

ON *CLEVEA PUSILLA* (STEPH.) RUBASINGHE & D.G. LONG (CLEVEACEAE,  
MARCHANTIOPHYTA) IN ASIA

О *CLEVEA PUSILLA* (STEPH.) RUBASINGHE & D.G. LONG (CLEVEACEAE,  
MARCHANTIOPHYTA) В АЗИИ

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Abstract

Identification of a small collection of thallose liverworts from Inner Mongolia (China) has revealed *Clevea pusilla* (Steph.) Rubasinghe & D.G. Long, the species new for the province, rare and poorly known Himalaya-East Asian taxon variably treated in the current literature. A morphological description, illustrations and differentiating characters from closely related *C. nana* (Shimizu & S. Hatt.) Borovich. & Bakalin and *C. spathysii* (Lindenb.) Müll. Frib. are provided.

Резюме

Обработка небольшой коллекции слоевищных печеночников порядка Marchantiales из Внутренней Монголии (Китай) позволила выявить новый для этой провинции, редкий и малоизученный вид - *Clevea pusilla* (Steph.) Rubasinghe & D.G. Long, объем которого, в настоящее время, крайне дискусионен. Приводятся морфологическое описание, отличия от *C. nana* (Shimizu & S. Hatt.) Borovich. & Bakalin и *C. spathysii* (Lindenb.) Müll. Frib. и оригинальные иллюстрации.

KEYWORDS: Hepaticae, *Clevea*, taxonomy, China.

The Cleveaceae is a small family including 4 genera worldwide. It has been recently revised by Rubasinghe (2011) and Rubasinghe *et al.* (2011a), who resurrected *Clevea* as the genus closely related, but different from *Athalamia*. That revision provides a global pattern of species distribution, however, in some regions the genus remains insufficiently known.

The nomenclatural and taxonomic history of *Clevea pusilla* is quite complicated. Stephani (1905) described a new genus *Gollaniella* with a single species *Gollaniella pusilla* Steph. basing on specimens collected by W. Gollan in Mussoorie State (NW India). Shortly after that Kashyap (1929) showed that *Gollaniella* is congeneric with *Athalamia*, and proposed a new combination, *Athalamia pusilla* (Steph.) Kashyap. Finally, this species was transferred to *Clevea* by Rubasinghe (2011a, b), as *Clevea pusilla* (Steph.) Rubasinghe & D.G. Long. Parallel to this, three other names appeared, important to the current discussion: 1) in 1906, Stephani (1898-1924) described *Clevea chinensis* Steph. from Shaanxi Province of China; 2) Shimizu & Hattori (1953) described *Gollaniella nana* Shimizu & S. Hatt.; 3) Shimizu and Hat-

tori (1954) described *Athalamia glauco-virens* Shimizu & S.Hatt. Because of the prevailing point of view on the identity of *Gollaniella*, *Clevea* and *Athalamia*, Shimizu and Hattori (1954) transferred *Gollaniella nana* and *Clevea chinensis* to the genus *Athalamia* and regarded them as closely related, but different species. Later, basing on *in vitro* cultures study, Hattori & Mizutani (1959) demonstrated that *A. nana* and *A. glauco-virens* are conspecific, and synonymized the latter name with *A. nana*. Rubasinghe *et al.* (2011a, b) regarded *Athalamia chinensis* (*Clevea chinensis*), *A. nana* (*Gollaniella nana*) and *A. glauco-virens* as synonymous with *Clevea pusilla*. Finally, Borovichev & Bakalin (2013) reviewed the Cleveaceae for the Russian Far East, concluding that *Clevea nana* (Shimizu & S. Hatt.) Borovich. & Bakalin is different from *C. pusilla* (Steph.) Rubasinghe & D.G. Long, not conspecific as Rubasinghe *et al.* (2011a, b) had regarded. Thus, the distribution of *C. pusilla* in this new narrowed sense needed to be discussed and verified.

In accordance with the new treatment, one specimen recently collected in Inner Mongolia Province of China proves to belong to *C. pusilla*, expanding the range of

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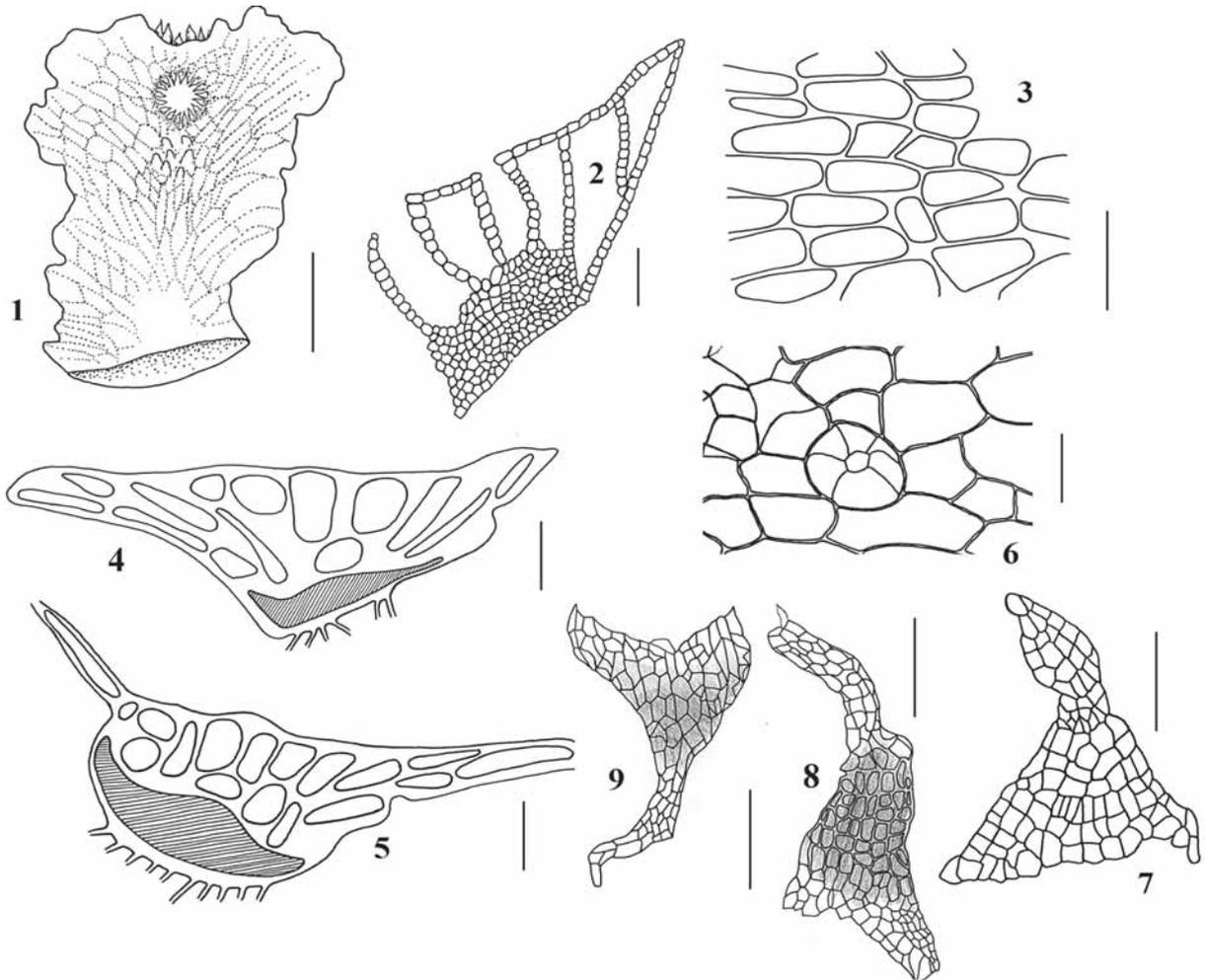


Fig. 1. *Clevea pusilla* (Steph.) Rubasinghe & D.G. Long 1 – thallus, dorsal view; 2, 4-5 – transverse section of thallus; 3 – dorsal epidermis of thallus; 6 – air pores of thallus dorsal epidermis; 7 – ventral scales of apex thallus; 8-9 – ventral scales of ventral surface. Scales: 2.5 mm – for 1; 250  $\mu$ m – for 4, 5, 9; 200  $\mu$ m – for 2; 150  $\mu$ m – for 8; 50  $\mu$ m – for 7; 40  $\mu$ m – for 3; 35  $\mu$ m – for 6. From: China, Huang Gang Liang Geological Park, V.A. Bakalin, *China-31-10-10* (VBGL, duplicate in KPABG).

species distribution. Next follows a description based on the studied specimens.

***Clevea pusilla*** (Steph.) Rubasinghe & D.G. Long, J. Bryol. 33: 168. 2011. – *Gollaniella pusilla* Steph., Hedwigia. 44: 74. 1905. – *Athalamia pusilla* (Steph.) Kashyap, Liverw. W. Himal. & Panjab, Plain 1: 87. 1929. – *Clevea chinensis* Steph., Nuovo Giorn. Bot. Ital. (ser. 2) 13: 347. 1906. – *Athalamia chinensis* (Steph.) S. Hatt. in Shimizu & Hattori, J. Hattori Bot. Lab. 12: 54. 1954.

Thalli small to medium in size, 6-10 mm long, 1.5-3(-5) mm wide; forming compact patches; simple or dichotomously branched, ventral branches commonly occurring; segments linear to  $\pm$  oblong-ovate or obcordate; apex slightly notched; upper surface delicate, with easily visible small polygonal areas corresponding to air-chamber partitions, but with pores invisible; color of upper surface pale to dull green; thallus margins incurved, clearly purplish when dry and slightly curved, slightly purplish when wet, loosely undulate. Dorsal epidermis smooth; epidermal cells delicate, sub- to isodiametric,

25-40(-45) $\times$ (20-)23-38(-40)  $\mu$ m, walls thickened, slightly rose to hyaline; trigones and intermediate thickenings vestigial to lacking; oil cells in epidermis lacking; pores simple, 10.5-18.0  $\mu$ m in diameter, surrounded by 1(-2) ring(s), each composed by 4-5(-6) cells, the outer rather inflated, radial walls delicate, lacking thickenings and never stellate. Thallus cross-sections  $\pm$ thick,  $\sim$ 300-550(-700)  $\mu$ m high at midrib; midrib shallow, relatively ill-defined. Aerenchyma well developed, one-layered near the apex and at the margins, 2-3(-4)-layered in the middle; air chambers without photosynthetic filaments, rounded to polygonal in the middle. Ventral tissue confined to middle part of thallus and absent in the wings, without oil cells. Lower surface greenish to purple; covered by purple to violet ventral scales. Rhizoids dimorphic – smooth and pegged, originated along midrib region, hyaline to whitish. Ventral scales dimorphic: first type of ventral scales irregularly scattered through ventral surface, deep purple to reddish, ovate to lanceolate, laterally imbricate, 300-500  $\mu$ m long, 120-330  $\mu$ m wide, cells delicate, large, subquadrate, 25-40(-45)  $\mu$ m, oil cells

lacking, tapering by 1 linear appendage with acute to long-acute apex, slime papillae lacking; second type of ventral scales forming cluster at thallus apex, slightly smaller, 100-200  $\mu\text{m}$  long, 50-95  $\mu\text{m}$  wide, similar in shape to the first type, with acuminate apex.

Sexual condition paroicous. Androecia in antheridial ostioles on main thallus behind the gynoecia; ostioles conical, purplish or hyaline with apex red tinged. Gynoecia dorsal, 1-(-2) per thallus, surrounded by rose scales. [No female receptacle and sporophytes seen].

*Specimens examined*: China, Inner Mongolia Province, Great Khingan Range, Huang Gang Liang Geological Park, (43°31'15.4"N 117°31'12"E), 1688 m alt. Coll. V.A. Bakalin *China-31-10-10* 4 August 2010 (VBGI, duplicate in KPABG); Japan, Kinki: Mie Prefecture, Doguranotaki, ca. 850 m alt. Coll. T. Kodama *19042* 7 August 1962 (NICH #71591, as *Athalamia nana*).

*Clevea pusilla* is closely related to *C. nana* and *C. spathysii*. It differs from *C. nana* by: 1) paroicous inflorescence versus autoicous inflorescence; 2)  $\pm$  thick, ~300-550(-700)  $\mu\text{m}$  at the middle versus  $\pm$  thin thallus, ~150-200(-350)  $\mu\text{m}$  thick at the middle; 3) slightly incurved thallus margins in wet conditions versus thallus margins  $\pm$  prostrate in wet conditions. *C. pusilla* resembles *C. spathysii* in pores with radial walls which are thin and never stellate, and in dimorphic ventral scales. However, it differs from the latter in: 1) color of thallus margins and ventral scales in *C. pusilla* purplish along margin and deep purple to reddish in ventral scale area whereas *C. spathysii* has blackish-purple color of ventral scales and margins often dark to blackish purple and 2) *C. pusilla* is characterized by eastern-Asiatic distribution versus Mediterranean of *C. spathysii*.

The species was found in cliff crevices in dry steppe with cliffs on a north-east-facing slope and on fine ground in cliff crevices on a northern slope covered by light woods with *Betula platyphylla*. One specimen from Japan (Mie Prefecture) was collected on moist soil in the cliff cave.

The distribution of *C. pusilla* is still poorly understood. The species was described from NW India (Stephani, 1905), and Kashyap (1929) considered it as one of the common species in the northwest Himalayas. The examined specimens expand this area to China (Inner Mongolia) and Japan. Rubasinge (2011) recorded *C. pusilla* from China (Shaanxi, basing on *Clevea chinensis* type), Japan and other parts of India and Nepal, however, as he adhered a broader approach to this species, with an inclusion of *C. nana*, this does not help ensure that all these records really belong to *C. pusilla*. Accord-

ing to Borovichev & Bakalin (2013), *C. nana* occurs in Japan (Honshu), China (Inner Mongolia), Mongolia, Asiatic Russia in Zabaikal'sky Territory, Chukotsky Autonomous District, and Primorsky Territory.

We suggest that further studies of *Clevea pusilla-nana* complex in eastern Asia would focus on distribution patterns and species variation limits as well as search for new localities of the taxa. Due to the current data, Inner Mongolia is the second place after Japan, where both *C. pusilla* and *C. nana* occur. Aside morphology (described by Borovichev & Bakalin, 2013) these species commonly differ in ecology. When *C. pusilla* prefers more open and dry habitats, *C. nana* occupies more wet and shady ones. One exception was Japan where *C. pusilla* was collected on "moist soil under a over-hanged rock" (NICH 71591). Thus, further studies should also clarify ecological preferences of both species.

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#### LITERATURE CITED

- BOROVICHEV, E.A. & V.A. BAKALIN 2013. The Survey of Marchantiales from the Russian Far East I. The Review of Cleveaceae (Hepatocae). – *Botanica Pacifica* **2**: 53-61.
- KASHYAP, S.R. 1929. Liverworts of the Western Himalayas and the Panjab Plain. – *Lahore*, **1**: 1-129.
- HATTORI, S. & D. SHIMIZU 1955. Marchantiales of Japan. IV. – *J. Hattori Bot. Lab.* **14**: 91-108.
- HATTORI, S. & M. MIZUTANI 1959. Marchantiales of Japan. V. – *J. Hattori Bot. Lab.* **21**: 132-137.
- RUBASINGHE, S.C.K. 2011. Phylogeny and Taxonomy of the Complex Thalloid Liverwort family Cleveaceae Cavers. In.: *Thesis (PhD)*. University of Edinburgh. Edinburgh, 1-264. <http://www.era.lib.ed.ac.uk/bitstream/1842/5298/1/Rubasinghe2011.pdf>
- RUBASINGHE, S. C. K., D. G. LONG & R. MILNE 2011a. A new combination and three new synonyms in the genus *Clevea* Lindb. (Marchantiopsida, Cleveaceae). – *J. Bryol.* **33**(2):168-169.
- RUBASINGHE, S.C.K., R. MILNE, L. FORREST & D. LONG 2011b. Realignment of the genera of Cleveaceae (Marchantiopsida, Marchantiidae). – *Bryologist* **114**(1): 116-127.
- STEPHANI, F. 1905. Hepaticarum species novae XI. – *Hedwigia* **44**: 72-75.
- STEPHANI, F. 1898-1924. Species Hepaticarum. 6. Supplementum ad. Vol. 1-5. – *Genève, Publication de l'Institut Botanique et Herbarier Boissier*: 763 pp.