

## ON THE GENUS *LESKEA* (LESKEACEAE, BRYOPHYTA) IN RUSSIA

### РОД *LESKEA* (LESKEACEAE, BRYOPHYTA) IN RUSSIA

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Abstract

The genus *Leskea* in Russia is represented by one widespread species, *L. polycarpa* Hedw. Records of *L. gracilescens* appeared to be erroneous. Analysis of nuclear ITS sequence data demonstrated that North American samples of *L. gracilescens* and *L. obscura* clearly differ from European and Asian populations in several characteristic substitutions. Anomalous morphology of plants from Yakutia and Amur Province is described and illustrated. Their distribution likely corresponds to a high and late floodings of big rivers, crossing permafrost areas.

Резюме

Род *Leskea* представлен в России одним широко распространенным видом, *L. polycarpa* Hedw. Указания на находки *L. gracilescens* в Амурской области были ошибочными. Анализ нуклеотидных последовательностей ядерного спейсера ITS показал, что североамериканские образцы *L. gracilescens* и *L. obscura* отличаются несколькими заменами от европейских и азиатских растений. Необычная морфология растений *L. polycarpa* из Амурской области и Якутии, вероятно, связана с сильными поздними паводками на больших реках, протекающих в зоне вечной мерзлоты.

KEYWORDS: *Leskea*, Russian Far East, Yakutia, ecomorphs

#### INTRODUCTION

The genus *Leskea* in Russia included just one species, *L. polycarpa* Hedw., in almost all publications (Abramov & Volkova, 1998; Abramova *et al.*, 1961; Ignatov, Afonina, Ignatova *et al.*, 2006). Although Hedwig (1801) described from Europe two species, *L. polycarpa* and *L. paludosa*, the latter one was considered as a variety of the former already by authors of 19th century (*e.g.* Schimper, 1860). Eleven infraspecific taxa within *Leskea polycarpa* are listed in Tropicos database (<http://www.tropicos.org/namesearch.aspx>, accessed 1 May 2018), but in recent checklists (Hill *et al.*, 2006; Ros *et al.*, 2013) and Floras (Brugués & Ruiz, 2018; Redfearn, 2014) they are usually not mentioned at all. *Leskea latifolia* Lindb. ex Broth., described from the Caucasus (Brotherus, 1892), was synonymized with *Amblystegium varium* (Abramov, 1969).

In the course of the flora inventory studies in the Nature Reserve «Norsky», Amur River basin in the Russian Far East, we recently reported *Leskea gracilescens* (Bezgodov *et al.*, 2013), as these plants were sufficiently different, agreeing in many characters with this species as it was circumscribed in moss floras of North America (Redfearn, 2014; Crum & Anderson, 1981) and espe-

cially moss flora of China (Cao *et al.*, 2002). In China this species was reported only recently from its NE part, on the right bank of Amur River in a relatively close proximity to the area where the mentioned Russian collection has been done. Chinese collections were reported as sterile (Cao *et al.*, 2002), while in Russian specimens sporophytes were immature, thus the sporophyte characters were impossible to use. However, catenulate foliage, smaller stem leaves with the smaller length to width ratio, straight and symmetric leaves, lacking characteristic oblique apical part, and occasionally blunt apices in both stem and branch leaves fitted the description of *L. gracilescens*.

Later in Yakutia, to the north of Amur Province, we collected *Leskea* with even more obtuse leaves, more similar to another American species, *L. obscura*. So we decided to test with DNA markers if the plant from Amur Province and Yakutia really belong to *L. gracilescens* or represent another taxon.

#### MATERIALS AND METHODS

**Sampling.** In addition to *L. gracilescens*-like plants, we included the most common phenotypes of *L. polycarpa* from the Russian Far East and Yakutia into the set for sequencing, and specimen from European Russia.

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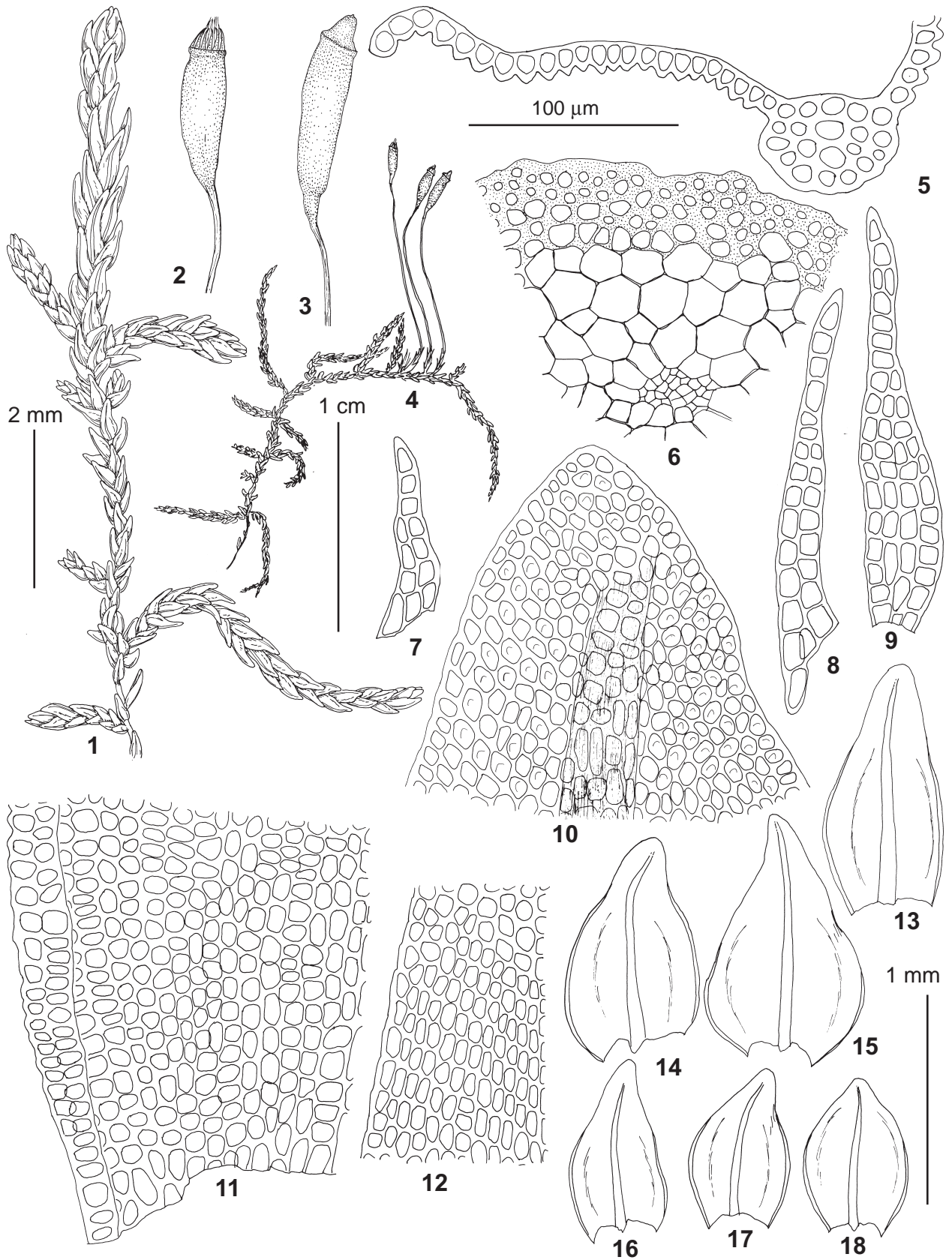


Fig. 1. *Leskea polycarpa* (from: Russia, Yakutia, Khangalassky Distr., 2.VIII.2016, Ignatov & Ignatova #16-160, MHA). 1, 4 – habit, dry; 2–3 – capsules; 5 – leaf transverse section; 6 – stem transverse section; 7–9 – paraphyllia; 10 – upper laminal cells; 11 – basal laminal cells; 12 – median laminal cells; 13–15 – stem leaves; 16–18 – branch leaves. Scale bars: 1 cm for 4; 2 mm for 1–3; 1 mm for 13–18; 100 μm for 5–12.

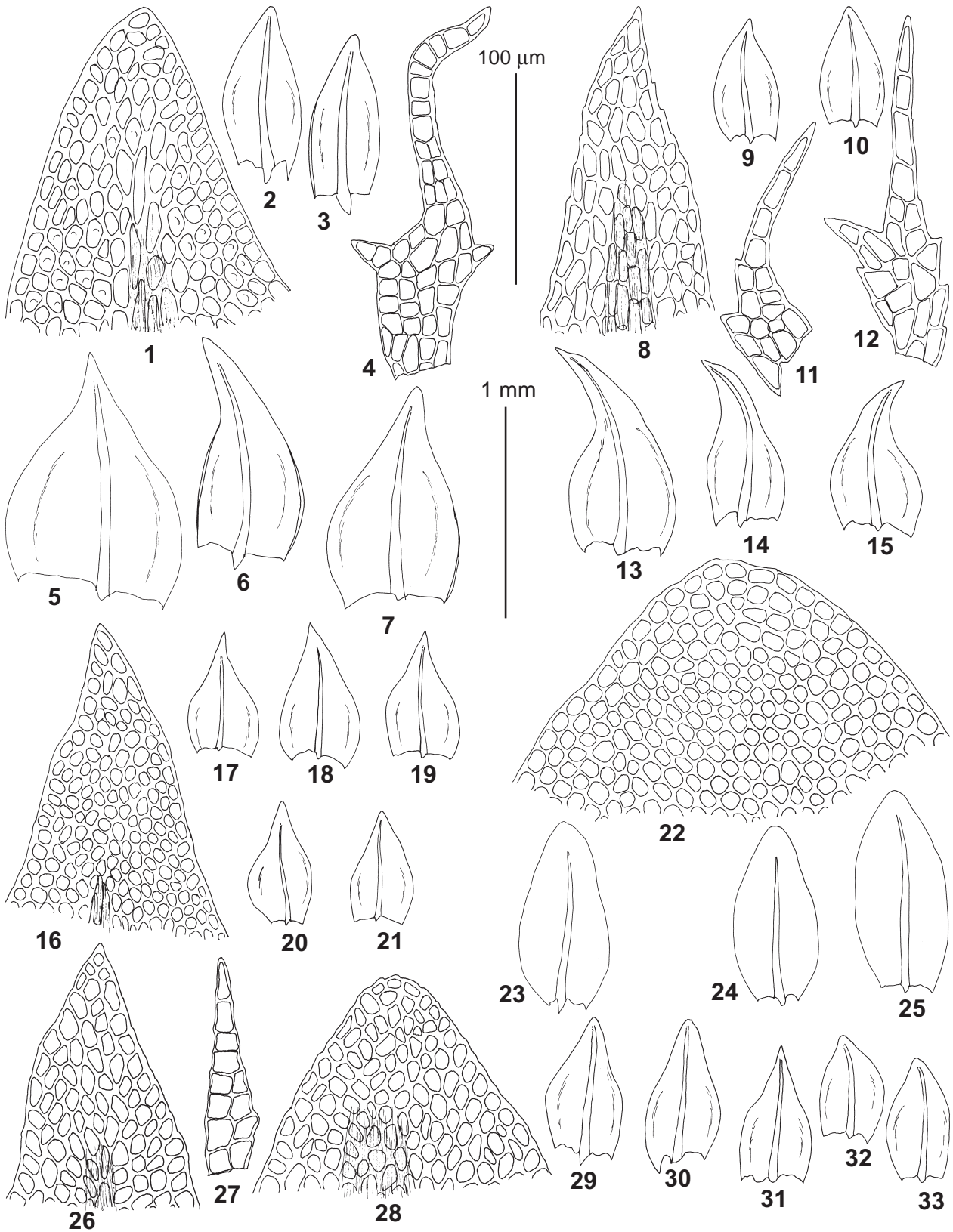


Fig. 2. 1–5 – *Leskea polycarpa* (1–7 from: Russia, Amurskaya Prov., 1.VII.2010, *Bezgodov* #34, MHA; 8–15 – from: Russia, Sakhalin, *Pisarenko* #0p03765, MHA); 16–21 – *L. gracilescens* (from: U.S.A., Ohio, *Buck* #50264, NY); 22–25 – *L. obscura* (from: U.S.A., *Buck* 22206, NY); 26–33 – *L. cf. gracilescens* (from: Russia, Amurskaya Prov., 1.VII.2010, *Bezgodov* #210, MHA). 1, 6, 16, 22, 26, 28 – upper laminal cells; 2–3, 9–10, 20–21, 32–33 – branch leaves; 5–7, 13–15, 17–19, 23–25, 29–31 – stem leaves; 4, 11–12, 27 – paraphyllia. Scale bars: 1 mm for 2–3, 5–7, 9–10, 12–15, 17–21, 23–25, 29–33; 100 µm for 1, 4, 8, 11–12, 16, 22, 26–28.



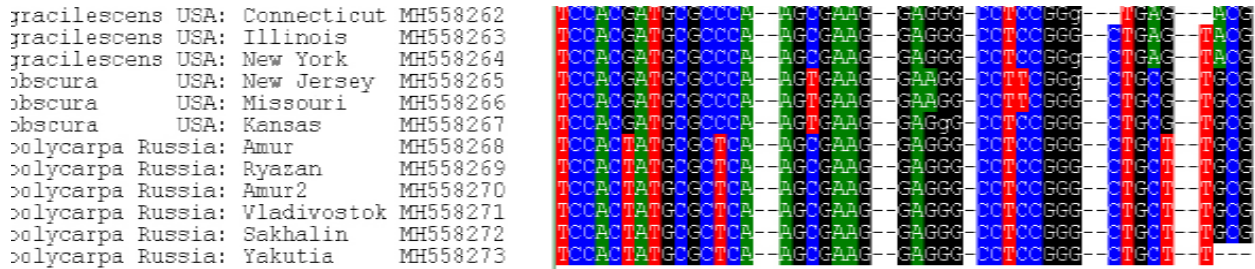


Fig. 3. Five fragments of the ITS alignment of *Leskea*, showing characteristic substitutions indicating identity of Russian plants of different morphotypes in contrast to American specimens of *L. gracilescens* and *L. obscura*. Specimens details are in Table 1 and complete alignment in Supplementary materials.

### Molecular protocols.

DNA extraction and amplification were done according to the laboratory protocols described in Gardiner *et al.* (2005). Voucher specimens and GenBank accession numbers are listed in Table 1. Sequences were aligned manually in BioEdit (Hall, 1999).

### RESULTS

The molecular results are partly shown in Fig. 3, and complete alignment is given as a supplementary material. There are only very few substitutions between American samples of *L. gracilescens* and *L. obtusa* and Eurasian plants, thus we present their distinction by a parts of alignment with substitutions, instead of a tree or haplotype network. The ITS region is found to be variable for separation of these three entities by characteristic substitutions. Among them, *L. gracilescens* and *L. polycarpa* lack infraspecific variation in these positions, and *L. obtusa* has one variable position.

Specimens from the Amur Province, as well as from Yakutia revealed no differences in sequences from specimens of the common phenotypes of *L. polycarpa*, both from the Far Eastern and European populations (Fig. 3).

### DISCUSSION

Although the present study results in no taxonomic novelties, the fact of such extreme variation is worthy describing and illustrating (Figs. 1–2). Obviously, the record of *L. gracilescens* from Russia and probably also from China are based on the ecomorphs of *L. polycarpa*.

Leaf apices in *L. polycarpa* are described as ‘blunt or

acute’ in “Moss Flora of North America” (Redfearn Jr., 2008); ‘acute to obtuse’ in “The moss flora of Britain and Ireland” (Smith, 2004); ‘agudo o acuminado’ in “Flora bryofitica Ibérica” (Brugués, 2018); “blunt to acute” in “Moss flora of the Middle European Russia” (Ignatov & Ignatova, 2004). Illustrations in all these floras show slightly secund leaves with more or less oblique apices, only rarely straight and symmetric. This character, along with differentiated stem and branch leaves (stem leaves being longer than wide), is considered as important for separating of *L. polycarpa* from *L. gracilescens* by Redfearn Jr. (2008): *L. gracilescens*, contrary to *L. polycarpa*, has straight leaves with symmetrical apices, as well as stem and branch leaves equally hardly longer than wide.

Most *Leskea* specimens from Russia fully agree with the mentioned features of *L. polycarpa*, except for the anomalous specimen from Amurskaya Province referred previously to *L. gracilescens*. In Fig. 2: 1–15, two specimens of *L. polycarpa* from Asian Russia are shown, with clearly asymmetrical stem leaves, oblique leaf apices and less oblong branch leaves with obtuse apices. However, specimen from Amurskaya Province (Fig. 2: 26–33) resembles *L. gracilescens* from North America (Fig. 2: 16–21) rather than *L. polycarpa* in shape of stem and branch leaves, which are straight and have symmetrical apices. Nevertheless, evidence from molecular markers suggests that this deceiving resemblance is likely caused by the influence of ecological conditions.

Another peculiar specimen with all leaves obtuse, even

Table 1. Specimens of the genus *Leskea* used in molecular study, with GenBank accession numbers.

Species	Specimen	Isolate	Genbank number
<i>L. gracilescens</i>	USA: Connecticut, coll. Tan #91502 (MHA)	OK555	MH558262
<i>L. gracilescens</i>	USA: Chicago, 6.X.2013 Ignatov (MHA)	OK556	MH558263
<i>L. gracilescens</i>	USA: New York, Buck 57814 (NY barcode 1221900)	OK541	MH558264
<i>L. obtusa</i>	USA: New Jersey, Buck 22206 (NY barcode 489277)	OK545	MH558265
<i>L. obtusa</i>	USA: Missouri, Buck 30103 (NY barcode 489398)	OK544	MH558266
<i>L. obtusa</i>	USA: Kansas, Buck 46377(NY barcode 680473)	OK542	MH558267
<i>L. polycarpa</i>	Russia: Amurskaya Province, 1.VII.2010 #69 (MHA)	OK428	MH558268
<i>L. polycarpa</i>	Russia: Ryazan, 11.XI.2009 Donskov (MHA)	OK551	MH558269
<i>L. polycarpa</i>	Russia: Amurskaya Province, 1.VII.2010 Bezgodov #34 (MHA)	OK552	MH558270
<i>L. polycarpa</i>	Russia: Vladivostok, Ignatov #08-355a (MHA)	OK553	MH558271
<i>L. polycarpa</i>	Russia: Sakhalin, Pisarenko #3765 (MHA)	OK554	MH558272
<i>L. polycarpa</i>	Russia: Yakutia, Ignatov & Ignatova 16-160 (MHA)	OK1438	MH558273

with rounded apices, was collected in Central Yakutia. However, its stem leaves are more longer than wide in comparison with branch leaves and have slightly oblique apices (Fig. 2), which is in agreement with circumscription of *L. polycarpa* according to Redfearn Jr. (2008). Capsules in this specimen are also slightly different from common morphotype of *L. polycarpa*, being straight and shorter than usual. However, molecular markers did not reveal any difference between this specimen and other specimens of *L. polycarpa*, pointing on wider morphological variability of this species in peculiar ecological conditions in permafrost areas of Asian Russia with repeated strong summer floods caused by the permafrost melting.

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