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TORTELLA DENSA (POTTIACEAE, BRYOPHYTA) IN RUSSIA

О TORTELLA DENSA (POTTIACEAE, BRYOPHYTA) В РОССИИ

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Abstract

Tortella densa (Lorentz & Molendo) Crundwell & Nyholm – a rare species with disjunctive Holarctic distribution is found in Russia for the first time in north-western periphery of the Anabar Plateau (Taimyr District, East-Siberian Subarctic), ca. 3500 km from the nearest localities in North Europe and Alaska. This species differs from the closely related *T. inclinata* (Hedw.) Limpr. by strongly and uniformly twisted leaves, and massive coroniform papillae on thickened outer cell walls in distal leaf lamina. The description and illustrations of Siberian specimen are given, and a comparison with European and American specimens are provided.

Резюме

Tortella densa (Lorentz & Molendo) Crundwell & Nyholm – редкий вид с преимущественно северным дизъюнктивным распространением в Европе и Северной Америке, впервые приводится для России с северо-западной периферии Анабарского плато (Таймырский Муниципальный р-н, восточносибирская Субарктика). Вид отличается от близкого *T. inclinata* (Hedw.) Limpr. однообразной сильной закрученностью листьев вокруг стебля, а также массивными коронообразными папиллами, сидящими на сильно утолщенных внешних стенках клеток дистальной части листа. Приводятся описание и иллюстрации сибирского образца и его сравнение с европейскими и американскими. Сибирское местонахождение вида удалено от ближайшего примерно на 3500 км.

KEYWORDS: *Tortella densa,* Pottiaceae, Bryophyta, taxonomy, ecology, disjunctions, Siberia, Taimyr, Anabar Plateau

The genus *Tortella* has never been specially revised in Russia. The checklist of East Europe and North Asia (Ignatov et al., 2006) listed 8 species for the country, but shortly after that a revision of Caucasian material added one more species (Ignatova & Doroshina, 2008), and the present study of Arctic material adds one more species new to Russia.

The recent exploration of Taimyr Peninsula in East Siberia by the first author revealed an unexpectedly rich and interesting moss flora in a calcareous massive on the western edge of Anabar Plateau. Its position far from the Russian borders is not the place where species not known from the country would be expected. However, several species found here appeared to be new for Russia, many of them being highly isolated from their neighboring populations, e.g. *Tortula cuneifolia, Bryoerythrophyllum latinervium, Microbryum starckeanum* (Fedosov & Ignatova, 2006, 2008; Fedosov, 2008). All of them are strict xerophytes, as well as the present addition to moss flora of Russia, *Tortella densa*.

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Most of these interesting findings were made in the vicinity of Afanas'evskie Lakes (ca. 71°35'N – 106°10'E). This area represents a watershed between the valleys of Fomich and Eriechka Rivers with elevation about 250-300 m. It is a Cambrian dolomite plateau covered with xeric tundra-steppe vegetation, with more or less steep rocky or gravelly slopes to creeks.

Tortella densa was described in 1864 from Germany (Bayern) as a variety of *T. inclinata,* as *Barbula inclinata* var. *densa* Lorentz & Molendo. Crundwell and Nyholm (1962) and Nyholm (1989) accepted this taxon as a species arguing this by the homogenous torsion of leaves in well developed plants. They described mixed tufts of *T. inclinata* (Hedw.) Limpr. and *T. densa,* which indicates that these differences are not environmentally induced. Eckel (1998, 2007) reported this taxon for North America in the rank of variety, with the thorough circumscription of its morphology and ecology. She noted one more morphological character of *T. densa*, massive pedestaled papillae on walls of distal laminal cells. Puche (2006) also accepted the taxon as a variety of *T. inclinata* in flora of Iberain Peninsula, while Smith (2004) in the moss flora of Britain and Ireland, and Hallingbäck (2008) in the Scandinavian flora treated *T. densa* as a distinct species. Smith (2004) reported also the difference in chomosome numbers, n=7 in *T. inclinata* and 14 in *T. densa*.

Recent molecular phylogenetic studies of the group (Werner et al., 2005; Grundmann et al., 2006) found these two species closely related, but the nrITS (based on GenBank data) of *T. densa* (AY854412, AY796267) differs from that of *T. inclinata* (AY854420) in five indels and two substitutions (per 794 positions), while the difference between *T. densa* and *T. tortuosa* (AY854424) is not much greater: five indels and five substitutions. Similarly, in *trn*L-F region, the difference between *T. densa* (AY950423) and *T. inclinata* (AY950430) is also comparable with that between *T. densa* and *T. tortuosa* (GQ428081): two and three substitutions respectively. These data additionally support the status of *T. densa* as a separate species.

Tortella densa (Lorentz & Molendo) Crundwell & Nyholm, Trans. Brit. Bryol. Soc. 4, 1962. – *Barbula inclinata* var. *densa* Lorentz & Molendo in Lorentz, Moosstudien 90. 1864. – *Tortella inclinata* var. *densa* (Lorentz & Molendo) Limpr., Laubm. Deutschl. 1: 604. 1888. Figs. 1-2.

Plants in moderately dense cushions, yellowish-green in upper part, yellow-brown below. Stems (0.5-) 1.0-1.5 cm, pale in upper part, orange in middle part to brownish below, orange in KOH, with inconspicuous scattered rhizoids mostly in leaf axils, without central strand, slightly or moderately branched, densely leaved. Leaves strongly and more or less uniformly spirally twisted around the stem in upper part, somewhat spreading below when dry, erect and spreading then moist, 1.8-2.5 mm long, lanceolate, narrowed to base, more or less tubulose proximally and keeled distally, acute to shortly acuminate and more or less strongly cucullate at leaf apex; margins not undulate, crenulate-papillose in upper part of leaf, entire or slightly serrulate below because of protruding cell angles; costa strong, 1/6–1/7 the leaf base width, 50-80 μm wide at base, gradually narrowed upwards, shortly excurrent, in cross section with guide cells in one row, adaxial and abaxial stereid bands, adaxial and abaxial epidermis not differentiated, adaxial surface entirely smooth, covered with elongate cells. Upper laminal cells round-hexagonal, (7-)7.5-9.0 (-11) μm, near leaf margins subquadrate, near apex in more or less apparent longitudinal rows, opaque, with indistinct outlines due to thick outer cell walls and massive pedestaled coroniform papillae that together are thicker than cell lumen. Basal laminal cells sharply differentiated, thin-walled, long to short rectangular, (30-)35-75×8.5-16 μm, smooth, transparent, forming V-shaped group, extending 1/5–1/4 of leaf length along costa and half of leaf length along margins, at the leaf base angles subquadrate, forming unclearly differentiated alar group or undifferentiated. [Dioicous. Gametangia and sporophytes unknown in Russia.]

Specimen examined: ASIAN RUSSIA, Krasnoyarsk Territory, Taimyrsky Municipal District, vicinity of Afanas'evskye lakes: 71.611 N; 106.071 E, on slope of plateau to creek canyon in 1 km north from middle of Afanas'evskye Lakes, *Fedosov #06-121* (MW).

The specimen from Anabar Plateau differs from the descriptions of North American and European collections in weak branching, while the strong branching is considered as one of the significant characters of the taxon by Eckel (1998). However, in other characters, e.g. strongly and homogenously spirally twisted leaves and massive pedestaled papillae on upper leaf cells, Siberian material agrees fully with *T. densa*. Eckel (1998) also notes the difference between some European and North American specimens. Plants from Alps form extremely high tufts (up to 8 cm), whereas American plants grow in relatively low tufts; that apparently depends on humidity and other habitat characters. Siberian plants, like American ones, form low cushions, probably due to unfavorite growth condition. In all other characters Siberian specimen falls within a variation described by Eckel (1998).

Differentiation. *Tortella densa* may be confused only with other *Tortella* species due to conspicous V-shape border between smooth translucent basal cells and papillose opaque medial laminal cells. Except *T. densa,* only *T. inclinata* and *T. rigens* Alberts are characterized by the combination of (1) acute or shortly acuminate leaf apex, (2) lacking of stem central strand, (3) smooth adaxial surface of costa, and (4) lacking of epidermis on both abaxial and adaxial surfaces of costa. However, *T. inclinata* has leaves loosely and irregularly curved to crisped when dry, and leaves of *T. rigens* are erect or slightly twisted at leaf tips, contrary to strongly and uniformly spirally twisted leaves of *T. densa*; two former species also differ from *T. densa* in not elevated papillae on laminal calls vs. pedestaled ones. *Tortella inclinata* is characterized by leaves somewhat obtuse at apex, while *T. densa* invariably has acute leaves; upper laminal cells are larger in *T. inclinata*, 10-12 μm vs. 7.5-9 μm in *T. densa.* Eckel (1998) also mentions that the leaf tips in *T. inclinata* are composed of 1-3 smooth cells contrary to 5-7 cells in *T. densa*. According to Eckel (1998), *T. rigens* differs in the following character combination: dark-green stem (orange to brown in *T. densa*), leaf apices never cucullate and often with narrowed deciduous apiculus (mostly cucullate without narrowed deciduous apiculus in *T. densa*), and laminal cells 12-17 μm (vs.7.5-9 μm in *T. densa*).

Distribution and ecology. *Tortella densa* has a much narrower distribution than the bipolar *T. inclinata,* but in Europe it is known from many countries: UK, Ireland, France, Spain, Switzerland, Germany, Poland, Austria, Italy, Romania, Czech Republic, Greece, Slovenia, Serbia, Croatia, Norway, Sweden (Crundwell & Nyholm, 1962; Düll, 1984; Eckel, 1998; Kürschner, 2005; Nyholm, 1989; Sabovljevic et al., 2008), covering about the same range as *T. inclinata*. Regional distribution however indicates that in southern areas of Britain and Scandinavia *T. inclinata* is more frequent to the south which is not the case for *T. densa* (Blockeel & Long, 1998; Hallingbäck, 2008), although in e.g. Ireland the distribution of both species is identical (Blockeel & Long, 1998). In mountains of Central Europe *T. densa* is reported to reach a somewhat higher elevations (in Germany to 2250 m vs. 1700 m for *T. inclinata*, cf. Düll & Meinunger, 1989), although in more oceanic climate of British Isles their altitudinal ranges have almost no difference: 0-580 m and 0-500 m correspondingly (Smith, 2004).

In North America, *T. densa* occurs in Alaska, British Columbia, Northwest Territories in the West and Michigan, Vermont and Wisconsin in the East. It is rare in the latter states, while *T. inclinata* is more common to the south, so the distribution pattern of both species is similar to that in northern Europe. However, in mountains of North America *T. inclinata* reaches the higher elevations, 1900 m vs. 1600 m for *T. densa*.

In Asia, *T. densa* was found up to now in only one locality in Turkey (Crundwell & Nyhom, 1962).

In Anabar Plateau *T. densa* was collected on calcareous fine soil at the base of dolomite lump and in Europe it also prefers calcareous substrates (Smith, 2004, Nyholm, 1989, Puche, 2006), more rarely on tree trunks in Spain (Puche, 2006). Contrary to that, in North America it was reported from sandstones and ancient alluvial deposits (Eckel, 1998). There is probably the only one type of habitats, the Scandinavian alvars (barrens on limestones covered with thin soil layer), where *T. densa* and *T. inclinata* grow together (Crundwell & Nyholm,

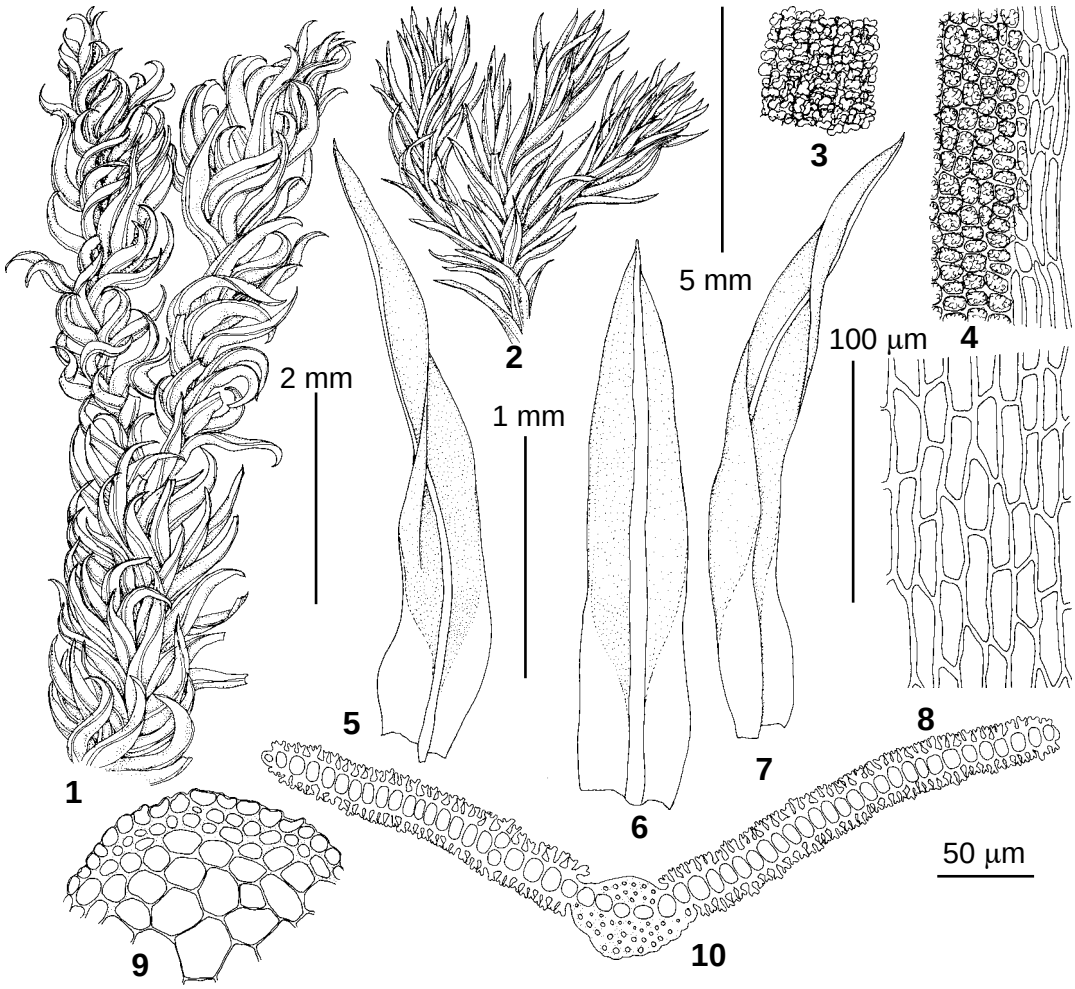

Fig. 1. *Tortella densa* (Lorentz & Molendo) Crundwell & Nyholm (from Russia, Krasnoyarsk Territory, Anabar Plateau, Afanas'evskie Lakes, *Fedosov #06-121*, MW): 1 – habit, dry; 2 – habit, wet; 3 – upper laminal cells; 4 – transition from basal to median laminal cells; 5-7 – leaves; 8 – basal laminal cells; 9 – stem transverse section; 10 – leaf transverse section. Scale bars: 5 mm for 2; 2 mm for 1; 1 mm for 5-7; 100 μm for 3-4, 8; 50 μm for 9-10.

1962; Eckel 1998). More commonly the latter species inhabits dunes and fresh alluvial deposits, often being a colonizer and a dominant species in a pioneer associations, although calcareous rock outcrops are also suitable for it (Savicz-Lyubitskaya & Smirnova, 1970; Eckel, 1998, 2007).

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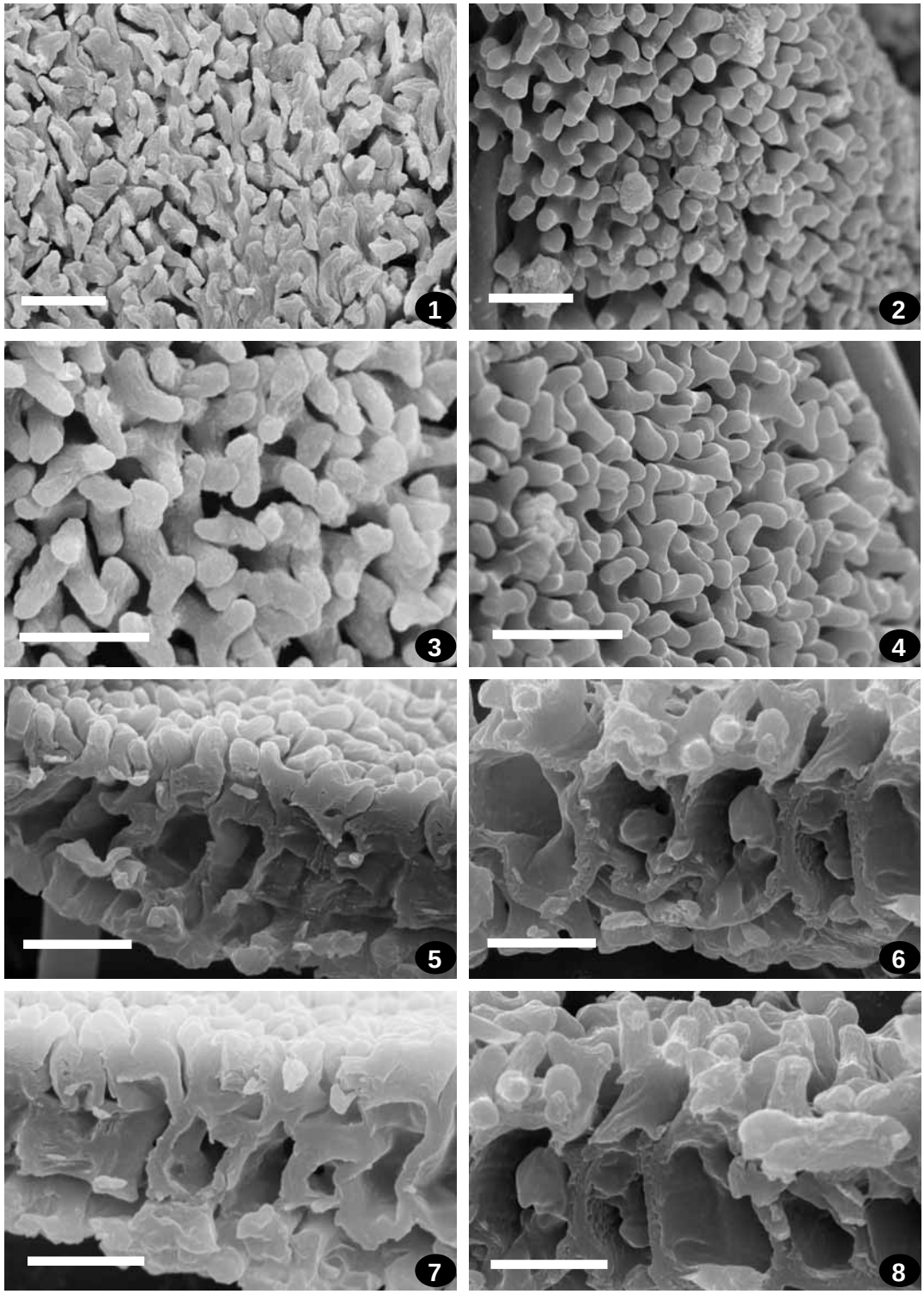

Fig. 2: 1, 3, 5, 7: *Tortella densa* (from Taimyrsky District, *Fedosov #06-121*) and 2, 4, 6, 8: *T. inclinata* (from Russia, Perm Province, Lysvinsky Distr., Chusovaja River Valley, Bezgodov, #74 MW): 1-4 – leaf surface views; 5-8 – leaf cross sections, showing difference in papillae. Scales 10 μm.

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