

Studies on the bryophyte flora of the Tien Shan Mountains. 1. Hypnaceae and Hylocomiaceae (Musci)

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Abstract Eleven species in three genera in Hypnaceae and four species in four genera in Hylocomiaceae are reported based on the collections made in the Tien Shan Mountains in 1995. *Hypnum callichroum* and *H. subimponens* subsp. *subimponens* are new records for the moss flora of Kazakhstan, and *Hypnum cupressiforme* var. *subjulaceum* and *H. recurvatum* are new to Kyrgyzstan. A key for the *Hypnum* species in Kazakhstan and Kyrgyzstan is shown.

Key words: Hypnaceae, Hylocomiaceae, mosses, Tien Shan Mountains, Russia, Kazakhstan, Kyrgyzstan

In 1995 a botanical survey led by Dr. Yuichi Kadota of National Science Museum, Tokyo, was carried out in the western part of the Tien Shan Mountains in collaboration with the Central Siberian Botanical Garden, Novosibirsk (cf. Kadota 1995). In July–August 1995 I collected bryophyte specimens as a member of the survey. Recently Ignatov *et al.* (2006) compiled the checklist of the mosses of East Europe and North Asia. The moss flora of Central Asia is insufficiently known.

Study area

The Tien Shan Mountains are a big mountain system in Central Asia and are situated along the border area between the former USSR countries and China. The botanical survey was made in the Dzhungarsky Alatau, the Zailisky Alatau, the Tereskey Alatau, the Central Tien Shan, the Kirghisky, the Alaisky and the Za Alaisky Range (Fig. 1), and locations are described below. The specimens examined are kept in the herbarium of the Department of Botany, National Museum of Nature and Science (TNS), and the duplicates in the herbarium of the Central Siberian Botanical Garden (NS).

Kazakhstan

Dzhungarsky Alatau (45°13'N, 80°20'E)

Zailisky Alatau (43°02'N, 77°00'E)

Kyrgyzstan

Tereskey Alatau (42°15'N, 78°30'E)

Kirghisky (42°34'N, 73°36'E)

Alaisky (39°35'N, 71°58'E)

Za Alaisky Range (39°25'N, 72°08'E)

This paper deals with taxa of the families Hypnaceae and Hylocomiaceae occurring in the Tien Shan Mountains based on the collections made by Higuchi in 1995. By the examination of the specimens, eleven species in three genera and four species in four genera were recognized in Hypnaceae and Hylocomiaceae, respectively. *Hypnum callichroum* and *H. subimponens* subsp. *subimponens* are new additions to the moss flora of Kazakhstan, and *Hypnum cupressiforme* var. *subjulaceum* and *H. recurvatum* are new to Kyrgyzstan.

Hypnaceae

Although the recent molecular phylogenetic analyses indicate that the Hypnaceae as well as its type genus *Hypnum* itself were polyphyletic



Fig. 1. Map of the surveyed areas showing the route and collecting sites (revised from Kadota 1995). Solid triangles indicate main base camps.

(e.g., Tsubota *et al.* 2002), the delimitation of the family is still controversial. Here I follow the system of Hypnaceae by Goffinet and Buck (2004) with some changes and *Hypnum* by a series of study by Ando respectively.

1. ***Callicladium haldanianum*** (Grev.) H. A. Crum, *Bryologist* 74: 167 (1971).

Specimen examined. Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 2480 m, July 21, 1995 (Higuchi 27952).

Distribution. Europe, Caucasus, Pakistan, N. and C. Asia, China, Korea, Japan and N. America.

2. ***Pylaisia polyantha*** (Hedw.) Schimp. in B.S.G., Bryol. Eur. 5: 89 (1851).

Specimens examined. Russia, Novosibirsk, Central Siberian Botanical Garden, 150 m, July 12, 1995 (*Higuchi 27723, 27725, 27728, 27730*); July 14, 1995 (*27736, 27743, 27752*).

Distribution. North Europe, Russia and N. America (Arikawa 2004).

Nine species and one subspecies of *Hypnum* including *H. callichroum*, *H. cupressiforme* var. *subjulaceum* and *H. subimponens* subsp. *subimponens* newly added here are known from Kazakhstan and/or Kyrgyzstan. The following key is revised from Ando (1973, 1976, 1993, 1994). The species with asterisk (*) are not present in this collection.

Key to the species of *Hypnum* in Kazakhstan and Kyrgyzstan

1. Perichaetial leaves not plicate; seta twisted to the right throughout the whole length when dry, rarely only slightly turned to the left below the capsule; spores maturing in fall to winter 2
1. Perichaetial leaves plicate; seta twisted to the right below, to the left above when dry; spores maturing in winter to spring, spring to summer or in summer to fall 3
 2. Leaves oblong-lanceolate; alar parts remarkably excavated and usually brown-colored; median cells (50–)60–70(–80)×3–4(–5) μm 5. *H. cupressiforme* var. *subjulaceum*
 2. Leaves ovate-lanceolate; alar parts not or weakly excavated, occasionally yellow- to brown-colored; median cells shorter and wider 6. *H. cupressiforme* var. *cupressiforme*
3. Epidermal cells of stem always much larger than the associated inner cortical cells, hyaline with thin outer walls (hyalodermous); sometimes phyllodioicous 4
3. Epidermal cells of stem not enlarged, with thick rarely thin outer walls, rarely partly enlarged and hyaline; not phyllodioicous 7
 4. Plants medium- to large-sized; leaves usually broadly acuminate; growing in moist habitats 7. *H. lindbergii*
 4. Plants small- to medium-sized; leaves slenderly acuminate; growing in drier habitats 5
5. Stem leaves weakly narrowed and not or only slightly rounded to the insertion; margins usually recurved below, sometimes so upwards; alar cells only slightly differentiated 6
5. Stem leaves more markedly narrowed and strongly or weakly rounded to the insertion; margins plane; alar cells well differentiated, forming a distinct group 4. *H. callichroum*
 6. Plants small-sized, procumbent or erect to ascending in dense tufts; stem leaves ovate-lanceolate, 1.3–1.5×0.4–0.5 mm; laminal cells 40–60(–70)×3–4 μm in lumina *H. hamulosum**
 6. Plants medium-sized, usually procumbent; stem leaves ovate- to oblong-lanceolate with longer acumen, 1.5–2.8×0.4–0.6 mm; laminal cells 50–80(–90)×3–4 μm 10. *H. subimponens* subsp. *subimponens*
7. Alar parts of leaves consisting of heterogeneous cells, with enlarged, thin-walled, hyaline cells at the outer angle *H. fertilis**
7. Alar parts of leaves consisting of homogeneous subquadrate to rectangular cells, in most cases without enlarged, hyaline cells 8
 8. Alar parts of leaf strongly excavate, composed of porose cells that are thick-walled 3. *H. bambergieri*
 8. Alar parts of leaf not or only slightly excavate, composed of cells that are not thick-walled 9
9. Plants large-sized; leaves more markedly dimorphic in stem- and branch leaves; stem leaves cordate-auriculate at base 12. *H. procerrimum*
9. Plants small- to medium-sized; leaves slightly dimorphic in stem- and branch leaves; stem leaves

- not cordate-auriculate at base 10
10. Leaves distinctly serrate; operculum rostrate; growing chiefly on tree-trunks
 *H. pallescens**
10. Leaves almost entire to serrulate; operculum shorter-apiculate; growing chiefly on rocks or earth 11
11. Autoicous; plants smaller (branch leaves 0.2–0.4 mm wide); pseudoparaphyllia numerous, narrow-lanceolate to filamentous; subquadrate alar cells 4–10 in the marginal row 8. *H. recurvatum*
11. Dioicous; plants usually larger (branch leaves 0.3–0.6 mm wide or more); pseudoparaphyllia fewer, wider-foliose; subquadrate alar cells 8–16(–20) in the marginal row 12
12. Pseudoparaphyllia semicircular or round-rectangular; leaves broader, more strongly concave, smooth, with plane margins; subquadrate alar cells numerous, 10–16(–20) in the marginal row 11. *H. vaucheri*
12. Pseudoparaphyllia ovate to lanceolate; leaves narrower, slightly concave, usually plicate, with revolute, occasionally plane margins; subquadrate alar cells fewer, 8–15 in the marginal row 9. *H. revolutum*

3. ***Hypnum bambergeri*** Schimp., Syn. Musc. Eur., ed. 1, Addend. 698 (1860).

Specimens examined. Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 2000 m, July 21, 1995 (*Higuchi 27957*); 2100 m, July 22, 1995 (*Higuchi 28023*).

Distribution. Spitsbergen, Iceland, Europe, Russia, Canada, Alaska and Greenland (Ando 1996).

Notes. This species is characterized by having falcate, smooth leaves with entire channelled acumen, incrassate, porose laminal cells and brown-colored alar parts of leaves. According to Ando (1996), the distribution of the species in Asia is limited to Siberia north of about 60°N and the Altai Mountains. Ignatov *et al.* (2006) reported this species from Kazakhstan and Kyrgyzstan as *Stereodon bambergeri* (Schimp.) Lindb.

4. ***Hypnum callichroum*** Brid., Bryol. Univ. 2: 631 (1827).

Specimen examined. Kazakhstan, North of Semipalatinsk, 340 m, July 17, 1995 (*Higuchi 27762*).

Distribution. Europe, Siberia and northern N. America (Ando 1997, as *H. callichroum* subsp. *callichroum*). New to Kazakhstan.

Notes. This species is characterized by the hyalodermatous stems and inflated hyaline alar

cells of leaves. Ando (1997) described a new subspecies of the species, *H. callichroum* subsp. *japonicum*, from alpine region of Japan, which is distinguished from subsp. *callichroum* by the smaller-sized plants usually showing more close branching and foliation, and the somewhat shorter laminal cells and setae.

5. ***Hypnum cupressiforme*** Hedw. var. ***cupressiforme***, Spec. Musc. 291 (1801).

Specimens examined. Kazakhstan, Sarkand, 900 m, July 20, 1995 (*Higuchi 27814+Hypnum revolutum*); Mts. Dzhungarsky Alatau, Maly Baskan, 1900 m, July 22, 1995 (*Higuchi 27985, 28085, 28088, 28089, 28096, 28106*); 2100 m, July 22, 1995 (*Higuchi 28029*); Mts. Zailisky Alatau, north of Almaty, 1750 m, July 25, 1995 (*Higuchi 28131*). Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2800 m, Aug. 1, 1995 (*Higuchi 28411*); 2900 m, July 31, 1995 (*Higuchi 28355*); 2920 m, Aug. 1, 1995 (*Higuchi 28428*).

Distribution. Widely distributed in the world.

6. ***Hypnum cupressiforme*** Hedw. var. ***subjucaceum*** Molendo, Ber. Naturh. Ver. Augsburg. 18: 183 (1865).

Specimens examined. Kazakhstan, Sarkand, 900 m, July 20, 1995 (*Higuchi 27785*); Mts. Dzhungarsky Alatau, Maly Baskan, 1900 m, July 22, 1995 (*Higuchi 28083, 28098, 28100*). Kyr-

gyzstan, Tien Shan, Mts. Tereskey Alatau, 3600 m, July 31, 1995 (*Higuchi 28375*); near glacier, 3600 m, Aug. 2, 1995 (*Higuchi 28459, 28466*); Mts. Alaisky, south of Gulcha, 2000 m, Aug. 9, 1995 (*Higuchi 28643, 28652, 28663, 28668*).

Distribution. Widely distributed in the Northern Hemisphere and New Zealand. New to Kyrgyzstan.

Notes. This variety is characterized by having subjulaceous branches and the not or weakly falcate leaves with excavated and usually brown-colored alar areas. Although Ignatov *et al.* (2006) doesn't list the variety from Kazakhstan, Ando (1990) cited the specimen of the variety from "Kasachstania, Montes Kungej-Alatau, 2000 m, Lisowski (NICH 208140)."

7. **Hypnum lindbergii** Mitt., J. Bot. 2: 123 (1864).

Specimen examined. Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 2400 m, July 21, 1995 (*Higuchi 27890*).

Distribution. Widely distributed in the Northern Hemisphere and Brasil.

Notes. Hedenäs (1990) transferred this species to the genus *Calliergonella* based on some characteristics, such as appendiculate cilia and large groups of strongly inflated alar cells of stem leaves.

8. **Hypnum recurvatum** (Lindb. & Arn.) Kindb., Enum. Bryin. Exot. 100 (1891).

Specimens examined. Kazakhstan, Sarkand, 900 m, July 20, 1995 (*Higuchi 27789*); Mts. Zailisky Alatau, north of Almaty, 1750 m, July 25, 1995 (*Higuchi 28126*). Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2500 m, Aug. 2, 1995 (*Higuchi 28502, 28503*); 2920 m, Aug. 1, 1995 (*Higuchi 28432, 28434*).

Distribution. Urals, Fennoscandia, Tatra, Carpathians, Alps, Jura, Pyrenees, Caucasus, Siberia, Mongolia, Canada, Montana and Greenland (Ando 1973). New to Kyrgyzstan.

Notes. This species is closely related to *Hypnum revolutum*, but is distinguished from it by having narrow-lanceolate to filamentous

pseudoparaphyllia (ovate to lanceolate in *H. revolutum*), leaves with margins plane or recurved below (usually margins revolute from the base up to near the apex in *H. revolutum*) and subquadrate alar cells 4–10 in the marginal row (8–15 in the marginal row in *H. revolutum*).

9. **Hypnum revolutum** (Mitt.) Lindb., Oefv. K. Vet. Ak. Foerh. 23: 542 (1867).

Specimens examined. Kazakhstan, Sarkand, 900 m, July 20, 1995 (*Higuchi 27814+Hypnum cupressiforme* var. *cupressiforme*); Mts. Dzhungarsky Alatau, Maly Baskan, 900 m, July 21, 1995 (*Higuchi 27820, 27825*); 1900 m, July 22, 1995 (*Higuchi 27979, 27980, 27984, 28001, 28067, 28073, 28079*); 2100 m, July 22, 1995 (*Higuchi 27834*); 2270 m (*Higuchi 28019*); 2400 m, July 21, 1995 (*Higuchi 27851, 27856, 27868, 27881, 27899*); 2550 m (*Higuchi 27907, 27931, 27939*); Mts. Zailisky Alatau, north of Almaty, 1750 m, July 25, 1995 (*Higuchi 28136, 28139*); near reservoir, 2500 m (*Higuchi 28142, 28153, 28159*); 2560 m, July 27, 1995 (*Higuchi 28259, 28265*); 2600 m (*Higuchi 28287*); 2680 m, July 26, 1995 (*Higuchi 28254*); 2800 m (*Higuchi 28177*); 2850 m (*Higuchi 28182, 28183*); 3100 m (*Higuchi 28205, 28208*); 3210 m (*Higuchi 28219, 28233, 28243, 28246*). Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2480 m, July 30, 1995 (*Higuchi 28317*); 2700 m (*Higuchi 28339*); 2920 m, Aug. 1, 1995 (*Higuchi 28427*); 3370 m, July 31, 1995 (*Higuchi 28398*); 3600 m, Aug. 2, 1995 (*Higuchi 28454, 28468, 28469, 28479*); 3640 m (*Higuchi 28386*); 3950 m, (*Higuchi 28381*); Mts. Kirghisky, 3400 m, Aug. 6, 1995 (*Higuchi 28637*); 3550 m (*Higuchi 28561, 28563, 28575, 28576*); near glacier, 3600 m (*Higuchi 28583, 28586, 28604, 28606, 28608*); Mts. Alaisky, south of Gulcha, 3550 m, Aug. 9, 1995 (*Higuchi 28658*); 3600 m (*Higuchi 28649*); Mts. Za Alaisky, 2700 m, Aug. 11, 1995 (*Higuchi 28694, 28698*).

Distribution. Widely distributed in the Northern Hemisphere and Antarctic Peninsula (Ando 1973).

Notes. This species is the commonest

species of the genus in the area investigated. *Hypnum revolutum* is variable in size, but is most distinct in having more or less plicate leaves with strongly revolute margins and alar parts of leaves consisting of homogeneous subquadrate cells.

10. **Hypnum subimponens** Lesq. subsp. **subimponens**, Trans. Am. Phil. Soc., n. ser. **13**: 14 (1880).

Specimens examined. Kazakhstan, Sarkand, 900 m, July 20, 1995 (*Higuchi 27790, 27809*).

Distribution. Siberia and northwestern N. America (Ando 1997). New to Kazakhstan.

Notes. This subspecies differs from *H. subimponens* subsp. *ulophyllum* (Müll.Hal.) Ando distributed in Himalayas, China, Taiwan, Korea and Japan by its larger plants, shorter costae of leaves and longer, arched capsules.

11. **Hypnum vaucheri** Lesq., Mem. Soc. Sc. Nat. Neuchatel **3**(3): 48 (1846).

Specimen examined. Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 1900 m, July 21, 1995 (*Higuchi 28101*).

Distribution. Widely distributed in the Northern Hemisphere.

12. **Hypnum procerrimum** Molendo, Flora **49**: 458 (1866).

Specimens examined. Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 2550 m, July 21, 1995 (*Higuchi 27932, 27941*); Mts. Zailisky Alatau, north of Almaty, 3210 m (*Higuchi 28222*). Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2920 m, Aug. 1, 1995 (*Higuchi 28412, 28414, 28438, 28439*); near glacier, 3600 m, Aug. 2, 1995 (*Higuchi 28476*).

Distribution. Widely distributed in the Northern Hemisphere.

Notes. This species is characterized by having smooth or slightly plicate only in upper parts of leaves, plane margins of branch leaves and alar parts of leaves consisting of numerous homogeneous subquadrate cells.

Hylocomiaceae

13. **Hylocomium splendens** (Hedw.) Schimp., Bryol. Eur. **5**: 173 (1852).

Specimens examined. Russia, Novosibirsk, Central Siberian Botanical Garden, 150 m, July 14, 1995 (*Higuchi 27747*). Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 1900 m, July 22, 1995 (*Higuchi 27993*); 2100 m, July 21, 1995 (*Higuchi 27836, 27837*); 2500 m (*Higuchi 27901*). Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2430 m, July 30, 1995 (*Higuchi 28331, 28336*).

Distribution. Widely distributed in the Northern Hemisphere.

14. **Pleurozium schreberi** (Brid.) Mitt., J. Linn. Soc. Bot. **12**: 537 (1869).

Specimens examined. Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2920 m, Aug. 1, 1995 (*Higuchi 28426*); 3640 m, July 31, 1995 (*Higuchi 28389*).

Distribution. Widely distributed in the Northern Hemisphere.

15. **Rhytidiadelphus triquetrus** (Hedw.) Warnst., Krypt. Fl. Brandenburg **920**: 996 (1906).

Specimens examined. Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2430 m, July 30, 1995 (*Higuchi 28318, 28320, 28326*).

Distribution. Widely distributed in the Northern Hemisphere.

16. **Rhytidium rugosum** (Hedw.) Kindb., Bih. K. Svensk. Vet. Ak. Handl. **7**(9): 15 (1883).

Specimens examined. Kazakhstan, Mts. Dzhungarsky Alatau, Maly Baskan, 2400 m, July 21, 1995 (*Higuchi 27891*); 2480 m (*Higuchi 27953*); Zailisky Alatau, north of Almaty, 3000 m, July 26, 1995 (*Higuchi 28202*). Kyrgyzstan, Tien Shan, Mts. Tereskey Alatau, 2920 m, Aug. 1, 1995 (*Higuchi 28413*).

Distribution. Morocco, Europe, Caucasus, Himalayas, N. and C. Asia, China, Japan, N. America, Mexico, Guatemala and Greenland.

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