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A NEW SPECIES OF *DIDYMODON* S. STR. (POTTIACEAE, BRYOPHITA) FROM ASIAN SUBARCTIC

НОВЫЙ ВИД ИЗ РОДА *DIDYMODON* S. STR. (POTTIACEAE, BRYOPHITA) ИЗ АЗИАТСКОЙ СУБАРКТИКИ

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Abstract

Didymodon jenisseensis sp. nova is described from Norilsk Town surroundings (north of Krasnoyarsk Territory) based on combined molecular and morphological data. According to the molecular data, it is most closely related to *D. rigidulus*, while morphologically it is very similar to *D. truncatus*. Its description, illustrations, distinctions from morphologically similar species, and ecological data are provided.

Резюме

Didymodon jenisseensis sp. nova описан из окрестностей г. Норильск (север Красноярского края) на основании комбинированных молекулярных и морфологических данных. Молекулярные маркеры указывают на его родство с *D. rigidulus*, но по морфологическим признакам он наиболее сходен с *D. truncatus*. Приводятся описание, иллюстрации, отличия от морфологически сходных видов и данные об экологии для этого вида.

KEYWORDS: mosses, new species, ITS, Siberia

INTRODUCTION

In the "Moss flora of Russia" the genus *Didymodon* s.l. is represented by 43 species (Ignatova, 2025). It is twice more than were listed for Russia in the Checklist of mosses of East Europe and North Asia (Ignatov *et al*., 2006). The increase in the number of species resulted both from new records (Afonina *et al*., 2010, 2016; Afonina & Ignatova, 2024; Ignatov *et al*., 2024) and description of species new for science (Afonina & Ignatova, 2007; Ignatova *et al*., 2024, 2025). Most these newly recorded species were from southern mountain regions of Far East, Siberia, and the Caucasus, where the species diversity of the genus appeared to be much higher than in arctic and subarctic areas. The most characteristic species of *Didymodon* distributed in the northern permafrost regions of Asian Russia are arcto-alpine *D. asperifolius, D. subandreaeoides, D. mongolicus*, and *D. leskeoides*; in Russia, *D. giganteus* and *D. gaochienii* are known only from Taimyr and Yakutia, but they also occur in mountains of Europe or China, and no species of the genus restricted solely to the northern regions were revealed.

In August of 2025 the senior author participated in the study of vegetation in the outskirts of Norilsk Town (north of Krasnoyarsk Territory). On one of the relevé plots, on the bank of Ambarnaya River (Pyuasina River basin), on soil in the *Salix*-grass community he collected several peculiar specimens of *Didymodon*, which did not fit well circumscription of any species already known in Russia. To evaluate their affinity, in addition to morphological comparison, we decided to use molecular markers, as was done in our previous studies.

MATERIAL AND METHODS

DNA was obtained from two samples collected in Norilsk surroundings. We used nuclear ITS1-2 and chloroplast *trn*G markers for comparison with sequences from GenBank and from our previous studies. Protocols of DNA extracting, PCR and sequencing were essentially the same as described in the previous *Didymodon* studies (Afonina *et al*., 2022; Ignatova *et al*., 2024). Newly obtained sequences were initially incorporated in the dataset of ca. 200 specimens used in the latter study. After a preliminary analysis the dataset was cut, retaining

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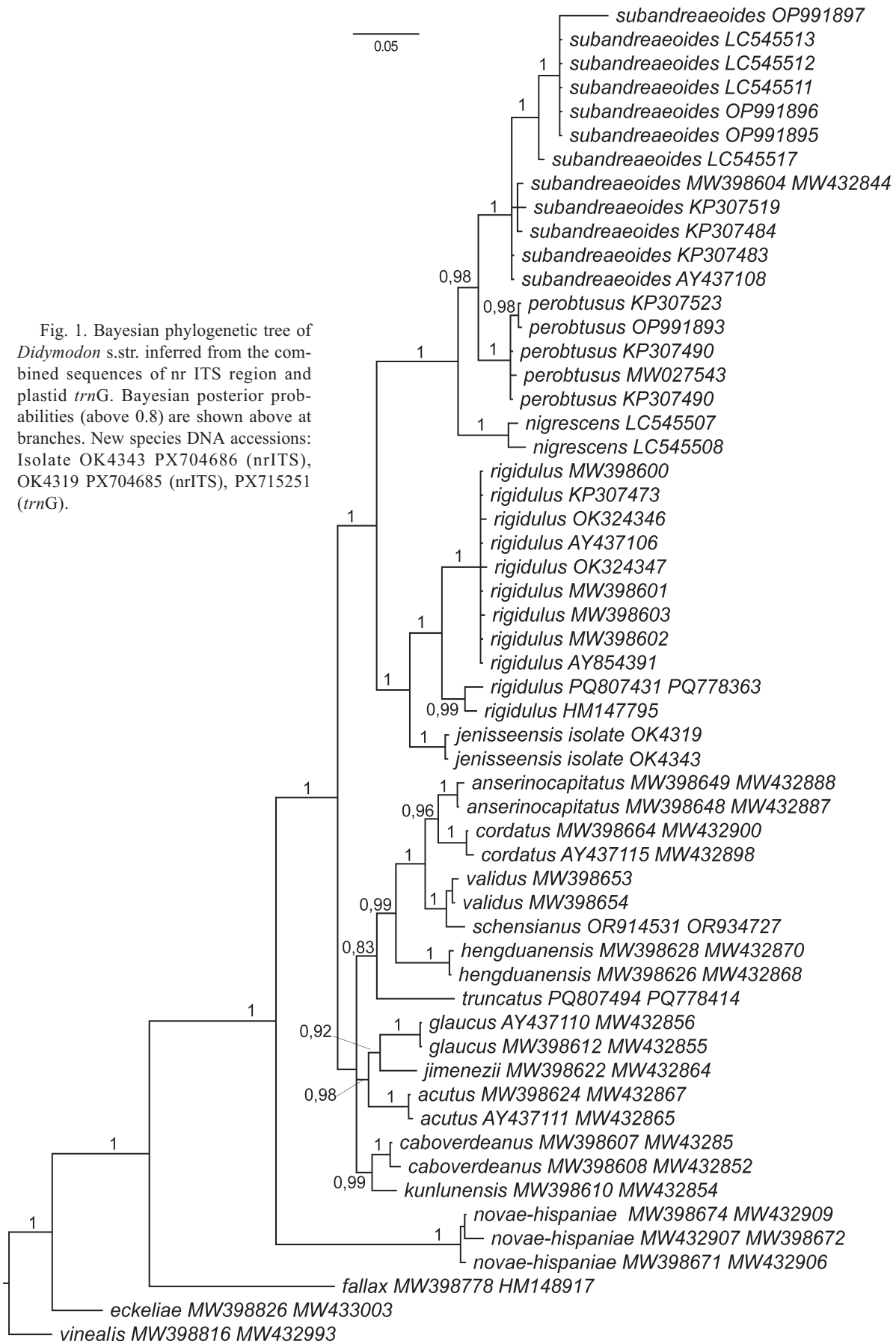

Fig. 1. Bayesian phylogenetic tree of *Didymodon* s.str. inferred from the combined sequences of nr ITS region and plastid *trn*G. Bayesian posterior probabilities (above 0.8) are shown above at branches. New species DNA accessions: Isolate OK4343 PX704686 (nrITS), OK4319 PX704685 (nrITS), PX715251 (*trn*G).

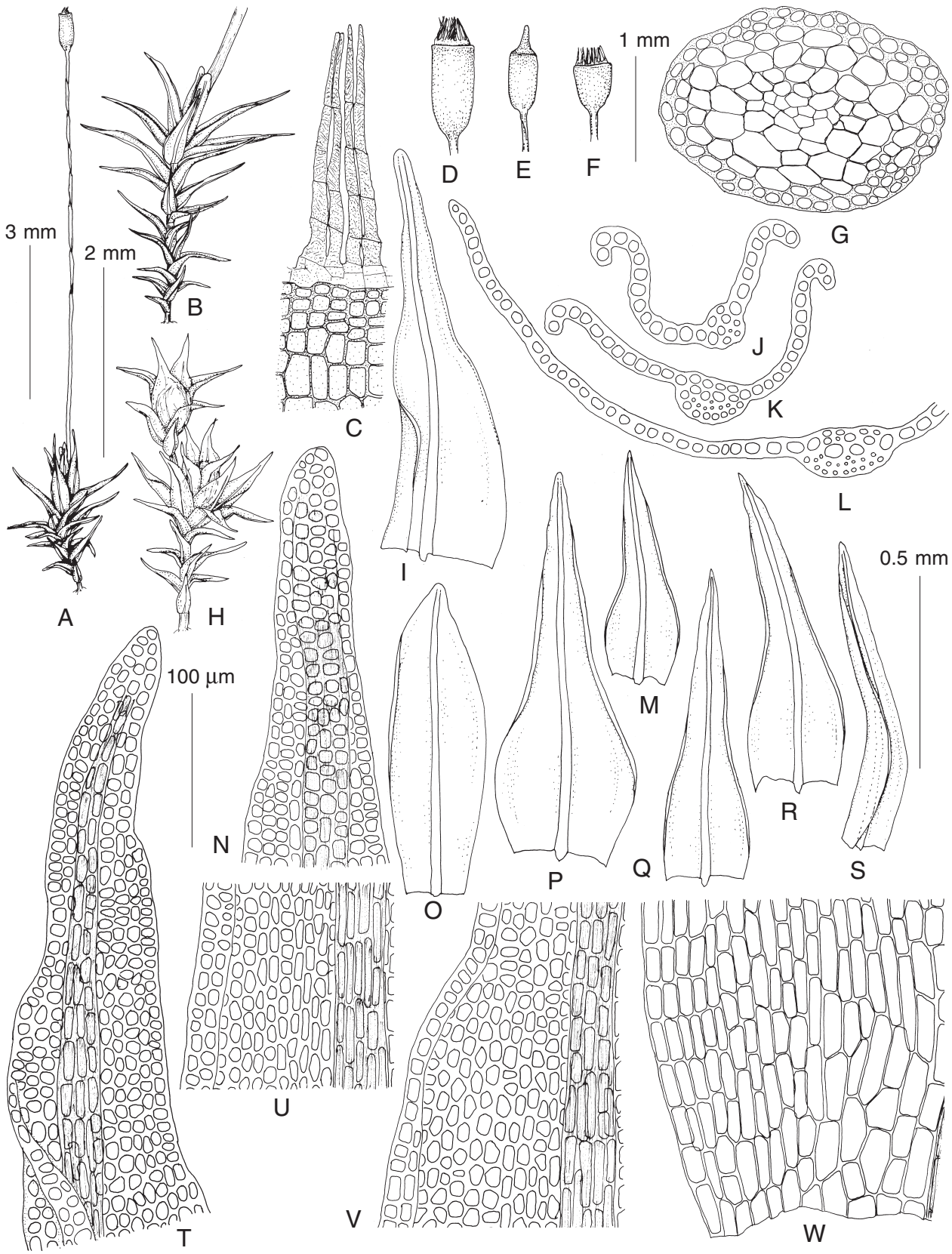

Fig. 2. *Didymodon jenisseensis* Ignatova & Mamontov (from holotype). A, B: habit, wet, female plants with sporophytes; C: peristome; D–F: capsules; G: stem transverse section; H: male plant, wet; I, M, P–S: stem leaves; J–L: leaf transverse sections; N: upper leaf cells and dorsal surface of costa; O: inner perichaetial leaf; T: upper leaf cells and ventral surface of costa; U: median leaf cells and costa, dorsal side; V: leaf cells at shoulder; W: basal leaf cells. Scale bars: 3 mm for A; 2 mm for B, H; 1 mm for D–F; 0.5 mm for I, M, O–S; 100 µm for C, G, N, T–W.

species more closely related to the species in question and leaving few outgroup taxa. The final alignment of 56 terminals included 1515 positions, 923 of nrITS and 592 of cp *trn*G region. Bayesian analysis was performed in MrBayes 3.2.6 (Ronquist *et al.*, 2012), with 2,000,000 generations, and the chain temperature of 0.02 in all analyses, reaching all PSRF=1.000 and all ESS>400. Consensus trees were calculated after omitting the first 25% trees as burn-in.

RESULTS

In the tree inferred from the Bayesian analysis, the newly obtained accessions OK4319 and OK4343 were resolved in a fully supported clade sister to a clade of *D. rigidulus* represented by 11 specimens. Their common clade appeared to be sister to a clade of three species: *D. nigrescens*, *D. subandreaeoides*, and *D. perobtusus*. However, in morphology plants from Norilsk possessed more in common with *D. perobtusus* and *D. subandreaeoides*, including leaf shape and size, unistratose lamina, and comparatively short peristome teeth. Nevertheless, they appeared to be distinct from the latter two species in some other features. Taking into account these morphological distinctions of specimens from Norilsk and their separate position in a molecular phylogenetic tree, we describe them below as a new species, *Didymodon jenisseensis.*

TAXONOMY

Didymodon jenisseensis Ignatova & Mamontov, species nova. Figs. 2, 3.

Type: Russia: Krasnoyarsk Territory, Norilsk urban okrug, lake Pyasino surroundings, Ambarnaya River valley, 69°26'26.9'' N, 87°54'07.3" E, *Salix* spp.-grass floodplain community, on soil, 12.VIII.2025, *Mamontov T29PP2-10034* (Holotype MHA9132204). Isolate OK4343, nr ITS DNA PX704686.

Diagnosis: The new species is similar to *D. perobtusus* and *D. subandreaeoides* in small size of plants, leaves with shoulders, obtuse apices, costa ending below apex, and unistratose lamina, but differs from them in shorter stems with fewer leaves, smooth laminal cells, costa with elongate superficial cells on both surfaces, absence of gemmae and brood branches, and stronger differentiated, oblong inner perichaetial leaves.

Etymology. The species name corresponds to Yenissey River, one of the greatest Siberian Rivers. The type locality is situated at ca. 70 km east of its lower course.

Description. *Plants* minute, growing as individual shoots scattered among other bryophytes, brownish-green, not glossy. *Stems* 2–3 mm long, simple, with weak central strand. *Leaves* loosely appressed and slightly flexuose when dry, erect-spreading to spreading when wet, crowded on stem, lower leaves 0.75–0.85×0.25 mm, ovate-lanceolate, upper leaves (0.9–)1.0–1.4×0.25–0.4 mm, from ovate base ±abruptly tapered into long, lanceolate acumina, rounded-obtuse at apices, canaliculate distally, not decurrent at bases; *margins* recurved on both sides at proximal 2/3–3/4 of leaf, entire; *costa* moderately strong, 40–50 μm wide at leaf base, slightly narrowing upwards, ending several cells below apex, prominent dorsally, flat ventrally, in transverse section semicircular, with elongate, smooth cells on both surfaces, without a pad of large, translucent cells on ventral surface below leaf apex, guide cells in 1(2) layers, dorsal stereids in 2–3 layers, ventral stereids lacking or few substereids present in proximal part, ventral and dorsal epidermis differentiated; *lamina* unitratose; *cells* in distal part of leaf isodiametric, irregular in shape and size, 8–11 μm in diameter, smooth; basal leaf cells rectangular, 17–25×8–10 μm, basal marginal cells not differentiated. *KOH reaction* yellowish-green. *Asexual vegetative reproduction* unknown. *Dioicous. Male plants* similar in size to female plants. *Sporophytes* usually present. *Inner perichaetial leaves* strongly differentiated, oblong, rounded to retuse at apex, 1.1–1.2×0.3–0.4 mm. *Setae* 7–8 mm long, reddish-brown, flexuose. *Capsules* short cylindric to cylindric, dark reddish-brown; *peristome* 160–300 μm long, basal membrane low, ca. 20 μm, teeth straight or weakly twisted, light orange-brown, with longitudinal slit, obliquely striate and finely papillose. *Spores* 15–19 μm.

Differentiation. *Didymodon jenisseensis* differs from the most closely related *D. rigidulus* in totally unistratose vs. partially bistratose leaf lamina; absence of ventral stereids in costa; elongate vs. quadrate cells on both surfaces of costa; and absence of brood bodies (usually present in *D. rigidulus*). There is more in common between *D. jenisseensis* and *D. perobtusus* or *D. subandreaeoides*, especially in having leaves with shoulders (occasionally present in the latter species), with obtuse apices, totally unistratose leaf lamina and irregular laminal cells. However, laminal cells of *D. jenisseensis* are smooth, while they are papillose and bulging in both other species, so their leaf margins are usually crenulate (vs. entire in *D. jenisseensis*). Stems of *D. perobtusus* and *D. subandreaeoides* are longer, to 0.8 mm, evenly foliate, with more numerous leaves, and they both often have unicellular gemmae; in addition, in the latter species axillary brood branches with smaller leaves are usually developed. Sporophytes are unknown in Russia in *D. subandreaeoides* and rare in *D. perobtusus*, whereas they were numerous in *D. jenisseensis*. Also, costa with elongate superficial cells on both sides in *D. jenisseensis* is an unusual character in *Didymodon* s. str.; it is currently known only in recently described *D. truncatus* from Altai Mts. Actually, the latter species is strikingly similar to *D. jenisseensis* in essential morphological characters: leaves with rounded apices; unistratose lamina; smooth, irregular in shape laminal cells; and costa with elongate cells on both surfaces. Its plants are also small, stem has weak central strand, but plants are sterile, with evenly foliate stems, leaves are smaller, 0.5–0.9×0.2–0.3 mm, usually oblong-lanceolate, without shoulders, with wider, rounded to truncate apices and weaker differentiated costa in transverse section. In the molecular-phylogenetic tree (Fig. 1) it occupies an isolated position sister to the clade including *D. hengsuanense*, *D. shensianus*, *D.*

Fig. 3. *Didymodon jenisseensis* Ignatova & Mamontov (from holotype). A: sterile plant, dry; B: sterile plant, wet; C: female plants with sporophytes, dry; D, F: peristomes; E: capsule; G: female plant with immature sporophytes, wet.

validus, *D. cordatus,* and *D. anserinocapitatus*, so it is quite distinct from *D. jenisseensis* by studied molecular markers. *Didymodon truncatus* is also known solely from the type locality; it formed low, dense, bright green tufts on rock surfaces along a stream on Yuzhno-Chuisky Mt. Range, at 2240 m a.s.l. It appeared to be unusual in its morphology within *Didymodon* s.l., and the discovery of another, not closely related species with similar combination of morphological characters is quite interesting.

Distribution and ecology. The species is currently known from a single locality in Norilsk outskirts. This locality belongs to forest-tundra zone of Siberian Subarctic, with scattered areas of larch forests; the species was collected on a plot at the river bank where *Salix*-grass community occurs (Fig. 4). Geologically, this area is characterized by strong Siberian Traps influence resulted in rich coal and ore deposits, including nickel, copper, platinum, and cobalt (Sevastianov *et al.*, 2014).

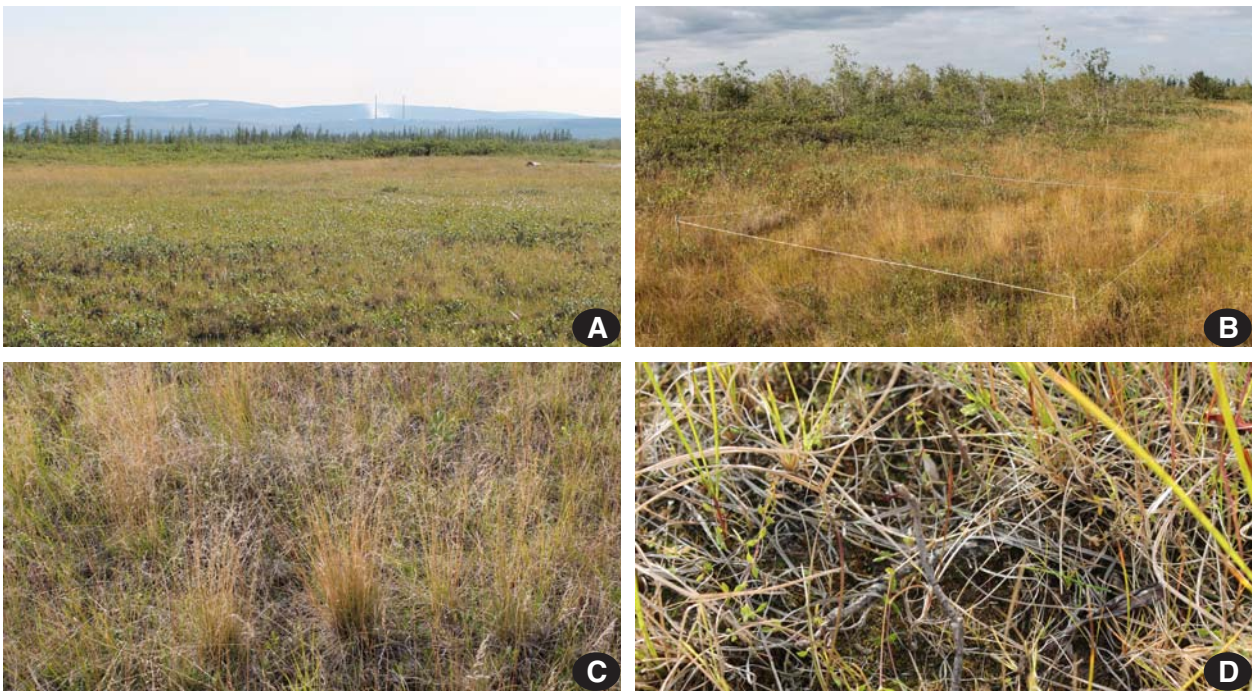

Fig. 4. Habitat of *Didymodon jenisseensis*: A: flood valley of Ambarnaya River; B: relevé plot #29 where the species was collected; C–D: *Salix*-grass community with soil patches.

Surroundings of Norilsk were strongly polluted due to mining and metallurgical plant activity, which also affected vegetation.

Specimens examined: Several specimens grow in a limited area, differing only by associated species (*Leptobryum pyriforme, Pohlia atropurpurea, Aongstroemia schreberiana, Oleolophozia perssonii, Mesoptychia badensis*). Second sequenced specimen has isolate OK4319; GenBank accession numbers PX704685 (nrITS), PX715251 (*trn*G) [*Mamontov T29PP2-10069* (MHA9132203)]. Other specimens: Mamontov *T29PP2-10056* (MHA9132209), *..-10068* (MHA9132210), *..-10057* (MHA9132211), *..-10066* (MHA9132212), *..-10034* (MHA9132213).

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