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HOW TO KNOW *MYUROCLADA LONGIRAMEA* (BRACHYTHECIACEAE, BRYOPHYTA)

КАК УЗНАТЬ *MYUROCLADA LONGIRAMEA* (BRACHYTHECIACEAE, BRYOPHYTA)

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Abstract

Morphological variation of *Myuroclada longiramea* and its distribution in Russia are described. This species was for a long time confused with *Bryhnia* species. Being one of the most variable species of Brachytheciaceae, *Myuroclada longiramea* is characterized by a broad variation in leaf shape from suborbicular to ovate-lanceolate within one stem comprising heteroblastic series. Such a variation pattern is the main diagnostic character of the species, usually allowing its recognition in the field. However in some cases only a limited part of this variation is present, and such phenotypes have often been confused with other species of the Brachytheciaceae and Amblystegiaceae. *Myuroclada longiramea* is a common species in the Russian Far East, South Siberian mountains and has scattered localities in boreal regions of the European Russia, where it was largely neglected earlier. Outside Russia it is known in northern China and northern Japan.

Резюме

Описана вариабельность морфологических признаков *Myuroclada longiramea* и распространение этого вида в России. В течение долгого времени его относили к роду *Bryhnia*. *Myuroclada longiramea* является одним из самых вариабельных видов Brachytheciaceae; для нее характерно широкое варьирование формы листа от округлой до ланцетной в пределах одного побега, представляющее гетеробластические серии. Такие побеги с листьями разной формы являются главным диагностическим признаком вида, по которому его можно узнать в поле. Однако в тех случаях, когда варьирование листьев хуже представлено, растения *Myuroclada longiramea* можно легко принять за другие виды Brachytheciaceae или Ambystegiaceae. *Myuroclada longiramea* широко распространена на российском Дальнем Востоке и в горах юга Сибири, и отдельные местонахождения вида известны в бореальной зоне европейской России, где вид долгое время не распознавали. За пределами России вид известен на северо-западе Китая и на севере Японии.

KEYWORDS: *Myuroclada*, Brachytheciaceae, heteroblastic series, *Bryhnia*

INTRODUCTION

Species identification in Brachytheciaceae is often difficult. Robinson (1962) explained the reason for this as follow: "Particularly important at the specific level are cases where no single specimen displays the full range of potential variation. Individual specimens of such highly variable species often show a very limited and distinctive morphology". We are hundred-percent agreeing with this.

Molecular evolution is sometimes slower than morphological one, and morphologically well-defined species do not always differ from their closest relatives in molecular markers. This is especially true in the subfamily Brachythecioideae, the terminal group in the phylogeny of Brachytheciaceae. There are examples where the nr ITS, the most variable region among widely used DNA markers in pleurocarpous mosses, provides no difference between species, *e.g.* in *Sciuro-hypnum* (Ignatov & Milyutina, 2007; Hedenäs *et al*., 2012) and *Brachythecium* (Ignatov *et al.*, 2008).

The opposite situations are known in the family as well. For example, in the genus *Kindbergia* in America a genetically distinct American endemic species that preliminary has been referred to *K. brittoniae* (Grout) Ochyra do not differ from the European *K. praelonga* (Hedw.) Ochyra in morphology (Hedenäs, 2010). Therefore the putatively invasive populations of *K. praelonga* cannot be distinguished from the native species based solely on morphology.

At the generic level, a clear molecular phylogenetic signal in molecular data has often a leading impact on the resolving of the puzzling taxonomic tangles. For example, *Eurhynchium* (sensu authors of 1980s) was split into six genera based on molecular data (Ignatov & Huttunen, 2002; Huttunen & Ignatov, 2004) and *Rhynchostegiella* was divided into four genera (Aigoin *et al.*, 2009); non-monophyly of *Homalothecium* was shown by Huttunen *et al*. (2008), while *Rhynchostegium* was lumped with epiphytic *Eriodon* and aquatic *Platyhypnidium* (Huttunen & Ignatov, 2010). Li *et al.* (2014) also showed that it is more

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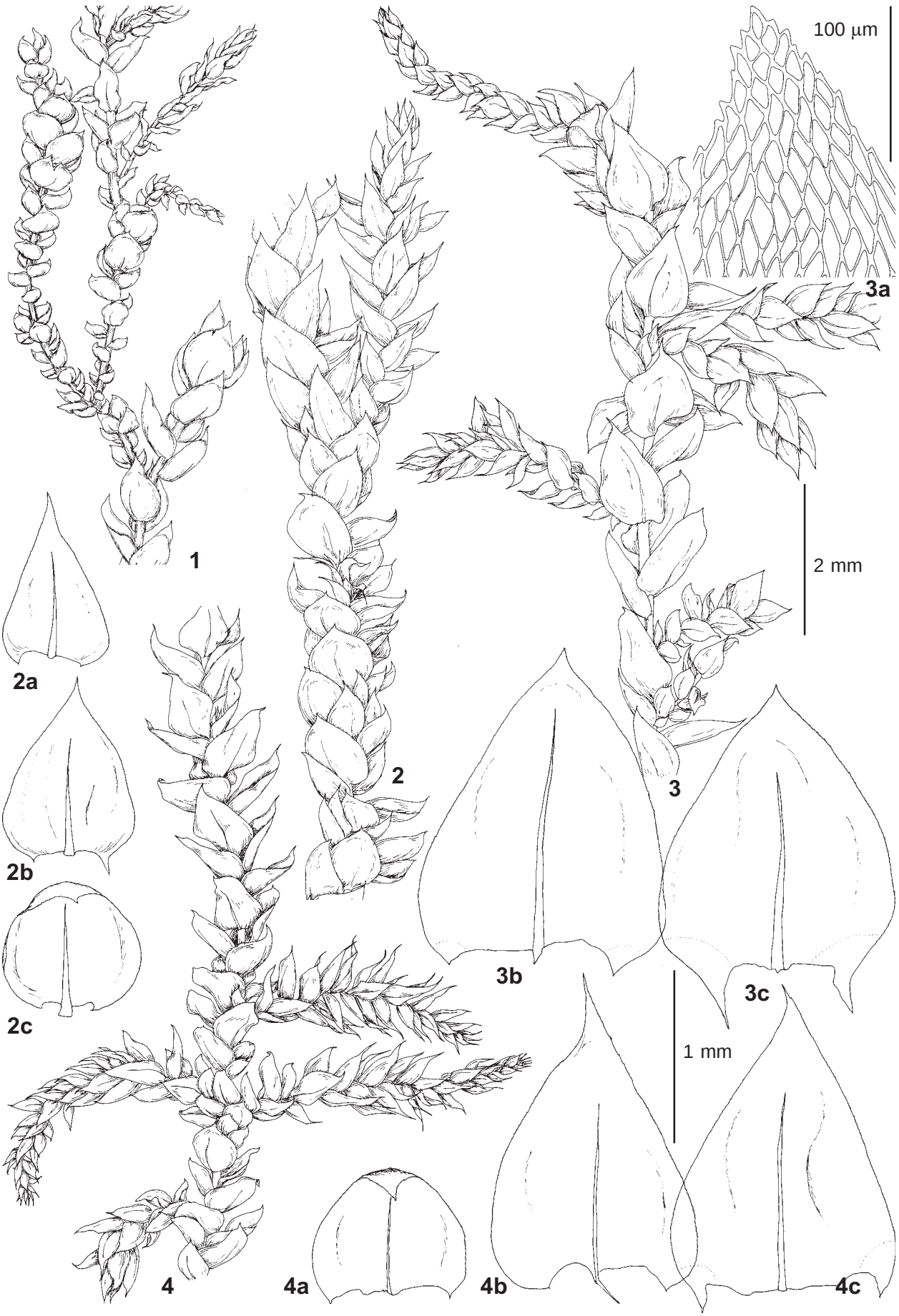
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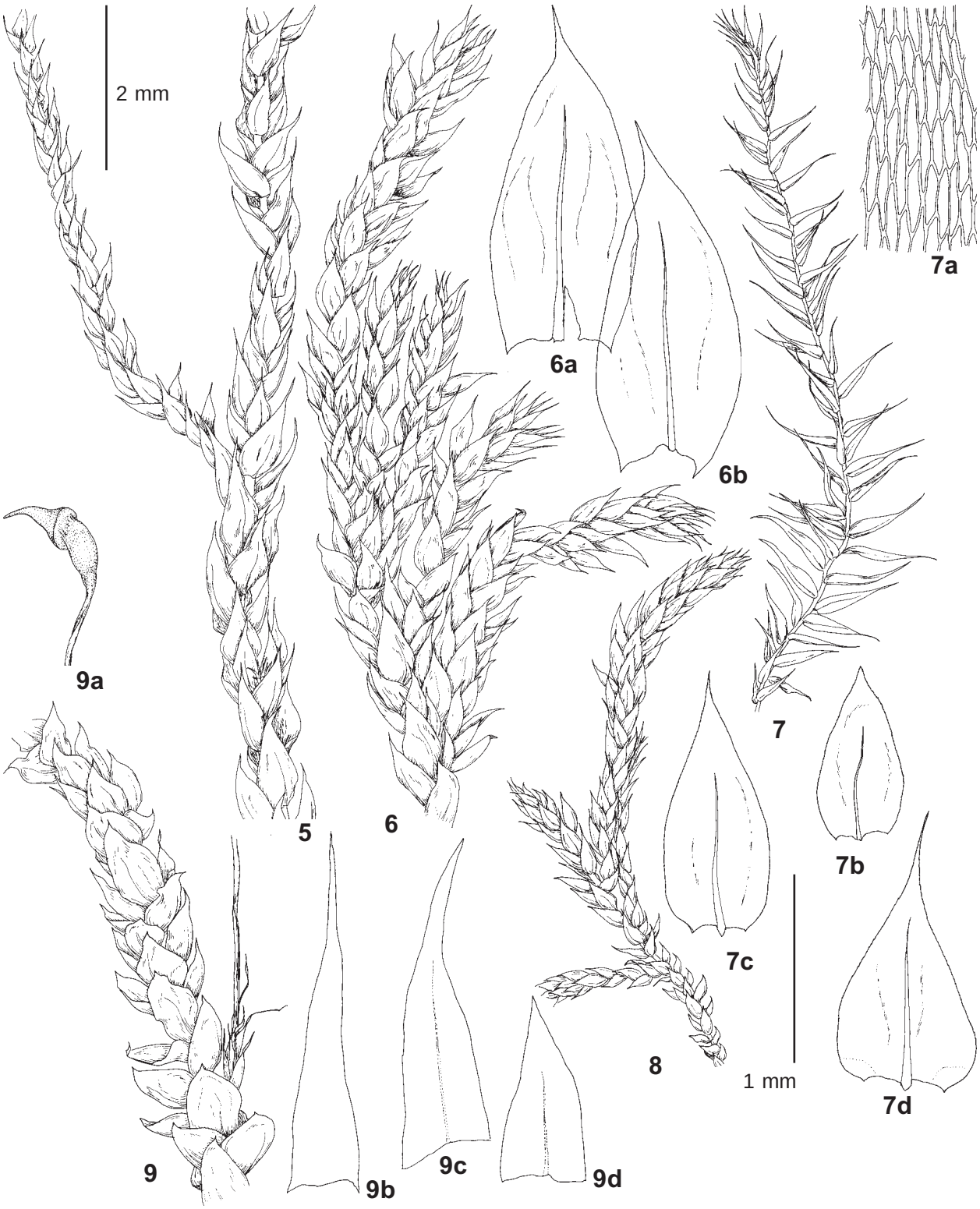

Figs. 1-9 (pages 498-499). *Myuroclada longiramea* (Müll. Hal.) M. Li, Y.-F. Wang, Ignatov & Huttunen, showing variation. From: 1 – northern European Russia, Arkhangelsk Prov., 25.VI. 1872, Brotherus, H-BR [from Popov *et al*., 2000]; 2 – Japan, holotype of *Bryhnia brachycladula* Card., Faurie 109, KYO [drawn from photo supplied by Bakalin; leaves are from relatively weak branch]; 3 – northern Asian Russia, Yakutia, Lenskie Stolby, 17.VIII.2000, M. Ignatov, MHA; 4 – Russian Far East, Sakhalin, 12.VIII.2006, Ignatov, MHA; 5 – Russian Far East, Vladivostok, 12.VIII.2006, Ignatov, MHA; 6 – Russian Far East, Amurskaya Province, 17.VII.2010, Bezgodov 501, MHA; 7 – same as 6, Bezgodov 500 (MHA); 8 – Russian Far East, Kamchatka, 20.VII.2002, Czernyadjeva 4 (MHA); 9 – Russian Far East, Vladivostok, Ignatov et al., 06-3363, MHA. Habit, supplemented by stem leaves and areolation from corresponding specimens; for 9 also capsule (9a) and perichaetial leaves (9b-d). Scale bars: 2 mm for habit and capsule; 1 mm for leaves and perichaetial leaves; 100 μm for cells.

natural to treat *Bryhnia* within the *Brachythecium*. The last mentioned authors found that not all species of the former *Bryhnia* belong to one lineage, and one of species, known in some treatments as *Bryhnia brachycladula* Cardot, groups with *Myuroclada maximowiczii* (G.G. Borshch.) Steere & W.B. Schofield in the molecular phylogeny. Thus, Li *et al*. (2014) transferred it to the latter genus under the name *Myuroclada longiramea* (Müll. Hal.) M. Li, Y.F. Wang, Ignatov & Huttunen.

This species occurs mainly in Russia, northern China and also in Japan, where it is very rare (Takaki, 1956). Being rare throughout most of its range and also very variable in morphology, it caused numerous misinterpretations in it identification. It has been reported as *Myurocalda maximowiczii* (Brotherus, 1925), *Bryhnia brachycladula* (Takaki, 1956), *B. novae-angliae* (Sull. & Lesq.) Grout (Ignatov, 1998; Popov *et al*., 2000) or *B. scabrida* (Lindb.) Kaurin (Ignatov & Ignatova, 2004), and *Eurhynchiadelphus eustegia* (Besch.) Ignatov & Huttunen (Ignatov *et al.*, 2005). Koponen (1987) considered that the species should be referred to *Eurhynchium serricuspis* Müll. Hal., a species recently synonymized with *Pseudokindbergia dumosa* (Mitt.) M. Li, Y.F. Wang, Ignatov & B.C. Tan (Li *et al.*, 2015).

The recent studies with an expanded set of specimens by Huttunen *et al.* (accepted in Taxon) and Li *et al*. (2014, 2015) including a number of additional problematic specimens from Russia allows a better outlining of the volume of *Myuroclada longiramea*. In the present paper we will give morphological circumscription for *Myuroclada longiramea* and discuss its distinction from superficially similar species from other genera. Additionally, characters important for identification and recognising it in the field are discussed.

Myuroclada longiramea (Müll. Hal.) M. Li, Y.-F. Wang, Ignatov & Huttunen, J. Bryol. 36(1): 15. 2014.

Rhynchostegium longirameum Müll. Hal., Nuovo Giorn. Bot. Ital., n. ser. 5: 202. 1898. Lecotype: "Bryotheca E. Levier, *Rhynchostegium longirameum* Müll. Hal. c. fr.", China, Shaanxi Prov., China interior, provincia Schen-si sept., in monte Tui-Kio-san, 17,IX.1896 *Jos. Giraldi*, determ. prof. C. Müller n 2237" (H-BR 3690006!, isolectotypes FI!, G!, S!; 2 syntypes in S!: C. Müller no. 2244 and s. n.). Selected and illustrated by Ignatov *et al*. (2005).

Bryhnia brachycladula Card., Bull. Soc. Bot. Genève 4: 379. 1912. Type in KYO (Fig. 2).

Bryhnia sibirica Broth. inedit. in H-BR 0526009: "*B. novae-angliae* (S.L.) Gr. foliis laxius areolatis. 3629. *Bryhnia sibirica* Broth. n. sp. (+*Mnium cuspidatum*), Siberia, prov. Jenisejsk, distr. Minusnsk, in ripas fl. Uta pr. pagum Beiskaya 2/7/1913 leg. J.V.Kusnetsov" .

Description. Plants robust to medium-sized, yellow-green to yellow-brownish or pale yellow. Stem prostrate, to 5 cm, irregularly branched, with numerous sympodial branches, or more rarely pinnate branching with short branches to 3 mm long with remote, spreading, subcomplanate leaves. Leaves strongly variable along shoots, although in some collections the variation is poorly presented, whereas in others it occurs in most shoots; distal leaves ovate-lanceolate to broadly ovate, acute to acuminate, 1.3–1.6×0.8–1.1 mm, moderately concave, their upper laminal cells 30–40 μm long, median laminal cells 30–60×8–11 μm; proximal leaves of many shoots much shorter, broadly acute to suborbicular and very concave, 1.0–1.3×1.0 mm, their upper laminal cells 15–20 μm long, median laminal cells 30–40×8–11 μm; costa reaching (0.4–)0.6–0.7 of leaf length, in acute and acuminate leaves ending in a stout tooth, sometimes with several teeth on abaxial side of costa near its end; in suborbicular and more concave leaves costa is thinner, not ending in spine; margin serrate to subentire; laminal cells smooth to somewhat prorate (few or many, but never all cells); alar cells enlarged and inflated, forming distinctly delimited submarginal group, reaching 1/2 of the distance to costa. Dioicous. Perichaetia with numerous conspicuously exserted paraphyses. Seta 12 mm, smooth. Capsule ovoid, inclined to horizontal. Operculum broadly rostrate. Annulus separated by fragments. Peristome perfect. Spores 13-17 μm. Calyptra naked.

Differentiation. The species is probably the most protean in Brachytheciaceae, exhibiting variation from julaceous shoots that mimic *Myuroclada maximowiczii* and *Bryhnia hultenii* E.B. Bartram to *Brachythecium rivulare*-like ones and sometimes even narrow-leaved shoots resembling depressed phenotypes of *Brachythecium mildeanum* (Schimp.) Schimp. or *Leptodictyum riparium* (Hedw.) Warnst. (Figs. 1-9).

The most remarkable character of *Myuroclada longiramea* is the heteroblastic leaf pattern, *i.e*. leaves that greatly vary along individial shoots. The series include obtuse and very concave proximal leaves, followed by ovate-triangular ones and finally ovate-lanceolate and acuminate distal leaves. A somewhat similar series are occasionally observed in species of *Brachythecium* sect. *Bryhnia*, represented in Russia by *Brachythecium hultenii* (E.B. Bartram) M. Li & Y.F. Wang and *B. noesicum* Besch. The easiest and most reliable difference between *M. longiramea* and the two *Brachythecium* species includes the papillae in the upper corner of the laminal cells on abaxial leaf side. This character is easy to check by studying intact leafy shoot in a slide, as papillae are well projecting on dorsal leaf side of both stem and branch leaves. Both *Brachythecium* species exhibit projecting upper angles in most cells on abaxial leaf surface, except for slender forms of *B. noesicum*. In *Myuroclada longiramea* laminal cells are not or only slightly prorate in stem leaves, although narrow branch leaves (especially in branches with leaves much smaller than in stem leaves) can have somewhat prorate cells. Even then the prorae are not on all cells, being usually conspicuous on rather few cells. Proration in *Eurhynchiadelphus eustegia* may be similar to *M. longiramea*, but it differs from the latter species in much longer leaves and very few (if any) short leaves at branch

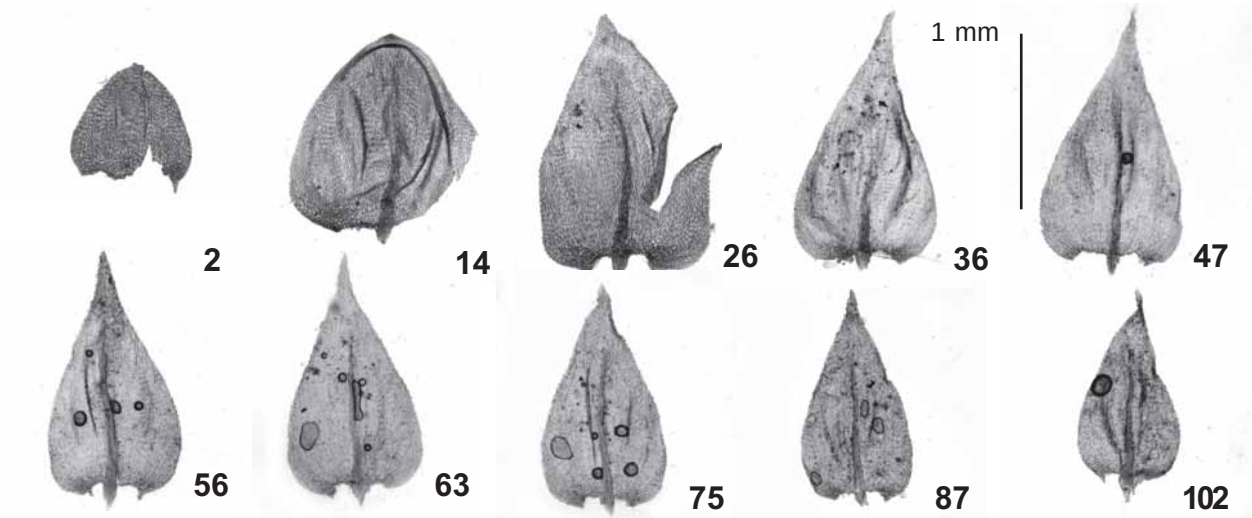

Fig. 10. Leaves from one shoot of *Myuroclada longiramea* (from Ignatov & Igantov #13-1282 MW), taken from approximately equal distance one from another (all shoot had 106 leaves, not counting very small young ones). Numbers indicate leaf number on the shoot from its base.

base. *Eurhynchiadelphus eustegia* is also phyllodioidous, a state never observed in *M. longiramea*.

The conspicuous heteroblastic variation pattern was observed in ca. 80% of the studied collections of *M. longiramea* and thus in most cases it alone is enough for recognising the species. It can not, however, be found in all shoots within a single collection, or it may be unclearly expressed in some shoots. Therefore, it is crucial for the species identification to have a good collection with at least several tens of shoots, for understanding the variation. This rule is important for many groups of mosses, but it is especially critical for many species of Brachytheciaceae.

Specimens with julaceous plants because of short and strongly concave leaves can easily be confused with *Myuroclada maximowiczii.* However, the latter species has never acute leaves, and leaves from thin shoots are abruptly acuminate or apiculate-attenuate, rather than acute. This difference has been specifically discussed and illustrated by Popov *et al*. (2000).

When most or all leaves are long and acuminate (Fig. 7), *M. longiramea* can be confused with as different species as *Brachythecium mildeanum* and *Leptodictyum riparium*, providing a quite unexpected problem. In this case, cell length is a helpful character for their differentiation: in *M. longiramea* both stem and branch leaves have shorter cells than in both latter species (cf. Fig. 7a). *Leptodictyum* can be excluded also by non-*Brachythecium* type of proximal branch leaves (previously called pseudoparaphyllia), which also are relatively long and narrow-acute.

Brachythecium rivulare Schimp. may sometimes look very similar to *M. longiramea*, having numerous short leaves, and cells in branch leaves may have a tendency to be short. However, in larger leaves cells in the middle part are usually longer than 70–80 μm, and commonly some cells are longer than 100 μm, whereas in *Myuroclada longiramea* cells are mostly shorter than 50 μm.

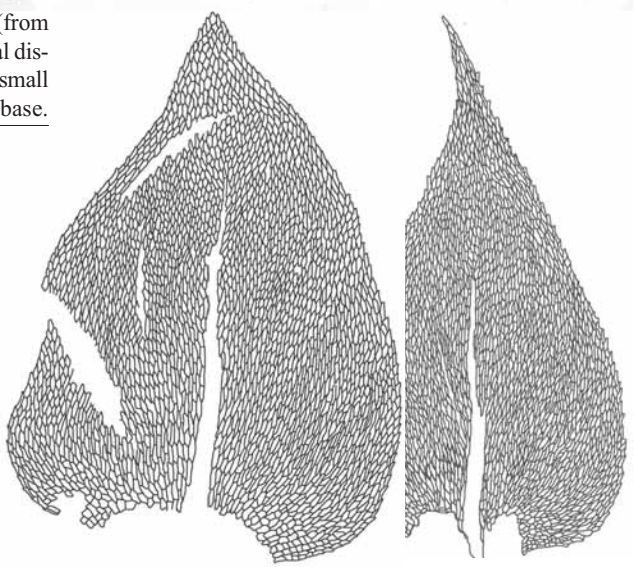

Fig. 11. Two leaves from the series shown in Fig. 10 (23th and 52th ones), with outlined cells. Having different shape, these leaves only slighly differ in number of cells along leaf margin (68 and 71) and in the widest place from costa to leaf margin (47 and 43).

Finally, plants of *Myuroclada longiramea* from northern Yakutia have blunt stem leaves,and it can be confused with *Eurhynchiastrum pulchellum* (Hedw.) Ignatov & Huttunen. Plants of the latter species are usually much smaller, with stem leaves commonly 0.3–0.4 mm wide only. However in some areas, especially in North America a quite robust phenotype of this species occurs (Ignatov *et al.*, 2008; Ignatov, 2014). In this case the most important distinction can be found in laminal cell proportion, which is about 3-7:1 in *M. longiramea* and 6-12:1 in *E. pulchellum.*

Variation. A series of variable leaves from one 'average' shoot is shown in Fig. 10. It is interesting that although leaves are so different in shape, they are composed of approximately the same number of cells (Fig. 11).

Ecology. The species grows in wet places in deciduous and mixed forests in moderate shade, *i.e*. in the same habitats where *Brachythecium rivulare*, *B. novae-angliae* and *B. hultenii* commonly occur. It also grows on shad-

ed mesic rock outcrops on slopes in the forest, and occasionally on soil on slopes in mesic forests.

Distribution area of *Myuroclada longiramea* includes Eastern Europe (see Popov *et al*., 2000, as *B. novae-angliae*; Ignatov & Ignatova, 2004, as *B. scabridens*), Altai (Ignatov, 1998, as *B. novae-angliae*) and other regions of South Siberia, Yakutia, Russian Far East from Kamchatka and Commander Islands to Primorsky Territory and Sakhalin, Japan (rare), China (Hebei, Jilin, Liaoning, Shaanxi, Xinjiang).

Selected specimens examined: EUROPEAN RUSSIA. ***Arkhangelsk Prov.,*** *Brotherus* 25.VI.1872 (H-BR); ***Kostroma Prov.***, *Popov #26* (MHA). ***Ryazan Prov***., *Volosnova* 2013 (MHA). ***Bashkortostan Republic***, Kaga River, Martynenko 256-1 (UFA), Uzyan River, *Martynenko 305-1* (UFA). ASIATC RUSSIA. ***Khanty-Mansi Autonomous Distr.***, Elisarovo Reserve, *Taran & Pisarenko op01377* (NVS); Surgut, *Taran & Pisarenko op00107* (NVS). ***Altai Republic:*** Aya, 300 m, *Tyulina* 2.V.1952 (LE); Bele, 500 m, *Ignatov 0/51* (MHA); Chemal Creek, 3 km upstream mouth, 450 m, *Ignatov & Ignatova 34/227; 34/238* (MHA); Kamga Bay, 440 m, *Zolotukhin* 20.X.1988 (MHA); Maima, 280 m, *Ignatov 35/28; 35/57* (MHA); Yailyu, 450 m, *Ignatov 1/15; 1/34; 1/53; 1/74; 1/89; 1/90*, 480 m, *0/2046* (MHA). ***Altai Territory,*** Cheremshanka, *Pisarenko op00682* (NVS). ***Kemerovo Prov.***, Novokuznetsk Distr., Kalachevo, *Pisarenko op02370* (NVS). ***Krasnoyarsk Territory:*** Enisejsk Gub., fl. Karbula prope p. Gavuljskoj NW Blagowetschtschensky, 29-VIII-1908, *Kusnezow* (H0528021). ***Irkutsk Prov.***, Slyudyanka, 8.VI.2005 Ignatov & Kazanovsky (MHA). ***Yakutia***, Lenskie Stolby, 17.VIII.2000, *M. Ignatov s. n.* (MHA). ***Amurskaya Prov***., Nora Reserve, *Bezgodov 500, 501* (MHA). ***Khabarovsk Territory:*** 2 km SE Sofiisk 95 m, *Alanko 31540c/1* 3.IX.1976 (H3017682); 25 km S of Khabarovsk, 175 m, *Alanko 32373/2* (H3017686); Bureya River, *Ignatov 97-1274, 1282, 1276, 1277, 1280* (MHA); Sovgavan Distr., Botchi Reserve, *Ignatov et al. 13-260, 275, 942, 103, 441, 436* (MHA); ***Primorsky Territory:*** Okeanskaya, 11.V.1909, *Kusnezow* (H0528022); Primorsky, 19.VIII.2007, *M. Ignatov s. n.* (MHA); Ignatov & Ignatova 13-1282 (MW); *Ignatov 07-408* (MHA). ***Sakhalin Prov.:*** *Ignatov & Teleganova 06-649* (MHA). ***Kamchatskaya Territory***, Pravy Kikhchik, 24.VII.2004, *Czernyadjeva 18* (LE); Commander Islands, Bering I., *Fedosov 10-3-429* (MW). CHINA. ***Jilin Prov.,*** Kavlin-tzu 5.IX.1905 *Siuzev* (H-BR 0528005); *Y.F. Wang 166* (HSNU); ***Liaoning Prov.***, Bai-shi-la-ji Mts., *Buck 23736* (H3058529); ***Hebei Prov***. *Y.F. Wang 19* (HSNU); ***Xinjiang Uygur Autonomous Region***, *Mamtimin 16979* (XJU).

Sporophytes. There are rather few collections with capsules other than type of this species: Russia, "Primorskaja, p. Okeanskaja, 11-X-1909 J. Kusnezov #500, 516" (S, H-BR 0528022, 0528023); China, Jilin, Mt. Chang Bai. Koponen 37271 (H3017685), 37293 (H3017689), 37296 (H3017684).

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