

BRYOPHYTE MOLECULAR BARCODING RECORDS. 6

БРИОЛОГИЧЕСКИЕ НАХОДКИ ПО РЕЗУЛЬТАТАМ ДНК-МАРКИРОВАНИЯ. 6

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Abstract

DNA-barcoding revealed/confirmed the range extension of the following liverworts: *Scapania gigantea* (Iturup Island), *Rudolgaea borealis* (Taimyr Peninsula), and *Solenostoma rossicum* (Yamal-Nenets Autonomous Area).

Резюме

С помощью ДНК-баркодинга выявлены или подтверждены находки за пределами основного ареала следующих видов печеночников: *Scapania gigantea* (о. Итуруп), *Rudolgaea borealis* (Таймыр) и *Solenostoma rossicum* (Ямало-Ненецкий Автономный Округ).

KEYWORDS: hepatics, new records, molecular markers, nrITS, Russia

INTRODUCTION

This paper continues the series of brief reports of new findings in the course of the bryophyte DNA studies. It presents various finding where the sequencing either confirms species identities, which are ambiguous by various reasons, or discloses their affinities, or support generic placements of certain taxa that have never been investigated for molecular markers earlier, or have never been barcoded previously, or have been barcoded from different parts of the world. Being obtained in the course of screening rather than special projects of a particular group, such data may remain unsubmitted to DNA databases and stay neglected and not searchable among published materials.

Scapania gigantea Horik.

Contributors: A.D. Potemkin, A.A. Vilnet, V.A. Bakalin²

Specimen: Russia, Sakhalin Province, northern part of Iturup Island, Tsirk Bay, Tsirk River lower course, 45°21'26"N, 148°37'11"E, 20 m a.s.l., sedge-peat moss wetland in the flood plain, wet stone near stream, 12.IX.2015, V.A. Bakalin & E.A. Borovichev K-72-25-15, det. V V.A. Bakalin as *Scapania uliginosa* (Lindenb.)

Dumort. and distributed in Hepaticae Rossicae Exsiccatae Fasc. IX. No. 300. Revised by Potemkin, Vilnet and Bakalin as *Scapania gigantea*. (LE, VBGI, KPABG).

GenBank accession numbers are OM501133 for ITS1-2 nrDNA and OM515128 for *trnL-F* cpDNA.

The ITS1-2 nrDNA and *trnL-F* cpDNA nucleotide sequences for specimen from Iturup Island were obtained according with protocols described in Potemkin *et al.* (2021). The test of genetic distances in MEGA 11 (Tamura *et al.*, 2021) suggested ITS1-2 nucleotide sequence divergence of the Iturup specimen from accessions of *Scapania gigantea* from Kunashir Island (MZ272035) in 0.9% and from Shikotan (MZ272036) – in 0.8%. The *trnL-F* sequence variability consists 0.4% with accession from Honshu (MZ274288), 0.2% with accession from Shikotan (MZ274290) and absent with accession from Kunashir (MZ274289). The new record increases infraspecific sequence variation in *Scapania gigantea* compared with previously published 0.6% in ITS1-2 and 0.1% in *trnL-F* (Potemkin *et al.*, 2021), but agrees with level of infraspecific variation in the genus *Scapania* (Bakalin *et al.*, 2019).

Distribution and habitat. Previously *Scapania gigantea* was reported from Kunashir, Shikotan, and Honshu Islands, and the Yunnan Province of China. In all

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known locations, it grows on rocks and sandy soil in mountain streams and on their banks (Potemkin *et al.*, 2021). This record of *Scapania gigantea* is the first for Iturup Island.

Taxonomic notes. Despite *Scapania gigantea* was not accepted in the World checklist of hornworts and liverworts (Söderström *et al.*, 2016), and in the Checklist of Japanese liverworts and hornworts (Katagiri & Furuki, 2018) after its resurrection by Potemkin (2001), its species status was confirmed by Potemkin *et al.* (2021).

Scapania gigantea from Iturup Island is distinct in the large plants, 4–6 cm long, deep purplish-black color, and characteristic development of teeth at and near the decurrent strip of the dorsal lobe.

2. *Rudolgaea borealis* (Frisvoll & Moen) Potemkin & Vilnet [*Gymnocolea borealis* (Frisvoll et Moen) R.M.Schust.]

Contributors: N.A. Konstantinova, E.D. Lapshina, A.A. Vilnet, G.N. Ganasevich

Specimen: Russia, Krasnoyarsk Territory, the southern part of the Taimyr Peninsula, southern tundra subzone in the middle reaches of the Dudypa River between the mouths of the Bataika and Avam rivers, sedge-hypnum floating fen on the shore of thermokarst lake with *Carex chordoriza*, *C. rotundata*, 38 m above sea level, 71.23266°N, 92.66041°E, single shoots in mats dominated by *Scorpidium revolvens* (Sw. ex anon.) Rubers with admixture of *Oncophorus demetrii* (Renauld et Cardot) Hedenas, *Cinclidium subrotundum* Lindb., *Warnstorffia sarmentosa* (Wahlenb.) Hedenäs. Coll. G.N. Ganasevich. YSU #4354. The plants in the specimen are large (to 2 mm wide) and warm dark brown in color, which is somewhat different from the description of the species as green to yellow and golden brown.

GenBank accession numbers are ON175945 for ITS1-2 nrDNA, ON185621 for *trnL-F* cpDNA.

The nucleotide sequences comparison between specimens from Gydansky (MZ343174, MZ353627) and Taimyr Peninsulas resolved in identity of reference loci.

The species was described as *Lophozia* subg. *Leiocolea* (Frisvoll & Moen, 1980), but then transferred to *Gymnocolea* (Schuster, 1986) and, finally, as a result of molecular phylogenetic estimation, isolated into a distinct genus *Rudolgaea* (Potemkin & Vilnet, 2021). Until recently, the species was recorded for Fennoscandia, where it is not uncommon as well as for Greenland (Damsholt, 2002). For Russia, *R. borealis* was first recorded just last year for Gydansky Peninsula (Potemkin *et al.*, 2021). Given the narrow ecological amplitude of the species and the occurrence of usually as individual shoots in the mats of mosses it can be assumed that the species overlooked during collecting and identification and has in fact circumpolar distribution, similar to distribution of rich fen mosses communities.

3. *Solenostoma rossicum* Bakalin & Vilnet

Contributors: N.A. Konstantinova, E.D. Lapshina, A.A. Vilnet

Specimen: Russia, Yamal-Nenets Autonomous Area, Nadymsky District, 40 km north of Pangody town, on the border of forest tundra and southern tundra subzones; *Larix sibirica*-*Salix*-*Polytrichum*-lichen tundra, on patches of bare clay soil, with admixture of *Blasia pusilla*, *Cephalozia bicuspidata*, *Nardia* sp., *Schistochilopsis incisa*, *Scapania obcordata*, *Solenostoma* cf. *pusillum*, 66.06586°N, 74.04234°E. Coll. E.D. Lapshina, 5VIII.2019 #378E/3-1-19, KPABG 124440.

GenBank accession numbers are ON185619 for *trnL-F* cpDNA, ON185620 for *trnG*-intron cpDNA.

The nucleotide sequence divergence of newly sequenced samples (0–0.5% in *trnL-F*, 0% in *trnG*-intron as calculated in Mega 11 (Tamura *et al.*, 2021)) fits well in level of infraspecific variability (Kusnetsova *et al.*, 2020).

Solenostoma rossicum is a recently described (Bakalin & Vilnet, 2012 as «*rossica*») but not universally accepted species (Vána *et al.*, 2013; Söderström *et al.*, 2016). As it turns out in the course of our work, the species differs quite well not only at the nucleotide sequence data, but also in appearance (Kusnetsova *et al.*, 2020). Based on the discovery of the species in the Khanty-Mansi Autonomous Area (l. c.), on the mountain pass of eastern slope of Subpolar Urals (65.21085°N, 61.97035°E) and taking into account the ecology of the species occurring on bare clay soil and, in particular, on mud boils and non-sorted circles in tundra, we assumed its much wider, possibly circumpolar distribution. The discovery of the species in the Yamal-Nenets Autonomous Area confirms this assumption.

ACKNOWLEDGMENTS

The study of A.D. Potemkin was carried out in the framework of the institutional research project of Komarov Botanical Institute of the Russian Academy of Sciences “Flora and systematics of algae, lichens, and bryophytes of Russia and phytogeographically important regions of the world” (no. 121021600184-6). The study of V.A. Bakalin was carried out in the framework of the institutional research project of Botanical Garden-Institute research project “Cryptogamic Biota of Pacific Asia” (no. 1021043000529-9). The study of E.D. Lapshina and G.N. Ganasevich was supported by the grant of the Tyumen region Government in accordance with the Program of the World-Class West Siberian Interregional Scientific and Educational Center (National Project “Nauka”).

LITERATURE CITED

- BAKALIN, V.A. 2014. The Revision of “*Jungermannia* s.l.” in the North Pacific: the genera *Endogemma*, *Jungermannia* s.str., *Metasolenostoma*, *Plectocolea* and *Solenostoma* (Hepaticae). – *Botanica Pacifica* 3 (2): 55–128.
- BAKALIN, V.A. & A.A. VILNET. 2012. New combinations and new species of *Solenostoma* and *Plectocolea* (Solenostomataceae) from the Russian Far East. – *The Bryologist* 115 (4): 566–584.

- BAKALIN, V., A. VILNET, MA W.Z. & K. KLIMOVA. 2019. The differentiation and speciation of *Scapania javanica* and *S. undulata* complexes in the Eastern Sino-Himalayas and perimeters for *Scapania* Sect. *Stephania* (Scapaniaceae, Hepaticae). – *Phytotaxa* **400**(3): 123–144. <https://doi.org/10.11646/phytotaxa.400.3.2>
- DAMSHOLT, K. 2002. *Illustrated flora of Nordic liverworts and hornworts*. – Lund, Nord. Bryol. Soc., 837 pp. Frisvoll, A. A. & A. Moen. 1980. *Lophozia borealis* sp. nov., a rich fen hepatic from Fennoscandia. – *Lindbergia* **6**: 137–146.
- KATAGIRI, T. & T. FURUKI. 2018. Checklist of Japanese liverworts and hornworts, 2018. – *Hattoria* **9**: 53–102.
- KUSNETSOVA, O.I. (ed.), N.A. KONSTANTINOVA, E.D. LAPSHINA, A.A. VILNET, O. M. AFONINA, A.I. MAKSIMOV, T.A. MAK-SIMOVA, M. S. IGNATOV. 2020. Bryophyte molecular barcoding records. 3. – *Arctoa* **29**(2): 216–218. doi: 10.15298/arctoa.29.15
- POTEMKIN, A.D. 2002. Phylogenetic system and classification of the family Scapaniaceae Mig. emend. Potemkin (Hepaticae). *Annales Botanici Fennici* **39**(4): 309–334.
- POTEMKIN, A.D. & A.A. VILNET. 2021. Reappraisal of *Gymnocolea* and description of a new genus *Rodolgaea* (Anastrophyllaceae, Marchantiophyta). – *Arctoa* **30**: 138–148. doi: 10.15298/arctoa.30.15
- POTEMKIN, A., V. BAKALIN, A. VILNET, K. KLIMOVA & E. KUZMI-NA. 2021. A survey of the section *Scapania* of the genus *Scapania* (Scapaniaceae) with description of new species *Scapania pseudo-uliginosa* and resurrection of *S. gigantea*. – *The Bryologist* **124**(4): 569–589.
- POTEMKIN, A.D., A.A. VILNET, E.I. TROEVA, & K.A. EROKHINA. 2021. *Gymnocolea borealis* (Anastrophyllaceae, Marchantiophyta) in Asia and Russia: morphology, ecology, distribution, and differentiation. – *Novosti sistematiki nizshikh rastenii* **55**(2): 487–494.
- SCHUSTER R. M. 1986. *Gymnocolea borealis* (Frisvoll & Moen) Schust. [*Lophozia (Leiocolea) borealis* Frisvoll & Moen] in North America. – *Lindbergia* **12**: 5–8.
- SÖDERSTRÖM, L., A. HAGBORG, M. VON KONRAT, S. BARTHOLOMEW-BEGAN, D. BELL, L. BRISCOE, E. BROWN *et al.* 2016. World checklist of hornworts and liverworts. – *PhytoKeys* **59**: 1–828.
- TAMURA, K., G. STECHER & S. KUMAR. 2021. MEGA 11: Molecular Evolutionary Genetics Analysis version 11. – *Molecular Biology and Evolution* **38**: 3022–3027. <https://doi.org/10.1093/molbev/msab120>
- VÁŇA, J., L. SÖDERSTRÖM, A. HAGBORG & M.J. VON KONRAT. 2013. Notes on Early Land Plants Today. 44. Comments on sexuality in *Solenostoma* (Solenostomataceae, Marchantiophyta) and on some newly described taxa. – *Phytotaxa* **152** (1): 33–47.

Received 28 April 2022

Accepted 3 June 2022