S. Parvitexta var. minor (NY).

**Higo**: Kiushiu, Hitoyoshi, K. Mayebara 1381 (NY); Kiushiu, Y. Kuwahara 1280, 132, 4225 (NY); Kyushu, Y. Kuwahara 5166 (NY).

2. *Scapania parvidens* Steph., Hedwigia 44: 15. 1904. Type: Japan. Without precise locality, *Faurie* 1296 (holotype, G!). Fig. 2

Plants small in size, 0.5–1.0 cm long, 1–1.5 mm wide with leaves, green to yellow-green. Stem ascending at upper part, unbranched or scarcely branched, in transverse section cortical cells in 2–3 layers, small, thick-walled, interior cells large, thin-walled. Leaves densely imbricate, nearly equally divided 2/3 their lengths. Keel long, straight, about 0.6 the length of the ventral lobe. Ventral lobe transversely inserted, somewhat concave backwards, hardly decurrent at base, obovate, 110–180 μm wide × 140–240 μm long, width equal to or 3/4 the length, apex rounded to obtuse, margins denticulate towards tip, sometimes nearly entire, teeth mostly 1-celled, rarely 2-celled, usually acute. Dorsal lobe subequal to slightly smaller than ventral lobe, 3/4 the ventral lobe in size, nearly transversely inserted, arching beyond the farther edge of the stem, not decurrent at base, oblong-oval, apex rounded to obtuse, margins of upper part with small, 1-celled teeth, entire below. Wings absent. Leaf cells small, rounded to subrounded, cells near margins 7–10 μm, median cells 12–15 μm, basal cells 15 μm wide × 30 μm long, walls slightly thickened, trigones not distinct. Cuticle smooth to finely roughened. Dioicous. Perianth terminal, oblong, dorsiventrally compressed, truncate above, upper part often bent towards the ventral side, mouth with small teeth. Gemmae rare, green, oval to ellipsoid, 1-celled.

Habitat: This species is common on granite at high altitudes (usually up to 1000 m), and also occurs on the thin soil over rocks.

Distribution: China, Japan.

*S. parvidens* was described as a species new to science from Japan by Stephani (1904). Later, the species was recorded in Japan by Müller (1905), Stephani (1910), Amakawa and Hattori (1954), etc. It was reported from Anhui by Chen and Wu (1965), Jilin by Koponen et al. (1983) and Yunnan Province by Gao and Cao (2000) in China before the present study. Based on checked specimens, new records of *S. parvidens* in China include Liaoning, Sichuan, Taiwan and Zhejiang Provinces, and Guangxi Autonomous Region.

*S. parvidens* is similar to *S. parvitexta*. The former differs from the latter by (1) smaller plants, only 0.5–1.0 cm long; (2) dorsal lobes nearly equal to the ventral lobes in size, with longer keels; and (3) teeth of leaf margins small, mostly consisting of 1-cell (rarely 2-celled). *S. parvidens* and *S. glaucoviridis* both have large dorsal lobes nearly equal to the ventral lobes, but *S. parvidens* has mostly 1-celled small marginal teeth and keels without wings, while *S. glaucoviridis* has larger marginal teeth consisting of numerous cells and keels with distinct wings.

**Specimens examined:**

Fig. 2. *Scapania parvidens* Steph. A–G, leaves; H–J, leaf margin teeth; K, leaf cells near margin; L, median leaf cells; M, basal leaf cells; N, perianth; O, P, cross section of leaf keel; Q, cross section of leaf; R, cells of perianth mouth; S, gemmae; T, cross section of stem; U, V, parts of plants, dorsal view; W, leaf insertion pattern, ventral view; X, leaf insertion pattern, dorsal view. Figs. N, R were drawn from C. Gao & G. C. Zhang 1405, others were all drawn from Faurie 1296, holotype of *Scapania parvidens*, by B. R. Zuo and T. Cao.

Line scales: 0.3 mm for W, X; 150 µm for A–G, N; 75 µm for U, V; 50 µm for H–J, R, T; 25 µm for K–M, O–Q.
Yunnan (云南): Gongshan (贡山), Dulongjiang (独龙江), Zangmu (藏穆) 937 (KUN, IFSBH).


Plants medium in size, about 2 cm long, 2.1 mm wide with leaves, pale-green, reddish above, often in dense tufts on ground. Stems dark-brown, 0.38 mm in diam., strong, usually unbranched. In cross section of stem, cortical cells in 3–4 layers, small, thick-walled, interior cells large, thin-walled. Leaves densely imbricate, often falcate towards one direction. Keel 0.7–0.8 the length of the ventral lobe, nearly straight, often with distinct wing. Ventral lobe nearly transversely inserted on the stem, concave, broad-ovate, 1.33 mm wide, about 1.55 mm long, not decurrent at base, apex rounded to obtuse, margins densely toothed towards the tip, teeth triangular, consisting of numerous cells, acute, nearly entire below. Dorsal lobe nearly equal to or slightly smaller than ventral lobe, transversely inserted and often appressed on the stem, arching beyond the farther edge of the stem, concave, broad-oval, 1.44 mm wide × 1.3 mm long, width longer than length, margins of upper part of lobe toothed, teeth similar to those of ventral lobe. Wings present, 1–6-celled. Leaf cells near margins 15 μm, median cells 18 μm wide × 22 μm long, cells near base 22 μm wide × 48 μm long, walls thickened, trigones distinct, large. Cuticle smooth. Dioicous. Perianth terminal, ovate, dorsiventrally compressed, upper part often bent towards the ventral side, mouth truncate, toothed, teeth consisting of several thick-walled cells.

Habitat: On banks and moist rocks at high altitudes, alt. 2000–3000 m.

Distribution: China, Japan, and Himalayas.

S. glaucovidis was described as a new species by Horikawa from Taiwan, China in 1934. Inoue (1972) treated S. okamurana Steph. ex Amak. & Hatt. (Amakawa & Hattori, 1954; Amakawa, 1964) as a synonym of S. glaucovidis and recorded this species from China (Taiwan), Japan, and Himalayas. According to present study, S. glaucovidis also occurs in Mt. Huangshan, Anhui Province and is newly recorded from mainland China.

S. glaucovidis is similar to S. parvitexta in having leaf margin teeth irregular, large, consisting of numerous cells, whereas S. glaucovidis has large dorsal lobes, nearly equal to or slightly smaller than ventral lobes in size, and long, straight keels with distinct wings. S. parvitexta has the dorsal lobe distinctly smaller, about 0.7–0.8 of the ventral lobe in size, and slightly concave keels without wings.

Specimens examined:

China. Anhui (安徽): Mt. Huangshan (黄山), P. C. Chen et al. (陈邦杰等) 6362, 7442 (PE). Taiwan (台湾): Taizhong (台中), Mt. Xiaoxueshan (小雪山), T. Cao & C. Gao (曹同, 高谦) 980960, 980948, 980984 (IFSBH, SHNU); Hualian (花莲), between Mt. Tailukota Shan and Mt. Patolu Shan, C. C. Chuang 5675 (PE); Ilan (宜兰), C. C. Chuang 6043 (PE).

In conclusion, comparisons of three Eastern-Asian species indicate that S. parvitexta, S. parvidens, and S. glaucovidis differ in several features (Table 1) and can be distinguished practically (key to the species). Therefore, the three should be treated as separate species.
Fig. 3. *Scapania glaucovidis* Horik. A–D, leaves; E, perianth mouth pattern; F, G, cells of perianth mouth; H, leaf margin teeth; I, J, cross section of leaf keel; K, median leaf cells; L, basal leaf cells; M, parts of plants with perianth and sporophyte, dorsal view; N, cross section of stem. Drawn by B. R. Zuo from *Horikawa 9222*, holotype of *S. glaucovidis*. Line scales: 150 µm for A–D; 100 µm for E; 75 µm for M; 50 µm for F–H, N; 25 µm for I–L.
Table 1  Comparison of Scapania glaucoviridis, S. parvidens and S. parvitexta in some criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>S. glaucoviridis</th>
<th>S. parvidens</th>
<th>S. parvitexta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wing of the leaf-keel</td>
<td>wing developed</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Dorsal and ventral lobes in size</td>
<td>dorsal lobe nearly equal to ventral lobe</td>
<td>dorsal lobe nearly equal to ventral lobe</td>
<td>dorsal lobe small equal to ventral lobe</td>
</tr>
<tr>
<td>Leaf-margin teeth</td>
<td>large, with numerous cells</td>
<td>small, 1-celled, rarely 2-celled</td>
<td>large, with numerous cells</td>
</tr>
<tr>
<td>Cuticle of leaves</td>
<td>smooth</td>
<td>smooth to finely roughened</td>
<td>coarsely verrucose</td>
</tr>
</tbody>
</table>

Key to the three species

1. Dorsal lobe nearly equal to ventral lobe.
2. Leaf margin teeth small, mostly 1-celled (sometimes 2-celled); keel without wing…………………………………………………………………………………………………… Scapania parvidens
1. Dorsal lobe distinctly smaller than ventral lobe
………………….. S. parvitexta
2. Leaf margin teeth large, consisting of numerous cells, keel with distinct wing………… S. glaucoviridis

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References

东亚分布合叶苔属(苔纲: 合叶苔科)
三种植物的比较和评估

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摘要  对最近被Potemkin作为同一种处理的合叶苔属Scapania中东亚分布的三种即细齿合叶苔S. parvidens Steph.、弯瓣合叶苔S. parvitexta Steph.和灰绿合叶苔S. glaucoviridis Horik.的模式标本及相关标本进行了比较研究。结果表明，它们仍应该作为三个独立不同的种来处理。对三个种的模式标本进行了绘图和描述，并详细讨论了三种之间的区别。

关键词  苔类植物; 合叶苔科; 合叶苔属; 细齿合叶苔; 弯瓣合叶苔; 灰绿合叶苔; 东亚; 评估