

Botanical Garden-Institute FEB RAS  
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# botanica pacific

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A JOURNAL OF PLANT SCIENCE  
AND CONSERVATION

VOLUME 3, No. 2 2014

VLADIVOSTOK 2014

# Botanica Pacifica

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ISSN: 2226-4701

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Издание зарегистрировано Федеральной службой по надзору в сфере связи, информационных технологий и массовых коммуникаций Министерства связи и массовых коммуникаций Российской Федерации; свидетельство ПИ № ФС 77–52771

Подписной индекс в каталоге  
Роспечати: 70659

Journal Secretariat:

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## Revision of the Russian Marchantiales. I. A Review of the Genus *Plagiochasma* Lehm. et Lindenb. (Aytoniaceae, Hepaticae)

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Manuscript received: 06.06.2014

Review completed: 20.10.2014

Accepted for publication: 28.10.2014

Published online: 30.10.2014

### ABSTRACT

The genus *Plagiochasma* Lehm. et Lindenb. counts two species in Russia. In the course of the present study, many specimens were re-identified and distribution patterns were defined more exactly. Identification key to the species known in the treated area is compiled. The species descriptions based on specimens from Russia are provided, and the data for distribution, ecology preferences and specific morphological characteristics are described for each taxon.

### Keywords

*Plagiochasma*, Aytoniaceae, Russia, taxonomy, phytogeography, Hepaticae

### РЕЗЮМЕ

Боровичев Е.А., Бакалин В.А., Мамонтов Ю.С. Ревизия порядка Marchantiales в России. I. Обзор рода *Plagiochasma* Lehm. et Lindenb. (Aytoniaceae, Hepaticae)

Проведена ревизия рода *Plagiochasma* Lehm. et Lindenb., представленного в России двумя видами. В ходе проведенного исследования значительное количество изученных образцов было переопределено и, таким образом, распространение видов существенно уточнено. Составлен ключ для определения видов рода в России. Рассмотрены распространение признаваемых таксонов в России, а также их экологические предпочтения и специфические черты морфологии.

### Ключевые слова

*Plagiochasma*, Aytoniaceae, Россия, таксономия, фитогеография, печеночники

This paper continues a series of works dealing with the taxonomy of Marchantiales in Russia (Borovichev et al. 2009, 2012, Borovichev & Bakalin 2013). *Plagiochasma* Lehm. et Lindenb. is relatively large genus of thallose hepatics and includes 16 species (Bischler 1998). The genus is one of the most distinctive within the genera of Marchantiales in Russia due to dorsal short-stalked female receptacles (sometimes almost sessile) without rhizoidal furrow; large, fleshy and almost globose involucre which beyond the margin of the receptacles. However, when sterile, species of *Plagiochasma* may be mistaken with *Reboulia hemisphaerica* (L.) Raddi or even *Pressia quadrata* (Scop.) Nees.

This study is largely based on a critical revision of ca. 50 specimens that are kept in the Botanical Garden-Institute, Vladivostok (VBGI, with incorporated collection from VLA) and the herbaria of the Polar-Alpine Botanical Garden-Institute (KPABG), Siberian Institute for Plant Physiology (IRK), Main Botanical Garden (MHA) and Komarov's Botanical Institute (LE). These herbaria altogether comprise over 90 % of all specimens available in Russia. Below we provide the review on distribution, morphology and taxonomy of species of the genus *Plagiochasma* for Russia.

***Plagiochasma* Lehm. et Lindenb., in Nov. Stirp. Pug. 4: 13. 1832. [nom. cons.]**

**Thalli** drought-tolerant; small- to medium-sized, (3–) 5–15 (–24) mm long, (1.5–) 2–5 (–6) mm wide; forming more or less pure mats; simply or sparingly dichotomously

branched, sporadically with ventral innovations; usually yellow to yellow-green, with often red-brown to purple secondary pigmentation, especially along margins, but never grayish blue or violet; **thallus dorsal surface** not reticulate; flat, sometimes slightly concave. **Dorsal epidermis** firm, with thin- to thickened cell walls, with or without trigones; **pores** elevated above epidermis; simple, surrounded by (1–) 2–3 concentric rings of (5–) 6–8 cells in each, with or without trigones. **Rhizoids** smooth and pegged, densely covering ventral surface of midrib of thallus. **Thallus underside** with ventral scales in two rows on each side to margins from midrib; with numerous scattered mainly hyaline oil-cells; each scale with 1–3 appendages, narrow to broad, often constricted at base; **appendage margins** often sinuous-dentate and bearing slime-papillae. **Monoicous** (autoicous). Antheridia in sessile receptacles on terminal or ventral branches. **Female receptacle** dorsal on leading thallus; **stalk of receptacle** hyaline to, sometimes, purple at the base; subsessile; without rhizoid furrow; **carpocephalum disc** with 3–4 lobes and 1–4 involucre, with single sporophyte in each; **pseudoperianth** lacking. **Spores** yellow to brown; distinctly tetrahedral, with a wide, the faces usually with coarse, rather regular areolas. **Elaters** yellowish; without spiral thickenings. [The description include features observed in the species of *Plagiochasma* recognized in Russia.]

**Type:** *Plagiochasma cordatum* Lehm. et Lindenb., Nov. Stirp. Pug. 4: 13. 1832

According to the current systematics the genus contains two subgenera: subgen. *Plagiochasma* and subgen. *Microphyllum* Bisch. (Bischler 1977) that differ from each other in pore morphology. Subgen. *Plagiochasma* characterized by pores somewhat elevated above the surface of dorsal epidermis and surrounded by several rings of cells. Contrary, subgen. *Microphyllum* characterized by not elevated pores surrounded by only single ring of small cells, sometimes with conspicuously thickened radial walls.

Two species of *Plagiochasma* were reported from Russia: *Plagiochasma pterospermum* C. Massal and *Plagiochasma japonicum* (Steph.) C. Massal. (Konstantinova, Bakalin et al. 2009). Both of them belong to the subgen. *Plagiochasma*.

### Key to the species already known in Russia or may be found here

1. Thalli apical segments similar in length to other segments; ventral scales with 1–2 triangular to widely triangular, hyaline to rose, pink or violet appendages, appendage length/width ratio 1.5–2.5 : 1, appendage apex not acuminate .....  
..... *P. japonicum* (Steph.) C. Massal.

- Thalli apical segments 2–4 times shorter than other segments; ventral scales with 1–3 narrowly-triangular (sometimes even linear) hyaline to reddish or rusty appendages, appendage length/width ratio 3 and more, appendage apex long acuminate ..... **2**

2. Epidermal cells thin-walled, without distinct trigones; epidermal pores with thin radial walls; spore proximal and distal faces either ridged by  $\pm$  irregularly formed alveoli or (rarely) regularly alveolar ..... *P. cordatum* Lehm. et Lindenb.

[the species is recorded from adjacent areas in China and Japan (Bischler 1979, Piippo 1990, Katagiri & Furuki 2012) and may be found in Russian Asia]

- Epidermal cells with thin or slightly thickened walls and almost nodulose trigones; epidermal pores with thickened radial walls; distal spore reticulated with regular and deep alveoli ..... *P. pterospermum* C. Massal.

***Plagiochasma pterospermum*** C. Massal., Mem. Acad. Agric. Verona 73(2): 46. 1897. – *Plagiochasma elongatum* var. *ambiguum* C. Massal., Mem. Acad. Agric. Verona 73(2): 49. 1897. – *Plagiochasma articulatum* Kash., New Phytol. 13: 320. 1914. – *Plagiochasma bicornutum* Steph., Sp. Hep. 6: 5. 1917. – *Plagiochasma quadricornutum* Steph., Sp. Hep. 6: 9. 1917. – *Plagiochasma nipponicum* Horik., Bot. Mag. (Tokyo) 51: 427. 1937. – *Plagiochasma intermedium* var. *nipponicum* (Horik.) Inoue, J. Hattori Bot. Lab. 25: 210. 1962. – *Plagiochasma sessilicephalum* Horik., J. Sci. Hiroshima Univ., ser. B, Div. 2, Bot. 2: 109. 1934.

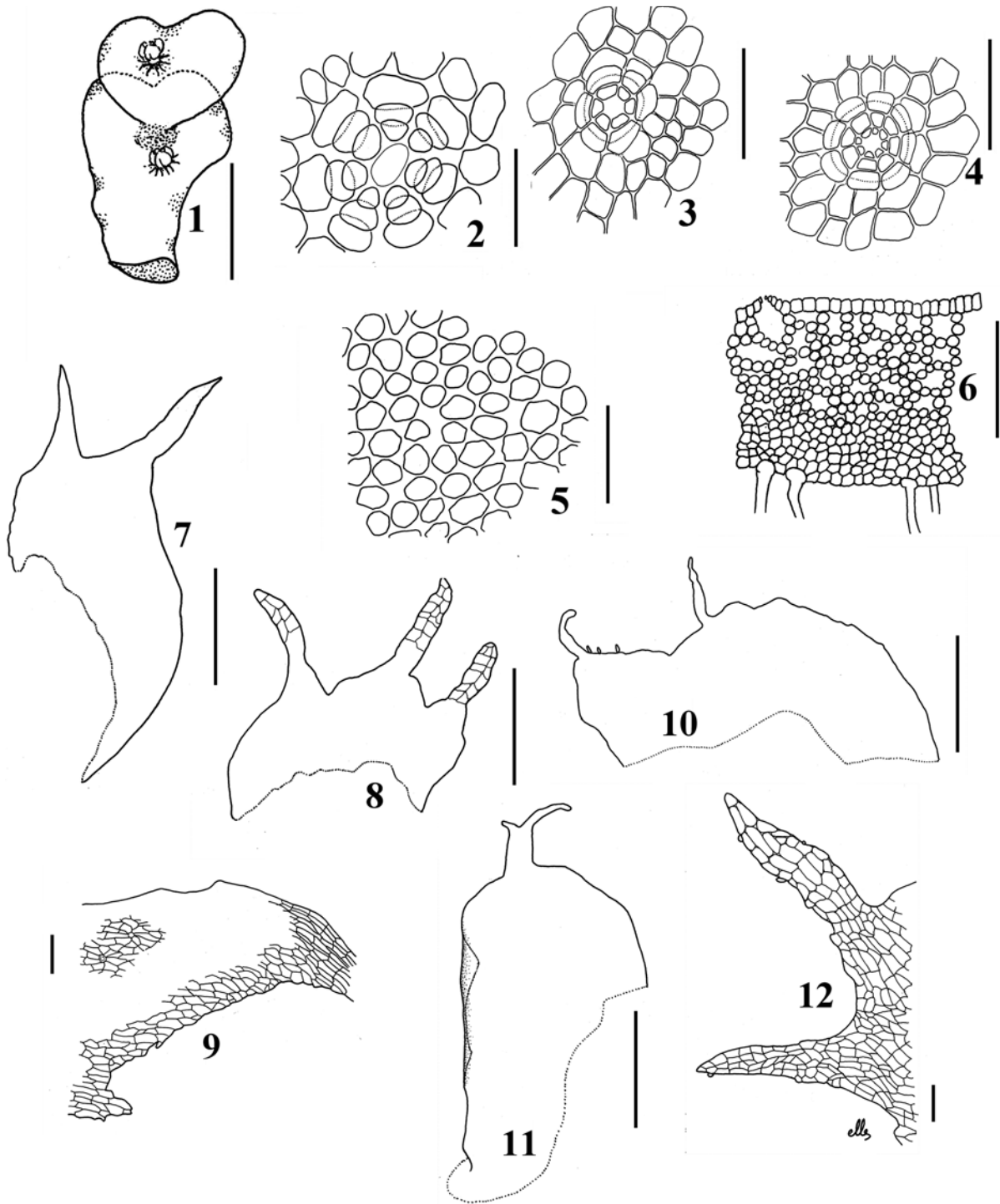
**Illustrations:** Kashyap, 1929 (pl. XVI, fig. 1–3 as *P. articulatum*); Horikawa 1934 (p. 110, fig. 1 (as *P. sessilicephalum*); Horikawa 1937 (p. 427, fig. 1; p. 428, fig. 2 (as *P. nipponicum*); Bischler 1979 (p. 57, fig. XI; p. 59, fig. XII; p. 63, fig. XIII); Bapna & Kachroo 2000 (p. 417, fig. 249A); Singh & Singh 2009 (p. 350, fig. 96; p. 351, pl. 89).

**Map:** Bischler 1979 (p. 60, carte 5).

**Exsiccatae:** Hattori S. & Mizutani M. 1954–2006. Hepaticae Japonicae Exsiccatae. Ser. 7, #331! (as *P. intermedium*); ser. 14, #690! (as *P. intermedium*); Deguchi H. & Yamaguchi T. 1999. Bryophytes of Asia. Facs. 6, #147! (as *P. japonicum*); Choi S.-S. 2009. Hepaticae Korea Exsiccatae! (as *P. japonicum*).

**Description** (Fig. 1): **Thalli** small- to medium-sized, 5–15 (–24) mm long, 2–4 (–6) mm wide, forming more or less pure mats; dichotomously branched, rarely with ventral innovations; **segments** oblong; apical segments frequently 2–4 times shorter than other segments; **apex** notched; **upper surface** not reticulate, flat, sometimes slightly concave; **upper surface** yellowish-green to olive-green or strongly yellowish, sometimes with red-brown secondary pigmentation; **thallus margins** undulate to crispate, strongly incurved when dry; purplish to red-brown tinged. **Dorsal epidermis** firm; **cells** (15–) 25–30 (–45)  $\times$  (10–) 15–24 (–35)  $\mu\text{m}$ , with thin- or thickened cell walls and large nodulose trigones; oil-cells sparsely distributed; **pores** elevated above epidermis; hole (15–) 20–28 (–32)  $\mu\text{m}$  in diameter, surrounded by (1–) 2–3 concentric rings of (5–) 7–8 cells in each, with thickened radial walls. **Aerenchyma** occupying 1/2 – 2/3 (–3/4) of the thallus height and 3–5-layered in the middle; **air chambers** small and empty. **Ventral tissue** parenchymatous, absent beneath the wing; consisting of small, thin-walled cells. **Midrib** relatively ill-defined, thallus over midrib (270–) 320–480 (–620)  $\mu\text{m}$  thick. **Rhizoids** smooth and pegged, densely covering ventral surface of midrib of thallus. **Ventral scales** shiny, purple, reddish to carrot-red at margin; asymmetrically lunulate; (700–) 1000–1600  $\mu\text{m}$  long and (300–) 600–800 (–1000)  $\mu\text{m}$  wide, **cells** 20–30  $\mu\text{m}$  long and (10–) 15 (–20)  $\mu\text{m}$  wide, with numerous scattered hyaline oil-cells; **appendage** 1–2 (–3) per each scale, plane, narrowly-triangular or lanceolate to linear; hyaline or reddish to carrot red; **appendage cells** (20–) 25–35 (–40)  $\mu\text{m}$  long and 20–25  $\mu\text{m}$  wide; with few marginal slime papillae; **appendage apex** long acuminate, terminated by 1 cell; **base** neither narrow nor plicate but appendage sometimes longitudinally plicate; length/width ratio 3–6 : 1. **Sexual condition** autoicous. **Male receptacle** on terminal or ventral branches, situated after female receptacle and always at base of articulation; forms V- to hoof-shaped or reniform disk or rarely loosely dispersed group in center of thallus; antheridial scales red or hyaline, acuminate at apex, margin with short slime-papillae. **Female receptacle** dorsal on leading thallus, situated at the base of articulation or in median part of the thallus; stalk of receptacle hyaline to, sometimes, purple at the base; sessile, up to 6 mm long, 0.5–0.8 mm wide; **archegonial scales** at base and rarely at apex of receptacle stalk, numerous, red to hyaline, partially tinged with red; narrowly lanceolate to almost linear, with slime papillae. **Carpoccephalum** disc with 3–4 lobes and 1–4 involucre, with single sporophyte in each. **Capsule** brown, globose. **Spores** 56–82  $\mu\text{m}$  in diameter; light- to dark brown; reticulated; wing margin well defined, 8–10  $\mu\text{m}$  wide. **Elaters** yellowish, 200 to 250  $\mu\text{m}$  long and 12–14  $\mu\text{m}$  wide; without spiral thickenings.

**Differentiation and variation.** *P. pterospermum* hardly differs from *P. japonicum* and *P. cordatum* Lehm. et Lindenb. and may be easily mistaken with them. The main differentiation features are given in the key. The misidentification of *P. pterospermum* seems to be very easy when sterile plants are in the hand. In the latter case the main attention should be paid to thallus size and epidermal cells features. *P. cordatum* has a wider, 4–6 (–7) mm wide and freely



**Figure 1** *Plagiochasma pterospermum* C. Massal. (1,3-4, 6-9, 12 – from Primorsky Province, Nakhodka City Area, Borovichev, 30.X.2013 (VBGI); 2, 5, 10-11 – from Primorsky Province, Dal'negorsk Town Area, Bakalin, 16.IX.2011 (VBGI). 1 – habit of plant, dorsal view; 2-4 – air-pores from dorsal epidermis of thallus; 5 – dorsal epidermis of thallus; 6 – part of transverse section with air-pore; 7-8, 10-11 – ventral scales with appendages; 9 – body of ventral scale; 12 – appendages of ventral scale. Scale bars: 3 mm for 1; 0.5 mm for 7-8, 10-11; 300  $\mu$ m for 6; 80  $\mu$ m for 3-5; 50  $\mu$ m for 2, 9, 12.

branched thallus, yellowish-green to dark green of thallus upper surface coloration, epidermal cells without distinct trigones and epidermal pores with thin radial walls with never nodulose trigones. Contrary, *P. pterospermum* characterized by narrower, rarely branched thallus, 2-4 (-6) mm wide, mostly with yellowish upper surface coloration, dorsal epidermal cells with nodulose trigones and pores with thickened radial walls.

When sterile, *P. pterospermum* and *P. japonicum* may be confused with *Reboulia hemisphaerica* or even *Pressia quadrata*. From *Reboulia hemisphaerica* the species of *Plagiochasma* differ in: 1) ventral scales with 1-3 widely to narrowly-triangular or lanceolate appendages (may be linear, but very rarely) vs. ventral scales with 2-3 (-4) narrow linear to long filiform appendages in *R. hemisphaerica*; 2) epidermal pores surrounded by (1-) 2-3 concentric cell rings vs. (3-) 4-6

concentric cell rings in *R. hemisphaerica*. From *Pressia quadrata* the *Plagiochasma* species differ in: 1) pores not visible with hand-lens vs. pores visible on the dorsal thallus surface with hand-lens as whitish or grayish colored points in *Pressia*; 2) simple pores vs. barrel-shaped pores in *Pressia*; 3) ventral scales with 1–3 widely triangular to narrowly-triangular or lanceolate appendages vs. single lanceolate appendage in *Pressia*; 4) presence oil-cells in ventral scales vs. lacking oil-cells in ventral scales in *Pressia*.

**Ecology:** *P. pterospermum* prefers Ca-rich substrates, commonly growing in rock cracks and crevices filled with fine-grained soils; more rarely it occurs on steep fine soil slopes to watercourses. It forms pure mats or sometimes associated with *Reboulia hemisphaerica* and *Mannia fragrans* (Balb.) Frye et L. Clark.

**Distribution:** The area of the species covers Southern (India, Pakistan, Nepal, Bhutan), South-Eastern (Philippines) and Eastern (China, Japan, Taiwan, Republic of Korea and Asian part of Russia) Asia (Bischler 1979, Piippo 1990, Yamada & Choe 1997, Long 2006, Piippo & Koponen 2013, Katagiri & Furuki 2012, Singh & Singh 2009, Konstantinova, Bakalin et al. 2009).

Kamimura (1939) recorded *Plagiochasma intermedium* Lindenb. et Gottsche for Moneron Island, a small island near Sakhalin, the Russian Far East. Later Bischler (1979) studied 21 specimens identified as *P. intermedium* from Asia (but not that from Moneron Island) and found most of them belong to *P. japonicum*, also *P. pterospermum*, and (only two specimens) to *P. cordatum*. In the same paper Bischler also writes (1979: 45): «Par contre, sa [*P. japonicum*] présence à Sakhalin où le climat est nettement continental, paraît peu probable». This was the reason the record of *P. intermedium* from Sakhalin was tentatively regarded by Bakalin (2006) and Konstantinova, Bakalin et al. (2009) as the record of *P. pterospermum*. Whether this suggestion is correct or not we could not check in the present study.

Seventy years later Andrejeva (2009) recorded this species from Republic of Altai, Irkutsk and Chita Provinces (South Siberia, Russia). We were able to study only one specimen of the three cited by Andrejeva (2009) that was collected in Republic of Altai. That record is the misidentification for *Plagiochasma japonicum* since plants have: 1) dorsal epidermis with slightly thickened walls, and without nodulose trigones; 2) ventral scales, pink to violet colored, with 1–2 widely triangular appendages, plicate, slightly constricted at base. We strongly suggest two other specimens mentioned in the cited paper (unavailable for us in the present study) should be also checked for other taxa.

In the course of the current study *P. pterospermum* was firstly found in Amurskaya Province, Khabarovsk and Primorskii Territories. Taking into account the general distribution patterns of this species, these records were highly expected due to the climatic conditions of the treated areas.

**Specimens examined:** **RUSSIA** (newly reported areas marked by asterisk). \***AMURSKAYA PROVINCE**, upper course of Amur River, slopes of cliffs, in shade, 18.VIII.1891, Korzhinskij, with antheridia and archegonia (VBGI, KPABG; as *Mannia sibirica*); **IRKUTSK PROVINCE**, Baikal Lake Area, Bolshie Koty Village vicinity, on rocks, 16.VIII.1982, Váňa (KPABG #105876, as *Reboulia hemisphaerica*; H #3179821; TNS; as *Mannia pilosa* (Hornem.) Frey & L. Clark); \***KHABAROVSK TERRITORY**, Sovetsko-Gavanskii District,

Botchi River Valley, upper course of the Srednyaya Botchi River, on shady rocks, 25.VIII.1924, Shishkin (LE, KPABG #114185); Middle part of Anuj River, 49°22'35.6"N 137°43'11.4"E, 202 m alt., vertical cliffs ca. 40 m of height along river, shaded in base by broadleaved *Betula*-forest, cliff crevice in part shade, 21.IX.2009, V.A. Bakalin #Kh72-17-09, Kh72-26-09 (VBGI; as *Reboulia hemisphaerica*); \***PRIMORSKII TERRITORY**, Dal'negorsk Town Area, upper course of Gorbusha River, Dovgalevskaya Mt., 44°37'02"N 135°39'22"E, 303 m alt., western-facing limestone cliffs, vertical wells in part shade, with antheridia, archegonia and juvenile sporophyte, 16.IX.2011, Bakalin #P64-4-11, P64-10-11 (VBGI; as *Reboulia hemisphaerica*); Partizanskaya Creek valley, limestone Massif Area, 44°35'12"N 135°33'24"E, 505 m alt., limestone fine-grained ground in deep crevices, with antheridia and gynoecia, 15.IX.2011, Bakalin #P63-15-11, P63-16-11, P63-17-11; P63-26-11 (VBGI; as *Reboulia hemisphaerica*); Shkotovskij District, Artyomovka River Valley ca 7 km southward of Mnogoudobnoe Settlement, Golubinaya Mt., 43°21'23.5"N 132°24'40.4"E, 100 m alt., small crevices in limestone cliffs in full sun, 18.V.2010, Bakalin #P2-3-10 (VBGI, KPABG; as *Reboulia hemisphaerica*); Nakhodka City Area, Sestra Mountain, 42°49'39.5"N 132°59'39.5"E, 328 m alt., calcareous rocks and cliffs with scattered oak and *Rhododendron* shrubs, middle part of deep canyon, on sliding clay soil in cliff crevice, 30.X.2013, Borovichev #BP-6-2a-13 (KPABG); ibidem, 42°49'39.4"N 132°59'37.6"E, 300 m alt., fine grained soil in base of cliffs, 14.VIII.2008, Bakalin #P47-6-08, 47-10-08, 47-15-08, 47-15-08 (VBGI, KPABG; as *Reboulia hemisphaerica*); ibidem, 42°50'19.2"N 133°00'12.6"E, 7 m alt., fine grained soil on cliffs shaded by *Quercus*, 17.X.2008, Bakalin #P71-2-08 (VBGI, KPABG; as *Reboulia hemisphaerica*); Partizanskij District, Lozovij Range, limestone cave, on humic vertical wall of entrance, 15.VI.1986, S.K. Gambaryan (VBGI; as *Plagiochasma japonicum*); **CHINA. INNER MONGOLIA PROVINCE**, Great Khingan Range, Saihanwula Nature Reserve, Zheng Valley, 1252 m alt., *Betula-Populus* forest in the valley, fine soil under big stone on steep slope, 3.VIII.2010, Bakalin #China-29-5-10 (VBGI; as *Reboulia hemisphaerica*); **JAPAN. OITA PREFECTURE**, Minamiamabe-gun, Honjo-mura, Onagara, Honjo River, 60 m alt., on limestone by stream, 10.V.1998, Yamaguchi, Itouga, Akiyama (MHA#66A; KPABG; Bryophytes of Asia. Facs. 6, #147 as *Plagiochasma japonicum*); Hepaticae Japonicae Exsiccatae. Ser. 7, #331 as *P. intermedium*; ser. 14, #690 as *P. intermedium*; Ishirouge, Iwaizumi cho, Shimonei-gun, Iwate Prefecture, 1.X.1977, Murai (TNS #043268); **KOREA**. Gangwon-do, Yeongwol-gun, Yeongwol-eup, Donggang River, on shaded limestone covered thin soil near the river, 29.IX.2009, Choi #5270 (KPABG; Hepaticae Korea Exsiccatae as *P. japonicum*).

**Plagiochasma japonicum** (Steph.) C. Massal., Mem. Accad. Agric. Verona 73(2): 47. 1897. — *Aytonia japonica* Steph., Bull. Herb. Boissier 5: 84. 1897. — *Plagiochasma japonicum* var. *chinense* C. Massal., Mem. Accad. Agric. Verona 73(2): 48. 1897. — *Plagiochasma koreanum* Steph., Sp. Hep. 6: 8. 1917. — *Plagiochasma levieri* Steph. in Levier, Nuovo Giorn. Bot. Ital. 13: 353. 1906. — *Plagiochasma macrosporum* Steph., Sp. Hep. 6: 8. 1817. — *Plagiochasma martenii* Steph., Sp. Hep. 6: 8. 1917. — *Plagiochasma paurianum* Udar & Chandra, Rev. Bryol. Lichenol. 33: 213. 1964.

**Exsiccatae:** Hattori S. & Mizutani M. 1954-2006. Hepaticae Japonicae Exsiccatae. Ser. 2, #99! as *Plagiochasma intermedium*; Ser. 6, #279! (as *P. intermedium*).

**Illustrations:** Kashyap 1929 (pl. XV, fig. 9–12 as *P. intermedium*); Udar & Chandra 1964 (p. 216, fig. 1 as *Plagiochasma paurianum*); Udar & Chandra 1965 (p. 77, fig. 1; p. 79, fig. 2; p. 81, fig. 3; p. 83, fig. 4; p. 85, fig. 5; p. 88, fig. 6, p. 91, fig. 7 as *P. intermedium*); Bischler 1977 (p. 73, pl. II, fig. 5–6, 10–15, 17; p. 83, pl. V; p. 47, fig. 7–9; p. 85, pl. VI, fig. 10–11); Bischler, 1979 (p. 40, fig. IV; p. 43, fig. VI; p. 47, fig. VII; ); Bapna & Kachroo 2000 (p. 416, fig. 248); Kazanovskiy 2008 (p. 639); Singh & Singh 2009 (p. 347, fig. 95; p. 348, pl. 88 as *P. intermedium*).

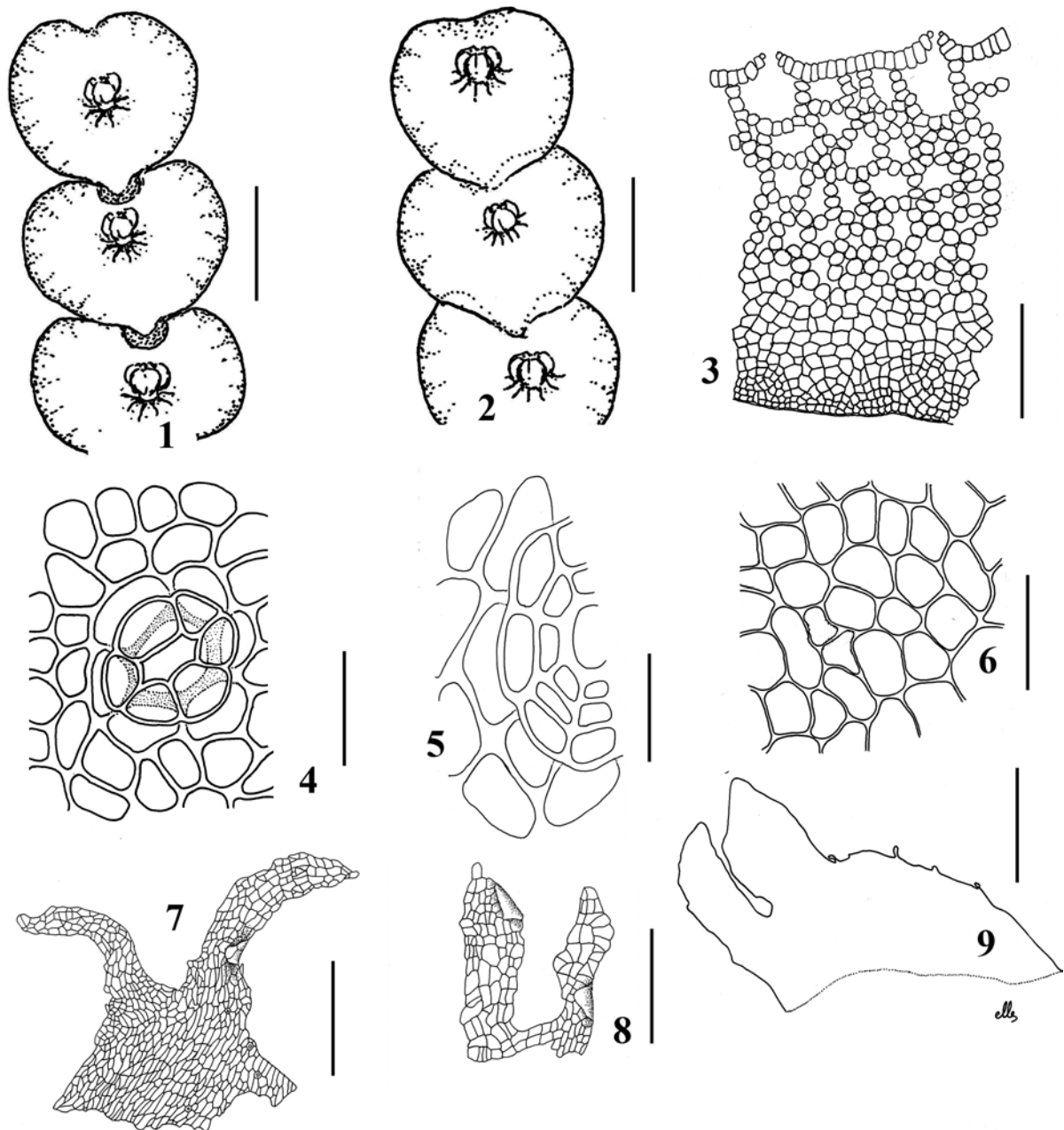


Fig. 2. *Plagiochasma japonicum* (Steph.) C. Massal. (1, 4–6 – from Khabarovsk Territory, Komsomol'sk District, Gambaryan, 2.IX.1987 (VBGI); 2–3, 7–9 – from Primorsky Province, Khasan District, Bakalin, 20.IX.2010 (VBGI). 1–2 – habit of plant, dorsal view; 3 – part of transverse section with air-pore; 4–5 – air-pores from dorsal epidermis of thallus; 6 – dorsal epidermis of thallus; 7, 9 – ventral scales with appendages; 8 – appendages of ventral scale. Scale bars: 3 mm for 1–2; 0.5 mm for 7, 9; 300  $\mu$ m for 8; 150  $\mu$ m for 3; 50  $\mu$ m for 4, 6; 40  $\mu$ m for 5

**Map:** Bischler, 1979 (p. 44, carte 3).

**Description** (Fig. 2, 3): **Thalli** small- to medium-sized, (3–) 5–15 (–20) mm long, (1.5–) 3–5 (–6) mm wide, forming more or less pure mats; simply or sparingly dichotomously branched, sporadically with ventral innovations; **segments** lingulate; **apex** emarginated or notched; **upper surface** not reticulate, plane; **color of upper surface** yellowish-green to dark green, frequently with reddish secondary pigmentation; **thallus margins** relatively broad, slightly undulate to crispate; suberect to strongly incurved (connivent dorsally) when dry; purplish. **Dorsal epidermis** firm, shiny; **cells** (17–) 22–28 (–35)  $\times$  (13–) 20–24 (–28), with thin to slightly thickened cell walls and small to medium,

not nodulose trigones; **oil-cells** sparsely distributed; **pores** slightly to conspicuously elevated above epidermis; 18–30 (–38)  $\mu$ m in diameter, surrounded by (1–) 2–3 concentric rings of (5–) 6–8 cells in each, with moderately to strongly thickened radial walls. **Aerenchyma** 1/2 – 2/3 of the thallus height in the middle, where 3–4-layered; **air chambers** small and empty. **Ventral tissue** parenchymatous, disappear to the wing; consisting of small, thin-walled cells, with solitary oil-cells. **Midrib** relatively ill-defined, thallus over midrib (320–) 400–600 (–720)  $\mu$ m thick. **Rhizoids** smooth and pegged, densely covering ventral surface of midrib of thallus. **Ventral scales** shiny, pink to violet; asymmetrically lunate; (860–) 1200–1600  $\mu$ m long and (600–) 800–1000  $\mu$ m

wide; **ventral scales body** asymmetrically crescentic with sinuous-entire margins or with sporadic development of irregularly projecting teeth; **cells size** 20–25  $\mu\text{m}$  long and 15–20  $\mu\text{m}$  wide; with numerous scattered hyaline or (rarely) silvery-shine oil-cells; **marginal cells** more slender and sometimes obliquely disposed; rarely with few marginal one-celled slime papillae; **ventral scales appendages** 1–2 per scale; plicate; fragile; triangular to widely triangular; **appendage cells size** 20–30  $\mu\text{m}$  long and 18–30  $\mu\text{m}$  wide; **appendage apex** not acuminate; hyaline to pink or violet; length/width ratio 1.5–2 : 1; slightly constricted at the base. **Sexual condition** autoicous, sometimes early decaying thallus bases gives an aspect of dioicous inflorescence. **Male receptacle** on terminal or ventral branches; V- or horse-shoe shaped; antheridia in loosely dispersed group; antheridial scales red to pink, sometimes hyaline, with slime-papillae. **Female receptacle** dorsal on leading thallus; stalk of receptacle hyaline, but sometimes purple at the base; sessile, 0–2.0 mm long, 0.5–0.8 mm wide; **archegonial scales** at base and rarely at apex of receptacle stalk numerous, hyaline to rose; narrow lanceolate to almost linear, with slime papillae. **Carpocephalum** disc concave medially, with 3–4 lobes; involucre 1–3, with a single sporophyte in each. **Capsule** brown, globose. **Spores** 60–90  $\mu\text{m}$  in diameter; light- to dark brown; reticulated; wing margin well defined, 12–15  $\mu\text{m}$  wide. Elaters yellowish, to 300  $\mu\text{m}$  in long and 10–15  $\mu\text{m}$  in diameter; without spiral thickenings.

**Variation:** Margin of ventral scales varies from entire (#P140-1-04) to dentate, where teeth vary from 1–2-celled (#P46-2-10) to long 3–8-celled (#26-08-1/1). Color of ventral scale oil-bodies varied from colorless to (rarely) silvery-shine (#26-08-1/1). *Variation in sexuality:* most authors regarded *Plagiochasma japonicum* as autoicous (Bischler 1977, 1979, Bapna & Kachroo 2000). Studying the material from Trans-Baikal and Primorskii Territories we found the male and female plants often growing in separate patches. Probably it is a result of destruction basal parts of normally autoicous-rosettes. Similar pseudodioicous cases were described for some species of Marchantiales (Schuster 1992, Borovichev et al. 2012, 2014).

**Distribution:** The area covers Southern (Bhutan, India), South-Eastern (Philippines, Hawaiian Islands) and Eastern (China, Mongolia, Japan, Taiwan, Korea and Asian part of Russia) Asia (Bischler 1979, Piippo 1990, Long & Grolle 1990, Meinunger et al. 1991, Yamada & Choe 1997, Katagiri & Furuki 2012, Konstantinova, Bakalin et al. 2009). Earlier, the species was reported in Russia from Altay (Potemkin 2010) and Buryatiya Republics (Kazanovskiy & Potemkin 1995), Zabaikalskii (Afonina et al. 2012) and Primorskii (Gambaryan 1992) Territories. In Siberia, *Plagiochasma japonicum* is widely distributed in the South of Trans-Baikal (Zabaikalskii) Territory, although not found northward of 54°N. In the course of the present study this species was additionally found in Khabarovsk Territory and Irkutsk Province. This species was recorded before for the Russian Far East from the only one locality in Partizanskii District of Primorskii Territory (Gambaryan 1992). However, the cited specimen (VBGI) contains plants of *P. pterospermum*. Due to data in hand this species is more or less common in

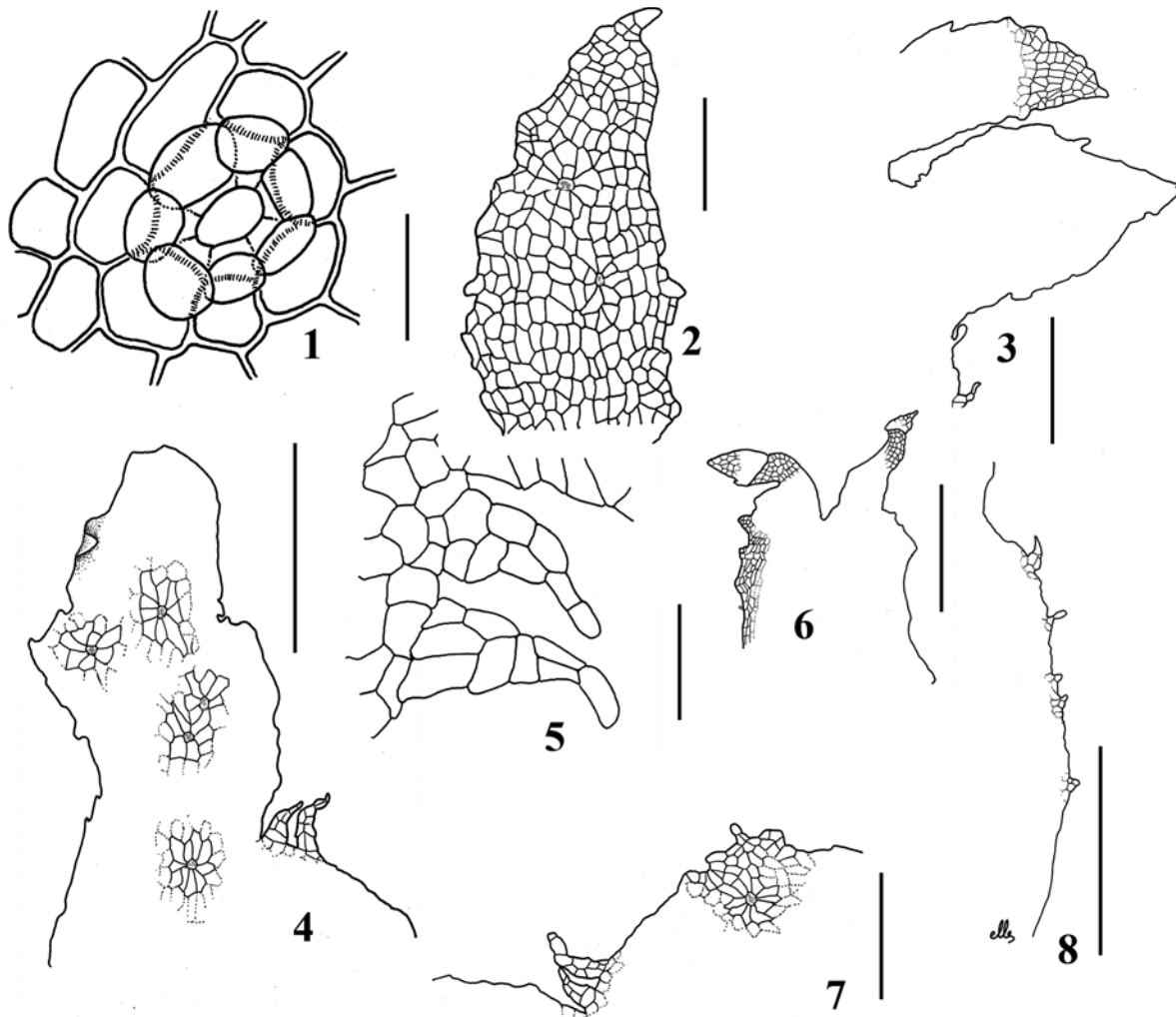
low elevations of mountainous system of the Russian Asia.

**Ecology:** In Siberia, the species occurs usually on South-facing rock outcrops, and grows on soil in rock niches or over thin soil layer over rocks, usually in part shade on slopes of mountains with forest or steppe communities. *Reboulia hemisphaerica*, *Clevea nana* (Shimizu et S. Hatt.) Borovich. et Bakalin, *Mannia fragrans* and *Targionia hypophylla* L. usually occur in the same places, and sometimes growing together with *Plagiochasma japonicum*. Altitude range in Siberia is about 600–1300 m a.s.l. In Trans-Baikal Territory and Irkutsk Province, *P. japonicum* was collected mostly in pure mats, usually bearing archegonia, but very rarely with antheridia and sporophytes. In the Russian Far East this is the species of broadleaved deciduous temperate forest belt. It occurs mostly in open to semi-shaded sites, in pure mats or in association with *Targionia hypophylla* and *Reboulia hemisphaerica*, on steep slopes to watercourses (aside of direct impact of the running water), in cliff crevices of different reaction (both of acidic tufa and Ca-rich limestone).

*Plagiochasma japonicum* included to the Red Data Book of Russia as rare species (Kazanovskiy 2008). Indeed, before it was known from very limited localities in Primorskii Territory (indication based on misidentification, see above) and area near Baikal Lake. Currently many additional localities for this species were found and we have not seen reasons to regard this species as rarity in the Russian liverwort flora.

**Specimens examined: RUSSIA** (newly reported areas marked by asterisk). **ALTAY REPUBLIC**, Altay State Nature Reserve, Chyulyshman River valley, left bank of Kurkure River, waterfall, on wet slope, with gynoecea, 23.V.1982, Zolotuhin & Koroleva (MHA, as *Reboulia hemisphaerica*); ibidem, Tokpak Creek, in the middle course, fine-earth on wet cliff, 23.VII.1993, Ignatov #36/29 (MHA, as *Peltolepis quadrata*); **\*IRKUTSK PROVINCE**, Slyudyanskiy District, Khamar-Daban Range, Margasan River Valley, rocky steep slope, on soil, with antheridia and sporogonia, VIII.2002, Kazanovskiy # T1/29 (IRK). **\*Khabarovsk Territory**, Komsomol'sk District, Tambovka Settlement, 50°55'11"N 138°11'28"E, rocky bank of Amur River, on humus, 2.IX.1987, Gambaryan (VBGI, duplicate in KPABG #116191); **Primorskii Territory**, Khasan District, Kravtsovka Village, Kravtsovka's waterfalls Area, wet tufa cliffs near waterfalls, with juvenile female receptacle, in mixture with *Targionia hypophylla* L., 20.IX.2010, Bakalin #P 46-2-10, 46-3-10 (VBGI); Southern macroslope of the Astafev's Mt. near Scalit'y Cape, cliff, on fine-grained soil in crevice, tangle of shrub, 15.X.2004, Bakalin #P140-1-04 (VBGI, KPABG; as *Reboulia hemisphaerica*); Partizansk District, southern slope of the Chandolaz Mt., cliff crevices, on fine-grained soil, 26.VIII.2007, Cherdantseva #26-08-1/1 (VBGI, KPABG); **Trans-Baikal Territory**, Kyra District, Sokhondinskii State Biosphere Reserve, Khentey-Chikoyskoye Nagor'e Uplands, Agutsa Forest Station, Kumyl-Aliya River Valley, Glubokaya Pad', 1.IX.2009, Yakovchenko (VBGI); Agutsa River Valley, granite outcrops on slope, 18.VII.2010, Afonina #A3510-2 (KPABG, LE); Ende River Valley, rocks on steep slope, 14.VII.2010, Afonina #A2710-1 (KPABG, LE); bank of river, on fine grained soil in a crack of the rock, with sporogonia, 24.08.2011, Mamontov #YuSM-171-11-1 (KPABG, LE); lower of Khukhje-Bajtsa Brook, southern facing rock outcrops on the mountain slope, on fine-grained soil between large boulders, with sporogonia, 27.VIII.2011, Mamontov #YuSM-181-4 (KPABG, LE); Kyra Settlement vicinity, Kyra River Valley, willow stand in the valley of the river, on fine-grained soil in the clefts and on ledges, 17.VIII.2011, Mamontov #YuSM-111-1-1 (KPABG, LE); 8 km NW of Mangut Settlement, on rocks, 25.VII.2006, Afonina ##A7306-1, A7306-3 (KPABG, LE); Karymskiy District, Daur'skiy Range, Aratsagon Mt., motley grass steppe, on soil in cleft of dry rock outcrops, with archegonia, 14.VII.2012, Mamontov #YuSM-265-3 (KPABG, LE); Akscha District, Akscha Settlement vicinity, Onon River valley, bank of the river, outcrops of schist in base of slope with bushes thicket,





**Figure 3** *Plagiochasma japonicum* (Steph.) C. Massal. (All from Primorsky Territory, Partizansk District, 26.VIII.2007 Bakalin #K66-14b-05 (VBGI). 1 – air-pore from dorsal epidermis of thallus; 2–3 – appendages of ventral scale; 4, 5, 7–8 – margins of ventral scale body; 6 – ventral scales with appendages. Scale bars: 0.5 mm for 6; 400  $\mu$ m for 8; 200  $\mu$ m for 3–4, 7; 100  $\mu$ m for 2; 50  $\mu$ m for 1

21.VII.2006, Afonina #A5806-1 (KPABG, LE); National Park “Alhanai”, Ilya River Valley, Dauriskiy Range, *Larix dahurica* forest in lower part of the mountain, on rock-blocks, 9.VII.2006, Afonina #A2206-2 (KPABG, LE); Gazimurskii Zavod District, Gazimurskii Range, Prjamoy Mul'day Brook Valley, southern facing rock outcrops on mountain slope, on soil in the cliff crack, with archegonia and antheridia, 22.VII.2012, Mamontov #YuSM-278-2 (KPABG, LE); Kalganskiy District, Nerchinskiy Range, southern facing rock outcrops on mountain slope, steppe herb community, with sporogonia, 26.VII.2012, Mamontov #YuSM-289-2 (KPABG, LE); Uljetovskiy District, Cherskiy Range, Ingoda River Valley, shrub-grass forest on southern facing mountain slope, on soil in rock niche, with archegonia, 05.VIII.2011, Mamontov, #YuSM-72 (KPABG, LE); **CHINA. INNER MONGOLIA PROVINCE**, Great Khingan Range, Saihanwula Nature Reserve, spurs of Han Mt., northern facing slope covered by dry steppe, fine-soil in dry crevices in full sun, 3.VIII.2010, Bakalin #China-30-7-10 (VBGI); **JAPAN. SAITAMA PREFECTURE**, Nakatsugawa, Ohtaki-mura, Chichibu, 3.V.1955, Inoue (TNS#204651; as *Plagiochasma pterospermum*); ibidem, 10.X.1959, Inoue (TNS#204660; as *Plagiochasma pterospermum*).

#### ACKNOWLEDGEMENTS

We are greatly indebted to the curators of IRK (S.G. Kazanovskii), MHA (M.S. Ignatov) and TNS (M. Higuchi) as well as Dr. S.-S. Choi (JNU) for specimen loans. The figure was kindly prepared by Mr. M.A. Bakalin to whom authors are sincerely grateful. We thank reviewers for a careful

revision of the manuscript and valuable comments. The work was partially supported by the Russian Foundation for Basic Researches (grants no. 12-04-01476, 13-04-00775, 13-04-01427, 14-34-50143).

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