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The Survey of Marchantiales from the Russian Far East I. The Review of Cleveaceae (Hepaticae)

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ABSTRACT

Cleveaceae (Marchantiales, Hepaticae) is reviewed for the Russian Far East. Within study area four species are recognized. *Clelea hyalina* var. *rufescens* (S.W. Arnell) Konstant. is newly recorded for the Russian Far East and adjacent Republic of Sakha (Yakutiya). Many specimens were re-identified and the data on the intra-regional distribution were strongly improved. Based on Far-Eastern material the identification keys to genera and species, their morphology and habitat descriptions, figures, as well as notes on distribution and lists of specimens examined are provided. *Clelea nana* (Shimizu & S. Hatt.) Borovichev & Bakalin *comb. nov.* is proposed

Keywords

Cleveaceae, *Clelea*, *Sauteria*, *Peltolepis*, the Russian Far East, taxonomy, Hepaticae

РЕЗЮМЕ

Боровичев Е.А., Бакалин В.А.

Обзор порядка Marchantiales с российского Дальнего Востока: I. Ревизия семейства Cleveaceae (Hepaticae)

Приведен обзор семейства Cleveaceae (Marchantiales, Hepaticae) на российском Дальнем Востоке. Всего в регионе известно 4 вида. Одна разновидность (*Clelea hyalina* var. *rufescens* (S.W. Arnell) Konstant.) приводится впервые для российского Дальнего Востока и прилегающей части республики Саха (Якутия). В ходе проведенного исследования значительное количество изученных образцов было переопределено и, таким образом, распространение видов существенно уточнено. Составлены ключи для определения родов и видов семейства, описаны распространение, морфология, экологические предпочтения всех таксонов, а также составлены оригинальные иллюстрации. Предложена новая комбинация *Clelea nana* (Shimizu & S. Hatt.) Borovichev & Bakalin *comb. nov.*

Ключевые слова

Cleveaceae, *Clelea*, *Sauteria*, *Peltolepis*, российский Дальний Восток, таксономия, печеночники

INTRODUCTION

Cleveaceae is a family of Marchantiales Limpr. including thalloid liverworts. In the recent worldwide revision of the family by Rubasinghe (Rubasinghe 2011, Rubasinghe et al. 2011 a, 2011 b) four genera are recognized: *Athalamia* Falconer., *Clelea* Lindb., *Sauteria* (Nees) Nees and *Peltolepis* Lindb. This point of view differs from the most of previous works commonly regarding *Clelea* as a synonym of *Athalamia* (Schljakov 1982, Schuster 1992, Damscholt 2002). However, as it was shown by Rubasinghe et al. (2011b), the genus *Athalamia* is polyphyletic and consists of two groups – *Athalamia* s. str., including *A. pinguis* Falconer, *A. handelii* (Herz.) S. Hatt., and *Clelea* with three species: *C. hyalina* (Sommerf.) Lindb. (= *A. hyalina* (Sommerf.) S. Hatt.), *C. spathysii* (Lindenb.) Müll. Frib. (= *A. spathysii* (Lindenb.) S. Hatt.), *Clelea pusilla* (Steph.) Rubasinghe & D.G. Long (= *A. pusilla* (Steph.) Kashyap). *Clelea nana* (treated below as separate species) was included by cited authors to *C. pusilla*.

The genera of the Cleveaceae are widely distributed from Boreal and Temperate to Arctic regions throughout the

Northern Hemisphere, being much rarer in Southern Hemisphere and almost entirely absent from Tropics. According to the checklist of hepatics of Russia (Konstantinova et al. 2009), seven species of the family are known in Russia.

In the course of taxonomic revision of the Cleveaceae in the Russian Far East we found that the distribution of species is imperfectly known due to the misidentification of many specimens assigned to other species of the Cleveaceae and the Aytoniaceae. Thus, the distribution of Cleveaceae taxa in the Russian Far East needs to be clarified.

The present account is largely based on the critical revision of 165 specimens that are kept at the Botanical Garden-Institute FEB RAS, Vladivostok (VBGI, with incorporated collection from VLA), as well as on the materials from the Herbarium of the Polar-Alpine Botanical Garden-Institute (KPABG) and Komarov's Botanical Institute (LE). These herbaria comprise over 90 % of all specimens available from the Russian Far East. As the result of the study we recognize four species of three genera of the Cleveaceae occurring in the Russian Far East. Below

we provide the review on distribution, taxonomy and morphology of the Cleveaceae representatives of treated area. The distribution of each species in the Russian Far East was previously published by Bakalin (2010). However, data provided in this paper are partly out of date now, and many additional new localities were found, which are given here.

Key to genera of the Cleveaceae of the Russian Far East

1. Thallus light-green to whitish or yellowish-green, without secondary pigmentation even in exposed sites; upper surface rather fleshy to spongiose in lower part; ventral scales with oil-bodies; carpocephalum stalk with one rhizoid furrow *Sauteria* [*S. alpina*].

– Thallus pale- or pure-green to reddish brown with reddish to purplish secondary pigmentation even in shaded sites (at least the bases of ventral scales are light pink or red-purplish); upper surface more or less flat; ventral scales without oil-bodies; carpocephalum stalk either without or with two rhizoid furrows 2.

2. Ventral scales not projecting beyond margin laterally; gynoecium terminal; androecial ostioles in sharply defined raised discs; carpocephalum stalk with two rhizoid furrows ..
..... *Peltolepis* [*P. quadrata*].

– Ventral scales projecting beyond margin laterally (sometimes only slightly); gynoecium dorsal; androecial ostioles in distinct rows or loosely scattered; carpocephalum stalk without rhizoid furrow *Clevea*.

SAUTERIA Nees, Naturg. Europ. Leberm. 4: 139. 1838.

– *Hampea* Nees, Naturg. Europ. Leberm. 4: 139, 1838 (non Schlechtendal 1837, Bombacaceae), nom. inval. – *Sauchia* Kashyap in *Journ. Bombay Nat. Hist. Soc.* 24: 347. 1916.

Type: *Sauteria alpina* (Nees) Nees

Sauteria is the oligotypic genus with two species – *S. alpina* (Nees) Nees and *S. spongiosa* (Kashyap) S. Hatt. (Rubasinghe 2011). Generally, species of *Sauteria* are arctomontane circumpolar, distributed mainly from tundra to northern taiga and in subalpine and alpine zones in the mountains of Eurasia and America (Singh & Singh 2009, Borovichev et al. 2012) with disjunction in Africa (Perold 2003). The genus is represented in the Russian Far East by *S. alpina* only.

Sauteria alpina (Nees) Nees, Naturg. Europ. Leberm. 4: 143. 1838. – *Lunularia alpina* Nees in Nees & Bisch., Flora (Regensburg) 13(2): 399. 1830. – *Sauteria alpina* (Nees) Nees var. *angustifrons* Kaal. in Jørgensen, Bergens Mus. Skr. 16: 27. 1934. – *Sauchia japonica* Shimizu & S. Hatt., J. Hattori Bot. Lab. 9: 34. 1953. – *Sauteria japonica* (Shimizu & S. Hatt.) S. Hatt. in Shimizu & Hattori, J. Hattori Bot. Lab. 12: 62. 1954. – *Sauteria alpina* (Nees) Nees var. *japonica* Shimizu & S. Hatt., J. Hattori Bot. Lab. 12: 64. 1954. – *Sauteria yatsuensis* S. Hatt. in Hattori & Shimizu, J. Hattori Bot. Lab. 14: 99. 1955.

Description (Fig. 1): **Thalli** medium sized, 8–12 (–14) mm long, (2–)3–6 mm wide, forming more or less pure mats or often with an admixture to other bryophytes; simple or sparingly dichotomously branched, sporadically with ventral branches; **segments** prostrate, without any trace of secondary pigmentation; **apex** rounded or notched; **upper surface** rather fleshy to almost spongy or in basal parts almost flat, with air chambers convex and inflated, sometimes

dorsal epidermis destroyed with age and surface becoming lacunose; **color of upper surface** light throughout to whitish or yellowish-green; **thallus margins** decolorans, slightly undulate. **Dorsal epidermis** delicate, hyaline, cells 30–40(–45) μm wide, (45–)50–70(–80) μm long, with thin walls and small to conspicuous trigones; **pores** simple, stellate, surrounded by single ring of 5–7(8) cells with thickened radial walls or with thin radial walls, but then in 1–2 concentric rings of 5–8 cells in each, not stellate. **Aerenchyma** well developed, occupying 1/2–1/3 of the thallus height in the middle, air chambers without photosynthetic filaments, isodiametric, elongated or narrow to canaliculate, 2–3(–4)-layered in the middle. **Ventral tissue** consisting of small, thin-walled cells, with solitary oil-cells, **oil-bodies** brownish to yellowish, (15–)18 \times 28 μm in diameter. **Midrib** relatively ill-defined, thallus over midrib (450–)550–950 μm thick. **Rhizoids** smooth and pegged, densely covering ventral surface of midrib of thallus, hyaline. **Ventral scales** shiny, hyaline to silvery white, usually irregularly scattered on ventral surface, often more conspicuous and large near apex, not projecting laterally or sometimes clearly projecting near thallus apex, asymmetrically ovate to triangular, 350–700(–900) μm long and (150–)200–600 μm wide; **marginal one-celled slime papillae** numerous; **appendage** one per ventral scale, acute to acuminate; **body cells of ventral scales** thin-walled, hyaline, large, 55–85(–95) μm long and 40–60 μm wide more or less isodiametric, **oil-bodies** yellowish to pale gray, (0)2–5(–7) per ventral scale, oil-cells 15–23(–25) μm in diameter. **Sexual condition** heteroicous. **Androecia** on both ventral and lateral branches or dorsally situated on leading thallus behind the female receptacle, **ostioles** from conical, without scales. **Gynoecia** arising in apical notch of leading thallus, later becoming lateral; stalk of receptacle hyaline or greenish, smooth, 7–15 mm long, with single rhizoidal furrow. **Carpocephalum** green to yellowish, cruciate to umbrella-shaped, disc convex, flat or concave medially, with (3–)4–6 relatively short lobes, each involucre with a single sporophyte. **Capsule** globose, brown to dull purplish, wall unistratose, cells of wall with annular to semiannular yellow-brown bands. **Seta** bulbous, short. **Spores** reddish brown, (45–)50–65 μm , weakly tetrahedral, with hemispherical papillae. **Elaters** brownish, 2–3-spiral.

Ecology: Obligate calciphyte, growing along streams on fine-grained soil among rocks, on shady cliffs in narrow creeks of limestone rocks covered by soil, on fine ground between boulders in rocky fields, in snow bed communities, on solifluction spots in wet tundras, sometimes hidden between mosses.

Distribution: *S. alpina* has arcto-montane circumpolar distribution, occurring mostly from tundra to the north of taiga and in subalpine to alpine belts in the mountains of Eurasia and North America (Borovichev et al. 2012). It is known in the Russian Far East from Chukotsky Autonomous District, Kamchatsky Territory, Magadan and Sakhalinskaya Provinces.

Note 1: According to the checklist of hepatics of Russia (Konstantinova et al. 2009), two species of *Sauteria* were reported from Russia: *S. alpina* and *S. japonica* (Shimizu & S. Hatt.) S. Hatt. As it was shown earlier (Borovichev et al. 2012) *S. japonica* regarded as synonymous with *S. alpina*.

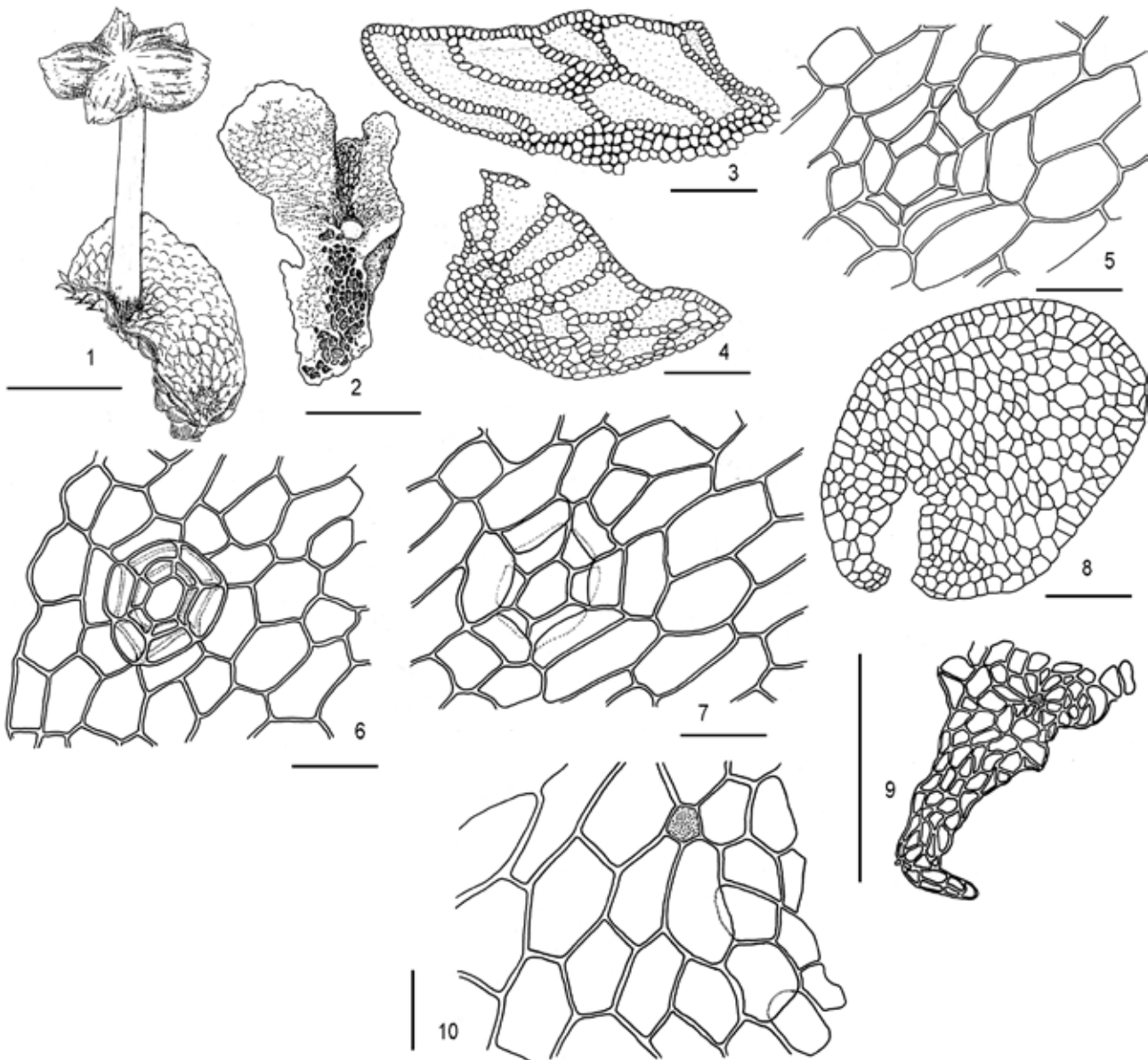


Figure 1 *Sauteria alpina* (Nees) Nees. 1, 2 – thallus, dorsal view; 3, 4 – transverse section of thallus; 5–7 – air pore of thallus dorsal epidermis; 8 – transverse section of receptacle stalk; 9 – ventral scales of thallus; 10 – cells of ventral scales. Scale bars: 4 mm – for 1, 2; 400 μ m – for 3, 4; 500 μ m – for 9; 200 μ m – for 8; 50 μ m – for 10; 40 μ m – for 5–7

Note 2: *Sauteria alpina* is morphologically variable taxon, particularly in sexual condition. Autoicous plants predominate in the Russian Far East, but in some specimens (e.g. Mag-56-8-11 and Mag-56-9-11) both paroicous and autoicous plants are presented, although paroicous plants are rarer. Pseudo dioicous plants of *Sauteria alpina* reported by R. M. Schuster (1992) from Greenland and E. A. Borovichev et al. (2012) from Svalbard are also found in specimens from Magadan Province (e.g. Mag-41-15-11). The position of androecia on the greatly reduced stalked ventral innovations is regarded as supposedly specific for *Sauteria spongiosa* and "*S. japonica*" (Shimizu & Hattori 1954, Hattori & Shimizu 1955, Rubasinghe 2011), although slightly reduced male ventral branches are not rare in specimens from the Russian Far East and occur in tundra zone of Chukotka and Magadan Province as well as in Sakhalin Island.

New records from the Russian Far East: MAGADAN PROVINCE: Khasynsky District, Ol'skoe Basalt Plateau, upper course of Maltna River, 60°39'09"N, 151°21'35"E, 1400 m alt., wet cliffs near the stream, 8.VIII.2011, V.A. Bakalin #Mag-51-3-11 (VBGI; KPABG); *ibid.*, 60°38'25.2"N, 151°28'28.7"E, 1000 m alt., narrow valley of the stream covered by the mosaic of open

Larix forest, *Alnus* thickets, grass tundra and gravelly barrens, peaty bank of the stream, 10.VI.2010, Bakalin #Mag-9-3-10 (VBGI; KPABG); *ibid.*, 60°39'13"N, 151°16'30"E, 970 m alt., small stream in *Pinus pumila*–*Alnus fruticosa* belt, fine-grained soil on the slope to the stream, 7.VIII.2011, Bakalin #Mag-47-8-11 (VBGI); *ibid.*, 60°38'47"N, 151°13'56"E, 1262 m alt., flat mountainous plateau covered by wet tundra, solifluction spots, fine-grained soil, 10. VIII.2011, Bakalin #Mag-56-8-11 (VBGI; KPABG); *ibid.*, 60°38'56"N, 151°31'13"E, 1100 m alt., moss tundra, wet slope to the stream, 10. VIII.2011, Bakalin #Mag-57-11-11 (VBGI); **Srednekanskiy District, Kolyma Upland, Tuonnakh Mts., middle course of Verina River, 63°19'30"N, 151°25'42"E, 652 m alt., on wet shady cliffs in narrow creek between limestone cliffs, 28.VII.2011, Bakalin #Mag-41-15-11 (VBGI; KPABG).**

Other specimens examined: RUSSIA, CHUKOTSKY AUTONOMOUS DISTRICT: Wrangel Isl., 25.VII.1985, O. M. Afonina (KPABG); 10.VIII.1985, Afonina (KPABG; LE); Nunligran 1.VII.1970, Afonina (KPABG); valley of Anadyr River, Southern Pekul'ney River, 10.VIII.1979, Afonina (LE), 24.VII.1980, Afonina (LE); Anadyr River Basin, upper course of the Yablon River, 7.VIII.1982, Afonina (KPABG); Cape of Krause, 1.IX.1975, Afo-

nina (LE); Yanrakynnot Settlement vicinity, 9.VIII.1976, Afonina (LE); **KAMCHATSKY TERRITORY**: Northern Koryakiya, 7.VIII.1984, Afonina (KPABG; LE); 8.VII.1988, E.Yu. Kuz'mina (KPABG); Northern Kamchatka, 11.VII.2003, Bakalin (KPABG, VBG1); Eastern Kamchatka, 24.VII.2003, Bakalin (KPABG); Bil'chonok Glacier, 21.VII.2003, Bakalin (KPABG, VBG1), 22.VII.2003, Bakalin (KPABG, VBG1), 24.VII.2003, Bakalin (KPABG, VBG1); upper course of the Kamenistaya River, VIII.1981, A. Mikulin (KPABG, VBG1); Central Kamchatka, Bystrinskij Nature Reserve, West slope of Alnej Vlc., 13.IX.2004, Bakalin; 14.IX.2004, Bakalin; **SAKHALINSKAYA PROVINCE**: Sakhalin Island, Nabil'sky Range, upper course of Skalistaya River, 15.VIII.2006, Bakalin; 17.VIII.2006, Bakalin; 20.VIII.2006, Bakalin; Chamga Mt., 11.IX.2009, Bakalin (VBG1; KPABG); Vostochno-Sakhalinskiye Mts., 20.VI.2006, Bakalin (VBG1; KPABG).

PELTOLEPIS Lindb., Morgonblad (Helsingfors) (106): 1, 1876; Bot. Notiser: 123, 1876.

Type: *Peltolepis quadrata* (Saut.) Müll. Frib.

Peltolepis is a monotypic genus including *P. quadrata* (Saut.) Müll. Frib.

Peltolepis quadrata (Saut.) Müll. Frib. Hedwigia 79: 74. 1940. – *Sauteria quadrata* Saut., Flora (Regensburg) 43: 351. 1860. – *Sauteria alpina* Ångstr. Bot. Notiser, 1839: 797 (p.p.; not of Nees, 1838). – *Sauteria grandis* Lindb., Medd. Soc. Fauna Fl. Fenn. 1: 113. 1876. – *Peltolepis grandis* (Lindb.) Lindb., Bot. Notiser, 1877: 74. – *Peltolepis sibirica* Lindb., Acta Soc. Fauna Fl. Fenn. 2(3): 4. 1882. – *Peltolepis grandis* (Lindb.) Lindb. var. *sibirica* (Lindb.) Lindb., Kongl. Svenska Vetenskapsad. Handl. 23(5): 12. 1889. – *Peltolepis grandis* (Lindb.) Lindb. var. *angustifrons* Lindb., Kongl. Svenska Vetenskapsad. Handl. 23(5): 13. 1889. – *Peltolepis quadrata* (Saut.) Müll. Frib. var. *japonica* Shimizu & S.Hatt., J. Hattori. Bot. Lab. 12: 69, 1954. – *Peltolepis japonica* (Shimizu & S. Hatt.) S. Hatt., in Hattori & Shimizu, J. Hattori. Bot. Lab. 14: 103, 1955. – *Peltolepis quadrata* (Saut.) Müll. Frib. var. *sibirica* (Lindb.) Damsh., Ill. Fl. Nord. Liverw. Hornw.: 738. 2002.

Description (Fig. 2): **Thalli** small to medium sized, 2–7(–9) mm wide, 5–12(–15) mm long, forming more or less pure mats or often with an admixture to other bryophytes; 1–2-times dichotomously branched, rarely with ventral branches; **segments** prostrate, lingulate to linear-lingulate; **apex** dilated to deep notched; **upper surface** firm and robust, smooth, reticulate with polygonal areas, one over each air-chambers, never lacunose; **color of upper surface** pale to dark green with purplish to rose tinge, frequent shining; **thallus margins** rather delicate, ascending, slightly undulate, with greenish or reddish to purplish secondary pigmentation. **Dorsal epidermis** delicate, **cells** mostly colorless, polygonal, (30–)35–55 μm long, (15–)20–28(–35) μm wide, thick-walled, **trigones** small or generally indistinct; **oil-cells** lacking or scattered; **pores** simple, not elevated to slightly elevated above epidermis, one per air-chambers; 18–25(–30) μm in diameter, surrounded by single ring of 5–6(–7) cells with thickened radial walls, such as they look stellate, or rarely not thickened. **Aerenchyma** well-developed, occupying 1/3–1/4 of the thallus height in the middle and ca 1/2 in the wings, air chambers without photosynthetic filaments, isodiametric to elongated, 2–3-layered in the middle, 1-layered in the wings. **Ventral tissue** without oil-cells, 1/2–2/3 the thallus thickness in the

middle. **Lower surface** greenish to rose, covered by ventral scales. **Midrib** relatively ill-defined to rounded keel, thallus over midrib 650–950 μm thick in cross-section. **Rhizoids** smooth and pegged, hyaline to rose, forming dense cluster along midrib region. **Ventral scales** in irregular rows on the ventral surface, hyaline to rose or reddish, never blackish purple; not projected behind thallus or slightly projecting behind margin thallus, asymmetrically ovate to triangular, 350–950 μm long and 250–450(–600) μm wide; **marginal one-celled slime papillae** 2–3 per ventral scale; **appendage** one per ventral scale, ill-defined to acute; **body cells of ventral scales** thick-walled, hyaline to rose, more or less polygonal, 40–55(–71) μm long and (26–)30–35 μm wide, **oil-cells** absent. Vegetative propagation is lacking. **Sexual condition** heteroicous. **Anteridia** forming in dorsal, compact well-defined disc, usually situated on leading thallus behind or before the female receptacle or on separate terminal branch; **disc** elliptical to circular, somewhat elevated surrounded by 4–6 purplish, ovate to elongate antheridial scales; **apex antheridial scales** with numerous marginal one-celled slime papillae. **Gynoecea** terminal, arising in a deep apical notch of leading thallus, later becoming lateral; **stalk of receptacle** greenish to purplish generally in the base, smooth, 7–10 mm long, with two rhizoidal furrows, naked. **Archegonial scales** at base of receptacle stalk absent, at apex numerous, lanceolate to almost linear, hyaline to purplish, with many slime papillae; **carpocephalum** green with purple tinge, umbrella-shaped, **disc** convex, flat or concave medially, ovate to obovate in outline, with 4–6(–7) relatively pointing downwards or horizontal, with small air-chambers, simple pores present or absent; each involucre with single sporophyte. **Capsule** globose, deep brown dehiscent by 4–6 irregular valves, wall unistratose, cells of wall with weakly pigmented annular to semiannular brownish bands. **Seta** bulbous, short. **Spores** reddish brown to brown, (40–)50–60 μm , spherical, densely covered by hemispherical papillae, lack distinct wing margins. **Elaters** brownish, (2–)3-spiral, (60–)90–170 μm long, 8–10 μm wide.

Ecology: This species is an obligate calciphyte, commonly growing on calcium-rich substrata (both humic and fine-grained mineral soil). At lower elevations it occurs chiefly on shady, moist steep slopes or cliff clefs, whereas in tundra zone and in corresponding mountain belt it occurs in open wet places and in snowbed habitats.

Distribution: *Peltolepis quadrata* has arcto-montane circumpolar distribution, and occurs from tundra to northern taiga and subalpine and alpine belts in the mountains of Eurasia and North America (Schuster 1992, Damsholt 2002, Rubasinghe 2011). In the Russian Far East it is currently known from Chukotsky Autonomous District, Kamchatka, Primorsky and Khabarovsk Territories, Magadan and Sakhalin Provinces.

Note: According to the checklist of hepatics of Russia (Konstantinova et al. 2009), both of worldwide recognized species of *Peltolepis* were reported for Russia: *P. quadrata* and *P. japonica* (Shimizu & S. Hatt.) S. Hatt. Afterwards, it was shown by S. Rubasinghe (2011) that *P. japonica* is the later synonym of *P. quadrata*. We agree with this conclusion. According to Shimizu & Hattori (1954) *P. japonica* differs from *P. quadrata* by (1) smaller size; (2) not so firm texture; (3) ovate ventral scales and (4)

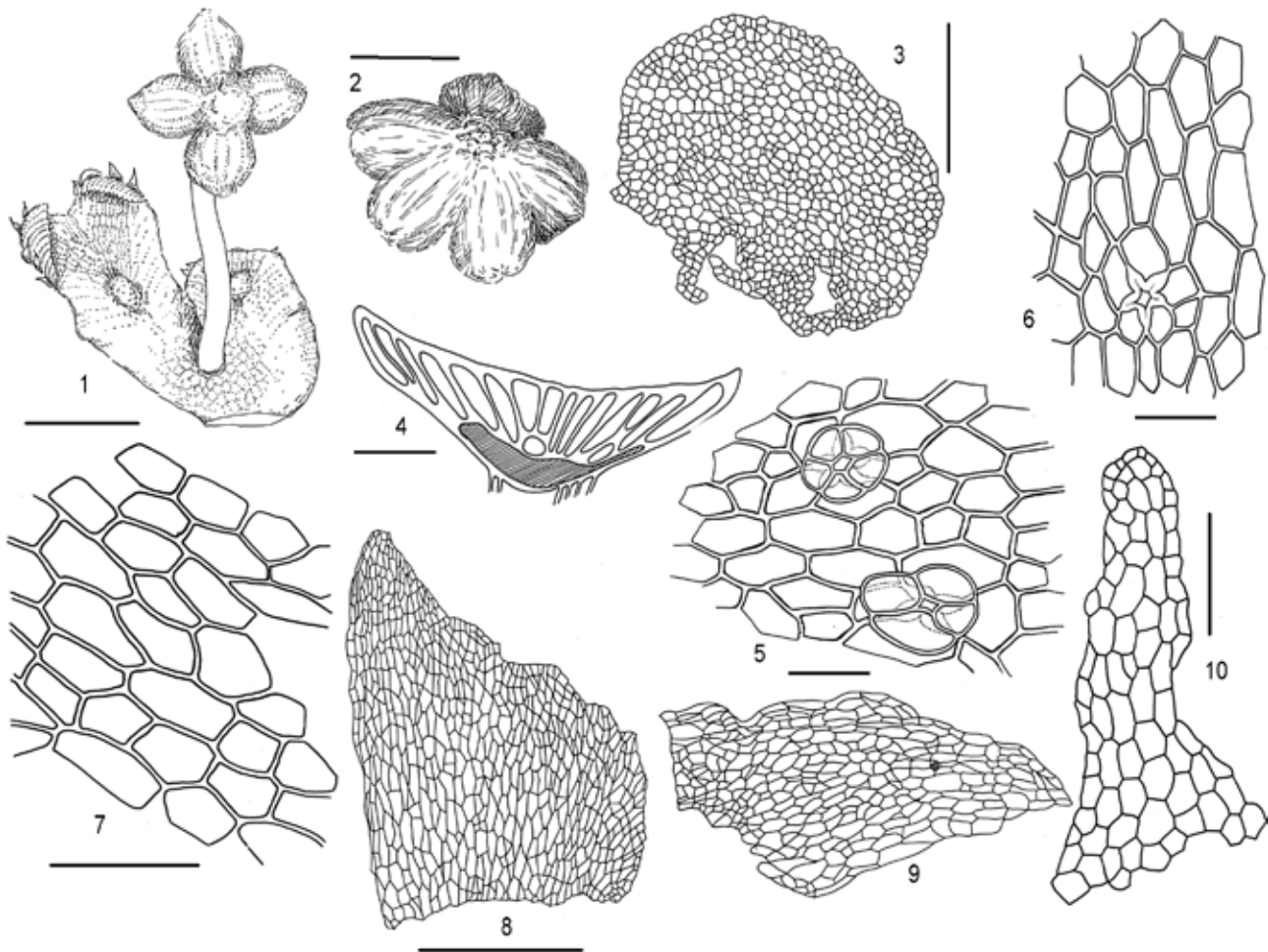


Figure 2 *Peltolepis quadrata* (Saut.) Müll. Fréb. 1 – thallus, dorsal view; 2 – carpocephalum, dorsal view; 3 – transverse section of receptacle stalk; 4 – transverse section of thallus; 5, 6 – air pores of thallus dorsal epidermis; 7 – dorsal epidermis of thallus; 8-10 – ventral scales of thallus. Scale bars: 4 mm – for 1; 2 mm – for 1.5 mm for 2; 500 μm – for 4; 350 μm – for 3; 250 μm – for 8, 10; 200 μm – for 5-6; 40 μm for 7

carpocephala without pores, disk is flattish above and never convex. During this study we found that shape of ventral scales, the degree of reduction of receptacle tissue, and the presence/absence of pores in receptacular tissue are highly variable features even within one specimen. Thus, the variability of listed features supports the treatment of *Peltolepis* as a monotypic genus. As the result, all records of *P. japonica* from the Primorsky Territory should be referred to *P. quadrata*.

New records from the Russian Far East: **MAGADAN PROVINCE:** **Khasynsky District,** Ol'skoe Basalt Plateau, upper course of Mal'tan River, 60°39'09"N, 151°21'35"E, 1400 m alt., wet slope, 8.VIII.2011, Bakalin ##Mag-51-57-11 (VBGI; KPABG); *ibid.*, south-facing slope of the Mt. 1350 m alt., 60°38'37.7"N, 151°26'21.5"E, 1150 m alt., crevices in the gravelly barren field, 11.VI.2010, Bakalin ##Mag-11-37-10a (VBGI; KPABG); **KHABAROVSK TERRITORY:** Nanajsky District, Tardoki-Yani Range, 48°53.285 N, 138°02.905 E, 1920 m alt., cliff ledge, 29.VIII.2012, V. Y Barkalov ##10, 16 (VBGI).

Other specimens examined: **RUSSIA, CHUKOTSKY AUTONOMOUS DISTRICT:** Kresty Bay, Egvekinot Settlement vicinity, 19.VIII.1977, Afonina (LE); Petlyanen River, 18.VIII.1972, V. V. Razzhivin (KPABG); Cape of Krause, 29.VIII.1975, Afonina (LE, as *Athalamia hyalina*); Tanyurer River Basin 14.VII.1979, Afonina (KPABG); Inchoun Settlement, 8.VIII.1975, Afonina (KPABG); **KAMCHATSKY TERRITORY:** Eastern Kamchatka, Pinachevskaya River Valley, 11.VIII.2001, Bakalin (KPABG, VBGI), Bil'chonok Glacier, 24.VII.2003, Bakalin (KPABG, VBGI), 22.VII.2003, Bakalin (KPABG, as *Sauteria alpina*); upper course of the Kamenistaya River, VIII.1981, Mikulin (KPABG,

VBGI); Northern Kamchatka, upper course of the Palana River, 11.VII.2003, Bakalin (KPABG, VBGI, as *Athalamia hyalina*); Bering Island, 10.VIII.2002, Bakalin (KPABG), 18.VIII.2002, Bakalin (KPABG, VBGI, as *Athalamia hyalina*); **SAKHALINSKAYA PROVINCE:** Sakhalin Island, Nabil'sky Range, in head of Khrebtovy Stream from Changa Mt., 11.IX.2009, Bakalin (VBGI; KPABG as *Sauteria alpina*); **PRIMORSKY TERRITORY,** Olginskij District, Margaritovo Settlement vicinity, 24.VIII.1980, S. K. Gambaryan (VBGI, as *P. japonica*); **JAPAN:** Nagano County, Akadoike Peak of the Yatsu volcano, 21.VIII.1953, D. Shimizu (Isotype VBGI, isotype of *Peltolepis quadrata* (Saut.) Müll.Fréb. var. *japonica* Shimizu & S. Hatt. from Hepaticae Japonicae Exsiccatae #253); Isotype #52826 NICH).

CLEVEA Lindb., Notiser Sällsk. Fauna Fl. Fenn. Förhandl. 9: 28. 1868. – *Spathysia* Nees Naturg. Europ. Leberm. 4: 178, 1838. nom. inval. (Art. 34.1 (b)). – *Spathysia* Nees ex Trevis., Memorie Real. Istit. Lombardo Sci. Mat. Nat. ser. 3, 4: 439. 1877. – *Gollaniella* Steph., Hedwigia 44: 74, 1905. – *Athalamia* Falc., Ann. Mag. Nat. Hist. ser. 2, 1: 375, 1848; Trans. Linn. Soc. London 20: 397. 1851 (p.p. excluding type).

Type: *Clevea hyalina* (Sommerf.) Lindb.

Thalli small to medium sized, (3–)5–8(–15) mm long and 1.5–6 mm wide, pale- or pure green to brownish, often with reddish tinge, non aromatic in fresh condition; simple or dichotomously terminally branched, occasionally

with ventral innovations; **margin** slightly to strongly undulate or scalloped, greenish, purplish to whitish brown. **Upper surface** rigid to delicate, polygonally reticulated (at least in younger parts), each polygon corresponds to each air-chamber inside of thallus. **Epidermal cells** in one layer, thick- or thin-walled, **pores** simple, slightly elevated above epidermis, surrounded by a single row composed by 4–5(–7) cells, with radial walls strongly unequally thickened ("stellate") to not thickened; without oil-cells. **Ventral tissue** developed in middle part of thallus and almost absent in the wings; without oil cells. **Aerenchima** well developed, (1)2–3(–4) layered, **air chambers** in the thallus cross section middle rounded or polygonal to narrower, without photosynthetic filaments and oil-cells. **Midrib** not strongly protruding on ventral surface, gradually narrowed to wings. **Rhizoids** dimorphic: smooth or pegged, hyaline to milky whitish, forming dense cluster or scattered along midrib region. **Ventral scales** hyaline to purplish or blackish purple, lanceolate or ovate, projecting beyond margin both apically and laterally (sometimes only slightly), occasionally forming a conspicuous dense brush at apical part of thallus; **oil-cells** absent; **marginal one-celled slime-papillae** present or lacking; **appendage** by one per ventral scale, long-acute to acuminate. **Vegetative propagation** lacking. **Sexual condition** dioicous, autoicous or paroicous. **Androecia** on separate male plant or terminal branch or on the same plant behind base of archegoniophore; ostioles conspicuous, greenish to purplish, with or without androecial scales. **Archegoniophores** dorsal, 1–3 on each plant, along midline; **receptacle stalk** light hyaline, green to purple tinged, smooth, without rhizoid furrow, **apical stalk scales** present, hyaline to purplish-tinged, linear or linear-lanceolate, with cells thin-walled, without oil cells; **carpocephalum** smooth or warty, umbrella- or cup-shaped, 2.5–4 mm in diameter, with a few or lacking air chambers and simple pores, deeply 1–4(–6) lobed, lobes turned downwards, horizontally or upwards, each involucre bearing one sporophyte; pseudoperianth lacking. **Capsule** dark brown, globose, with unistratose wall; **wall cells** with annular and semi-annular bands. **Seta** short. **Spores** coarsely papillose reddish brown. Vegetative propagation lacking.

Clevea has a nearly worldwide distribution, although still are not recorded from Australia and New Zealand. Their distribution is connected with mountainous ranges (Rubasinghe 2011). The genus includes four species, two of them are known in the Russian Far East and one (*C. pusilla*) is recorded from adjacent areas in China and Japan and may be found in our area.

Key to species of *Clevea* in the Russian Far East and adjacent area

1. Plants dioicous; pores with \pm thick radial walls such as looks stellate; ventral scales hyaline to purplish, never blackish purple *C. hyalina*.

– Plants monoicous; pores with thin radial walls, not stellate; ventral scales purple to blackish purple or sometimes hyaline 2.

2. Plants autoicous, with antheridia on separate terminal branch of the same thallus; thallus \pm thin, ca. 150–200

(–350) μm thick at the middle; thallus margins \pm prostrate in wet conditions; ventral scales dichromatic (with markedly defined colorless appendage and purple colored body); sciophytic mesophyte *C. nana*.

– Plants paroicous, with antheridia on main thallus behind the female receptacle; thallus \pm thick and spongy, ca. 300–550(–700) μm thickness at the middle; thallus margins slightly incurved in wet conditions; ventral scales monochromatic (both body and appendage often pink to purplish colored); heliophytic xerophyte [*C. pusilla*].

Clevea hyalina (Sommerf.) Lindb. Not. Sällsk. pro Fauna et Flora Fennica 9:291. 1868. – *Marchantia cruciata* Sommerf., Suppl. Florae Lapponicae 79, 1826. nom. illeg. non L. – *Marchantia hyalina* Sommerf., Magazin Naturvidensk. (Christiana) II. Ser., I, fasc. 2: 234. 1833. – *Santeria hyalina* (Sommerf.) Lindb., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 23: 561, 1867. – *Athalamia hyalina* (Sommerf.) S. Hatt., J. Hattori Bot. Lab. 12: 54, 1954. – *Santeria suecica* Lindb., in Gottsche & Rabenhorst, Hep. Eur. no. 347, 1866. – *Clevea hyalina* (Sommerf.) Lindb. var. *suecica* (Lindb.) Lindb., Bot. Not. 7: 78. 1877. – *Clevea suecica* (Lindb.) Lindb., Musci Scand. 9: 1. 1879. – *Clevea hyalina* (Sommerf.) Lindb. var. *kernii* Müll.Frib. ex Kern, Jahresber. Schles. Ges. 86: 14. 1908. – *Clevea trabutiana* Steph. Sp. Hepat. 6: 5, 1917. – *Athalamia trabutiana* (Steph.) S. Hatt., J. Hattori Bot. Lab. 12: 54, 1954.

Description (Fig. 4): **Thalli** medium sized, 6–12 mm long, 3–5(–7) mm wide; forming compact patches or rarely growing as single plants over or among mosses; dichotomously branched, **ventral branches** present; **segments** widely obovate to widely lingulate and lingulate; **apex** rounded to slightly notched; **upper surface** distinctly reticulate in younger parts, obscurely reticulate with age; color of **upper surface** pale- or pure green to reddish-brown, in older parts often somewhat nitid; **thallus margins** slightly- to strongly incurved when dry and almost plane when wet, thin, undulate to scalloped, purplish to brownish or whitish brown. **Dorsal epidermis** cells thin- to moderately thick-walled, 40–60 \times 25–40 μm ; **pore** simple, 13–18(–21) μm in diameter, surrounded by 5–7 cells, radial walls often strongly thickened such as look stellate. **Thallus cross-sections** \pm thin, 400–600 μm at midrib. **Ventral tissue** developed in middle part of thallus and almost absent in the wings, occupying 1/2–1/3 the thallus thickness near the apex, at the younger parts, but 1/4–1/5 in the middle of older parts. **Aerenchima** well developed, occupying 1/2–2/3 the thallus thickness; 2–3(–4)-layered in the thallus middle; **air-chambers** polygonal to narrower, without photosynthetic filaments. **Lower surface** pale brown to greenish, hidden in ventral scales; **midrib** not strongly protruding on ventral surface, in middle part of thallus often rounded, gradually narrowing into wings. **Rhizoids** hyaline to milky whitish, forming dense cluster along midrib region. **Ventral scales** in several irregular longitudinal rows, hyaline to rose or pale purplish, never blackish purple; triangular to lanceolate, \pm projecting behind thallus margin both apically and laterally (often only slightly), sometimes forming a conspicuous dense brush at apical part of thallus, (250–)400–800(–1050) μm long and (160–)250–680 μm wide; **body cells of ventral scales** thin-walled, hyaline to rose, large, (45–)60–86

μm long and (30–)45–60 μm wide; **appendage** by one per ventral scale, narrowly long-acute to acuminate; **oil-cells** absent; **marginal one-celled** slime-papillae 0–4 per ventral scale. **Sexual condition** dioicous. Male and female plants intermixed, male plants smaller. **Androecia** dorsal, in antheridial ostioles, scattered along median line of the thallus, **ostioles** greenish to purplish, conspicuous, **androecial scales** lacking or one for each ostiole to numerous, rose to purplish, 200–350 μm long, with 1–4(–6) hyaline to rose appendages. **Gynoeceia** dorsal, 1–3 along the midline, when unfertilized surrounded by a cluster either hyaline or purplish lanceolate scales; **receptacle stalk** cylindrical, hyaline to (generally at base) purplish, smooth, 5–9 mm long; **apical stalk scales** present, situated below carpocephalum; **carpocephalum** yellowish- to brownish green, umbrella-shaped, deeply 2–5-lobed, rarely horizontal, each involucre containing one sporophyte. **Capsule** globose, dehiscing by 3–5 irregular valves, **wall** unistratose, cells spindle-shaped, 40–60 mm long, 22–30 mm wide, with annular and semi-annular bands. **Seta** bulbous short up to 0.5–0.6 mm. **Spores** reddish brown to brown, 40–60 μm in diameter, surface densely covered by hemispherical sacs, obtuse. **Elaters** brown, 150–225 μm long, 8–10(–11) μm wide, 2–4 spiral.

Clevea hyalina in the Russian Far East falls into two varieties: *C. hyalina* var. *hyalina* and *Clevea hyalina* var. *rufescens* (S. W. Arnell) Konstant.

Clevea hyalina var. *hyalina* is characterized by: 1) pale or pure green with purplish tinged upper surface of thallus; 2) purple to reddish tinged thallus margins; 3) \pm thin-walled cells of dorsal epidermis; 4) absence of androecial scales or rare presence of androecial scales by one for each ostiole.

It is more or less rare taxon being known in the Russian Far East in Chukotsky Autonomous District and Kamchatsky Territory only.

Specimens examined: RUSSIA, ZABAICAL'SKY TERRITORY, Chita City Area 26.IX.1909, P. Mihno (KPABG); CHUKOTSKY AUTONOMOUS DISTRICT, Anadyr River Basin, Enmynyaam River 3.VII.1980, Afonina (LE); Yanrakynnot Settlement vicinity 23.VI.1976, Afonina (LE, KPABG, as *Mannia*); Arakachechen 9.VIII.1962, V. Gavrilyuk (KPABG as *Peltolepis quadrata*); Cape of Krause, 30.VIII.1975, Afonina (LE); KAMCHATSKY TERRITORY: Bering Island, 10.VIII.2002, Bakalin (KPABG as *Peltolepis quadrata*).

Clevea hyalina var. *rufescens* (S. W. Arnell) Konstant. Polish Botanical Journal 57(1):185. 2012. – *Clevea hyalina* f. *rufescens* S. W. Arnell in S. W. Arnell & O. Mårtens. Ark. Bot. Ser. 4(6):123. 1959. – *Athalamia hyalina* f. *rufescens* (S. W. Arnell) Damsh., Ill. Fl. Nord. Liverw. Hornw.: 745. 2002.

C. hyalina f. *rufescens* S. W. Arnell was elevated to a variety – *Clevea hyalina* var. *rufescens* by Konstantinova (Konstantinova & Savchenko 2012) basing on the studies of the material from Svalbard. It is characterized by: 1) red-brown colored upper surface of thallus; 2) brownish to whitish brown thallus margins; 3) moderately thick-walled cells in dorsal epidermis; 4) numerous purplish colored antheridial scales in male plants. The variety has never been reported for the Russian Far East and East Siberia. In the course of the present research we were able to identify it from Chukotsky Autonomous District, Magadan Province as well as westward adjacent Republic of Sakha (Yakutiya).

Both *C. hyalina* var. *rufescens* and *C. hyalina* var. *hyalina* are obligate calciphytes. They mostly grow on calcareous soil in small crevices or caves on steep slopes, cliffs of limestone or schist, detritus in small crevices in calcareous rocks, in snow bed communities, solifluction spots in wet tundras, where often hidden between mosses.

New records: RUSSIA, KRASNOYARSK TERRITORY, Mariya Pronchischeva Bay, 10.VIII.1972, N. V. Matveeva (KPABG); CHUKOTSKY AUTONOMOUS DISTRICT, Wrangel Island, Somnitel'naya Bay, $\sim 70^{\circ}55'N$, $179^{\circ}28'E$, snowbed communities on southern slope, on fine-grained soil, 23.VII.1985, Afonina (KPABG, VBG1), 10.VIII.1985, Afonina (LE); *ibid.*, *Papaver-Pedicularis*-communities on lower sea terrace, on rock cracks, 21.VII.1985, Afonina (KPABG, VBG1); Pikul'ney Range, Tanyurer River Basin, Bezmyannoe Lake vicinity, $\sim 64^{\circ}51'01"N$, $174^{\circ}28'33"E$, solifluction spot, on fine-grained soil, 14.VII.1979, Afonina (KPABG, VBG1), *ibid.*, mountain fruticulose-grasses-moss tundra, on fine-grained soil among mosses, 18.VII.1979, Afonina (LE, KPABG); Anadyr River Basin, upper course of the Enmynyaam, $\sim 66^{\circ}12'27"N$, $173^{\circ}31'51"E$, cliffs rocks on slope, on fine-grained soil, 3.VII.1980, Afonina (KPABG); MAGADAN PROVINCE, Kolyma Upland, Tuonnakh Range, upper course of the Verina River, $63^{\circ}16'41"N$, $151^{\circ}03'44"E$, 1340 m alt., tundra belt, stony fields, fine-grained soil near stream, 23.VII.2011, V.A. Bakalin #Mag-26-3-11 (VBG1, KPABG). New records from the area adjacent to the Russian Far East: REPUBLIC OF SAKHA (YAKUTIA), the middle part of the course Indigirka River, In'yaly River, $\sim 65^{\circ}22'46"N$, $141^{\circ}56'35"E$, stony slope, on fine-grained soil, 20.VI.1976, Afonina (LE, KPABG).

Clevea nana (Shimizu & S. Hatt.) Borovichev & Bakalin

We propose *Clevea pusilla* (Stephani) Rubasinghe & Long and *Athalamia nana* although being related, nevertheless are not conspecific. Main differences "*Athalamia nana*" from *Clevea pusilla* are given in the key. A new combination is needed to be proposed – *Clevea nana* (Shimizu & S. Hatt.) Borovichev & Bakalin *comb. nov.* – Basionym: *Gollaniella nana* Shimizu & S. Hatt., J. Hattori Bot. Lab. 9: 34. 1953. – *Athalamia nana* (Shimizu & S. Hatt.) S. Hatt. in Shimizu & Hattori, J. Hattori Bot. Lab. 12: 54. 1954. – *Athalamia glauco-virens* Shimizu & S. Hatt., J. Hattori Bot. Lab. 12: 56. 1954. – *Athalamia glauco-virens* Shimizu & S. Hatt. f. *subsessilis* Shimizu & S. Hatt., J. Hattori Bot. Lab. 12: 58. 1954.

Description (Fig. 4): **Thalli** small to medium sized, (3–)5–8(10) mm long, 1.5–3(–4) mm wide, in older thalli to 12 mm long and 4–6 mm wide; growing as single plants or among mosses or forming compact patches; simple or 1–3 dichotomously branched, **ventral branches** rare; **segments** wider ovate to \pm lingulate; **apex** slightly- to deeply notched; **upper surface** with small polygonal areas, air-chambers partitions prominent, but pores \pm visible in wet conditions only; **color of upper surface** pale- to dark green; **margins** incurved, clearly purplish along margin and thallus apex in **dry** conditions, \pm flattened in wet conditions, with purplish tinge, sometimes greenish along margin, undulate to scalloped. **Upper epidermal cells** delicate, thin-walled, slightly yellowish or rose to hyaline, isodiametric, 28–35 \times 25–30(–35) μm , with distinct trigones, **oil cells in epidermis** lacking; **pores** simple, 8.0–18.0(–20) μm in diameter, surrounded by a single row of 4–5(–7) cells, with radial walls slightly thickened (never stellate) to not thickened. **Thallus cross-sections** \pm thin, ~ 150 –200(–350) μm at midrib. **Ventral tissue** occupying 1/3–1/2 near the apex and at the younger parts, but almost not defined in middle of older parts, confined only in middle part of cross-section

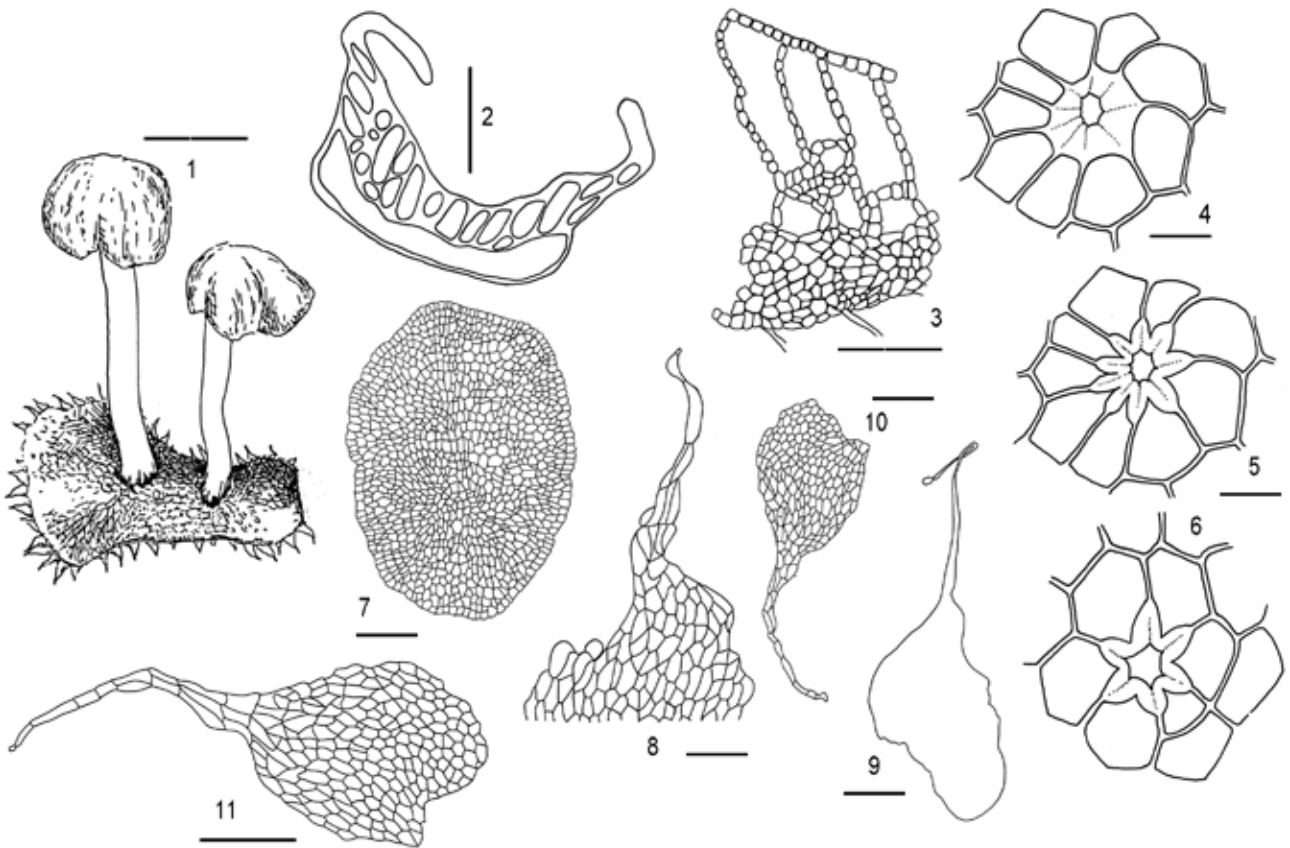


Figure 3 *Clevea hyalina* (Sommerf.) Lindb. 1 – female thallus, dorsal view; 2, 3 – transverse section of thallus; 4–6 – air pores of thallus dorsal epidermis; 7 – transverse section of receptacle stalk; 8–11 – ventral scales of thallus. Scale bars: 3 mm – for 1; 400 μm – for 2; 250 μm – for 3; 200 μm – for 11; 150 μm – for 7, 9–10; 100 μm – for 8; 40 μm for 4,3; 250 μm – for 8, 10; 200 μm – for 9; 20 μm – for 5–6; 40 μm for 7

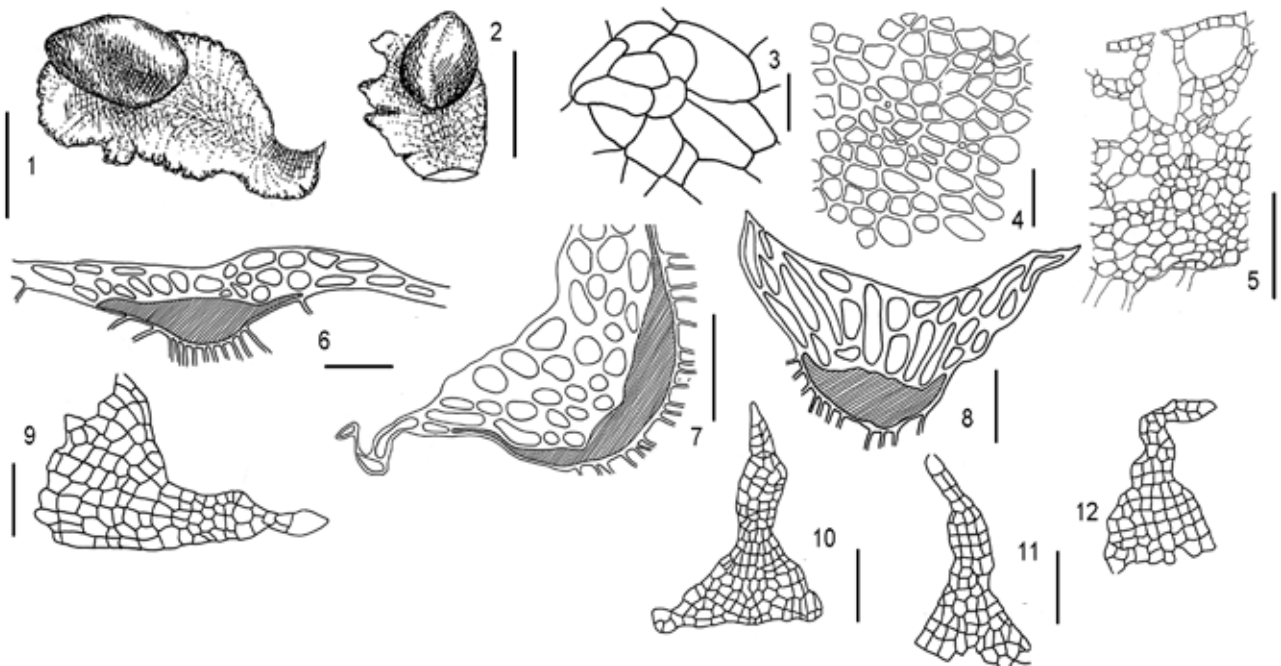


Figure 4 *Clevea nama* (Shimizu & S. Hatt.) Borovichev & Bakalin 1, 2 – thallus, dorsal view; 3 – air pores of thallus dorsal epidermis; 4 – dorsal epidermis of thallus; 5–8 – transverse section of thallus; 9–12 – ventral scales of thallus. Scale bars: 2 mm – for 2; 1.5 mm – for 1; 150 μm – for 5, 9–12; 100 μm – for 3, 6–8; 50 μm – for 4

and absent in the wings, **oil-cells** lacking. **Aerenchima** well developed, **air-chambers** wide and rounded, 2–3-layered near the apex and at the margin, 1–2-layered in the middle (where air-chambers narrower than higher). **Lower surface** greenish to rose; **midrib** shallow, relatively ill-defined. **Rhizoids** hyaline to whitish, forming cluster along midrib region. **Ventral scales** purplish hyaline or rose to blackish purple, in 2–3 irregular longitudinal rows or scattered throughout ventral surface, ovate to lanceolate, 300–700 µm long, cells delicate, large, subquadrate, 25–40(–45) µm, **appendage** by one per ventral scale, narrowly long-acute to acuminate, always colored; **oil cells** absent; **marginal one-celled slime-papillae** rare. **Sexual condition** autoicous. **Androecia** in antheridial ostioles on a separate terminal branch of the same plant; **ostioles** conical, hyaline to purplish, conspicuous, **androecial scales** lacking. **Gynoeceia** dorsal, 1–2 per thallus; **female receptacle** stalk often apparently sessile, pale purple and hyaline, 0.7–1.2 mm long, apical stalk scales present, lanceolate to linear, slime papillae not defined; **carpocephalum** greenish and hyaline, cup-shaped, with 1–3 lobes pointing upwards, rarely horizontal. **Capsule** globose, dark brown, dehiscing to 4–6 irregular valves, wall unistratose, cells with annular and semi-annular bands. **Seta** short, bulbous, **Spores** brown to dull brown, 40–55(–60) µm in diameter, densely warty, warts 8–10 across diameter. **Elaters** brownish yellow to brown, 110–200 µm long, 8–10 µm wide at middle.

Ecology: The species grows on humus and soil covering calcareous cliffs, as well as on slopes to stream and fine-grained soil in snow-bed communities in tundra.

Distribution of *Clevea nana* is poorly known, currently it is reliably known for Chukotsky Autonomous District

and Primorsky Territory within the Russian Far East. Outside that area it is known from Zabaikal'sky Territory, Japan, China and Mongolia (see specimens examined list).

Specimens examined: **RUSSIA, ZABAICAL'SKY TERRITORY**, Chita City Area 26.IX.1909, P. Mihno (KPABG as *Clevea*); **CHUKOTSKY AUTONOMOUS DISTRICT**, Wrangel Isl., Somnitel'naya Bay 23.VII.1985, Afonina (KPABG, VBGI as *Athalamia hyalina*), 10.VIII.1985, Afonina (LE as *Athalamia hyalina*); **PRIMORSKY TERRITORY**, Lazovsky District, Solnechnaya Pad' stream valley 20.IX.2012, Bakalin (VBGI); Nakhodka City Area, Sestra Mountain 14.VIII.2008, Bakalin (VBGI); 17.X.2008, Bakalin (VBGI); Khasansky District, Kedrovaya Pad' State Reserve, Kedrovka River 17.V.2007, Bakalin (VBGI); Partizansky District, Lozovyi Settlement 15.IX.1974, L. V. Bardunov (VBGI); **JAPAN**, Saitama County, Chichibu Mts. 3.IX.1953, D. Shimizu (IRK, isotype of *Athalamia glauco-virens* Shimizu & S. Hatt. f. *subsessilis* Shimizu & S. Hatt. from Hepaticae Japonicae Exsiccatae #253; NICH, holotype of *Athalamia glauco-virens* Shimizu & S. Hatt. f. *subsessilis* Shimizu & S. Hatt. #52755); *ibid.*, 31.VIII.1953, D. Shimizu (NICH, isotype of *Athalamia nana* #52773; ##52765, 55678); **CHINA, INNER MONGOLIA PROVINCE**, Great Khingan Range, A Xi Ha Tu Geological Park 6.VIII.2010, Bakalin (VBGI); **MONGOLIA**, Zavhan, Numreg-gol 8.VIII.1991, R.V. Kamelin (KPABG).

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