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Three moss novelties in the flora of North Macedonia

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Key words: bryophytes, new records, SE Europe, floristic, chorology, the Balkans.

Ključne besede: mahovi, nove ugotovitve, JV Evropa, flora, horologija, Balkan.

Abstract

Three moss species are recorded for the first time in the Republic of North Macedonia. These are *Brachytheciastrum dieckei, Kiaeria starkei* and *Orthotrichum schimperi.* Details on records are given including distribution, georeferences and ecology.

Izvleček

V republiki Severni Makedoniji so prvič zabeležene tri vrste mahov. To so *Brachytheciastrum dieckei, Kiaeria starkei* in *Orthotrichum schimperi.* Podane so podrobnosti o najdbah vključno z razširjenostjo, georeferencami in ekologijo.

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Introduction

Bryophyte flora in the Balkan Peninsula remains unevenly explored and documented. Rather low intensity in bryophyte flora investigation is a consequence of small although very significant bryology tradition up to the late 20th century within the region, low financial/research possibilities and political instability. Many areas of the Balkans remained neglected and even nowadays there are completely bryologically unknown. One of the areas poorly known, especially in terms of recent records and bryophyte diversity knowledge, is North Macedonia (Martinčič, 2009).

North Macedonia is situated in South-eastern Europe, in its central southern part. It has an extraordinary geological complexity with commingle sedimentary, metamorphic and igneous rock formations that create interesting relief consisting of mountains, gorges, canyons, ravines, valleys and other orographic formations within alteration of Mediterranean and continental climate types (Spirovska, 2003). North Macedonia, although a relatively small country (25,713 km^2), shelter a rather rich biodiversity with high ratio of endemic and relict species (Mihajlov et al., 2011), at least as regarded by tracheophytes, vertebrates and some invertebrates. According to Gaston & David (1994) and Spirovska (2003), North Macedonia is regarded as one of the European biodiversity hot spots. The analyses of known bryophyte flora within the North Macedonia indicates that the region is to be also bryologically rich as inferred by the number of species to surface ratio (Sabovljević et al., 2011).

As regards the bryophyte flora of the North Macedonia, in the species survey by European countries, Hodgetts & Lockhart (2020) stated one hornwort, 104 liverworts and 470 mosses. Sabovljević et al. (2001) and Sabovljević (2004) predicted many new bryophyte records for the country with the intensification of moss and liverworts distribution studies. Indeed to the list of species Hodgetts & Lockhart (2020), species recorded afterwards should be considered as well (Ellis et al., 2022; Sabovljević et al., 2022, 2023a, b, c; Tomović et al., 2022, 2023a, b).

The aim of the present study was to contribute to the knowledge of underexplored bryophyte flora of North Macedonia.

Material and Methodology

The mount Jablanica, situated in the far west of the North Macedonia in the border area with Albania, was subject to bryological expedition in June 2018. The highest peak is Crn Kamen (2258 m of altitude). There are more peaks higher than 2000 m a.s.l., namely Strižak, Krstec, Raduč, Kamenjar, Pupuljak, Nezirica, Slepčaren and Čumin vrv. Among the peaks there are lower situated bigger or smaller plateaus with streams, ponds and wetlands. Additionally, there are a lot of glacial evidences in the area, since in the latest glaciation the highest parts were covered with glaciers. Today there are four glacial lakes, namely Vevčansko, Podgorsko, Gorno Launiško and Dolno Labuniško. The mountain range direction is north to south, between the Debar valley and the Ohridsko lake. It makes natural borderline between Albania and North Macedonia for nearly 50 km. In the east it is limited by the river Crni Drim. The part of the massive in North Macedonia is 255 km^2. The area is interesting since its orogenesis dates from tectonic uplift in Oligo-Miocene. Thus, above Paleozoic schists, there are Triassic limestone rocks. The climate in this area is typical montane with the influence of Mediterranean and continental types.

The nomenclature follows Hodgetts et al. (2020).

Results

The material collected in the area includes over 1000 samples to voucher in bryophyte collections of the Hungarian Natural History Museum (BP) and University of Belgrade Bryophyte Collection (BEOU-Bryo). Here, out of studied material, three new national records are presented.

Brachytheciastrum dieckei (Röll) Ignatov & Huttunen

Jablanica Mts, downwards from Gorna Belica, limestone cliff along the road, 41°13'03,2" N, 20°33'43,4" E, 1223 m, 23.06.2018, leg. Papp, B., Pantović, J.P., Sabovljević, M.S., Szurdoki, E., det. Papp, B., BP 196990.

It was collected on the bottom of the cliff, where on the shaded boulders was formed and on soil among them very rich bryophyte vegetation. The site was a good place for growing many bryophyte species from the family Brachytheciaceae (e.g. *Brachytheciastrum olympicum* (Jur.) Vanderp., Ignatov, Huttunen & Goffinet, *Brachythecium rutabulum* (Hedw.) Schimp., *B. glareosum* (Bruch ex Spruce) Schimp., *B. tommassinii* (Sendtn. ex Boulay) Ignatov & Huttunen, *Cirriphyllum crassinervium* (Taylor ex Wilson) Loeske & M. Fleisch., *Homalothecium sericeum* (Hedw.) Schimp., *Oxyrrhynchium hians* (Hedw.) Loeske, *O. schleicheri* (R. Hedw.) Röll, *Rhynchostegium murale* (Hedw.) Schimp.), Mniaceae (*Mnium marginatum* (Dicks.) P. Beauv., *M. stellare* Hedw., *Plagiomnium rostratum* (Schrad.) T. J. Kop., *P. undulatum* (Hedw.) T. J. Kop.), Pottiaceae (*Bryoerythrophyllum recurvirostrum* (Hedw.) P.C. Chen, *Didymodon insulanus* (De Not.) M.O. Hill, *D. rigidulus* Hedw., *Gymnostomum aeruginosum* Sm., *Syntrichia handelii* (Schiffn.) Bachurina, *Tortula subulata* Hedw., *Trichostomum crispulum* Bruch.), and some others such as *Pseudoleskea* species (*P. incurvata* (Hedw.) Loeske, *P. saviana* (De Not.) Latzel), *Timmia* species (*T. austriaca* Hedw., *T. bavarica* Hessl.), *Thamnobryum*

alopecurum (Hedw.) Gangulee accompanied by many liverworts like *Cololejeunea calcarea* (Lib.) Schiffn., *Mesoptychia collaris* (Nees) L. Söderstr. & Vana, *Pellia endiviifolia* (Dicks.) Dumort., *Plagiochila porelloides* (Torr. Ex Nees) Lindenb. and *Scapania aspera* M. Bernet & Bernet.

Jablanica Mts, from Gorna Belica towards Čumin vrv, in *Fagetum* 41°13'28,7" N, 20°32'43,6" E, 1485 m, 24.06.2018, leg. Papp, B., Pantović, J.P., Sabovljević, M.S., Szurdoki, E., det. Papp, B., BP 197091.

It was found on soil in the forest accompanied by the following species: *Bartramia ithyphylla* Brid., *Brachytheciastrum velutinum* (Hedw.) Ignatov and Huttunen, *Eurhynchiastrum diversifolium* (Schimp.) J. Guerra, *Fissidens viridulus* (Sw.) Wahlenb., *Plagiochila porelloides* and *Solenostoma confertissimum* (Nees) Schljakov.

Jablanica Mts, from Gorna Belica towards Čumin vrv, acidic grassland 41°13'23,6" N, 20°32'27,8" E,1623 m, 24.06.2018, leg. Papp, B., Pantović, J.P., Sabovljević, M.S., Szurdoki, E., det. Papp, B., BP 197116.

It had a quite big population on soil in the grassland growing together with *Bartramia ithyphylla, Heterocladiella dimorpha* (Brid.) Ignatov & Fedosov, and several liverworts like *Barbilophozia hatcheri* (A. Evans) Loeske, *Cephaloziella divaricata* (Sm.) Schiffn., *Marsupella funckii* (F. weber & D. Mohr) Dumort., *Obtusifolium obtusum* (Lindb.) S. W. Arnell, *Schistochilopsis incisa* (Schrad.) Konstant. and *Solenostoma confertissimum*.

Brachytheciastrum dieckei shows a distribution range from the western Mediterranean and Macaronesia to eastern Mediterranean and the Middle East (Orgaz et al., 2010). In South-eastern Europe it is known only from Albania, Croatia, Greece and Montenegro (Orgaz et al., 2013).

It is similar to *Brachytheciastrum velutinum* and shares the character of rough seta with it. It can be distinguished by its ovate-lanceolate leaves with usually broadly recurved margins. Many laminal cells on the dorsal side in the upper part of the leaf are prorate, especially those around the costa, which is ending in a distinct spike. The marginal cells of the alar group are ascending as a column of 5–10 cells (Orgaz et al., 2013).

Kiaeria starkei (F. Weber & D. Mohr) I. Hagen

Jablanica Mts, from Podgorečko Bačilo towards Labunište lake, alpine zone with siliceous and limestone rocks, 41°16'30,1" N, 20°31'46,9" E, 1738 m, 25.06.2018, leg. Papp, B., Pantović, J.P., Sabovljević, M.S., Szurdoki, E., det. Papp, B., BP 197217.

It grew on siliceous rocks accompanied by *Hymenoloma crispulum* (Hedw.) Ochyra, *Pseudoleskea saviana* and several species of Grimmiaceae (*Grimmia alpestris* (F. Weber & D. Mohr), *G. anomala* Schimp., *G. muehlenbeckii* Schimp., *G. ovalis* (Hedw.) Lindb., *Racomitrium sudeticum* (Funck) Bruch & Schimp. and *Schistidium confertum* (Funck) Bruch & Schimp.). In South-eastern Europe it is known from Albania, Bosnia-Herzegovina, Bulgaria, Montenegro (where it is data-deficient (DD)), Romania and Slovenia (where it is red-listed as endangered (EN) species) (Hodgetts and Lockhart, 2020).

Orthotrichum schimperi Hammar

Drim valley towards Debar, river bank, 41°20'54,7" N, 20°37'26,3" E, 620 m, 23.06.2018, leg. Papp, B., Pantović, J.P., Sabovljević, M.S., Szurdoki, E., det. Papp, B., BP 197076.

It was found on *Salix* bark together with *Lewinskya striata* (Hedw.) F. Lara, Garilleti & Goffinet.

This epiphyte species was previously treated as a synonym of *Orthotrichum pumilum* Sw. (Frey et al. 1995; Schäfer-Verwimp, 2001), and it has not received adequate attention in the past. However, in the European bryophyte checklist of Hill et al. (2006), it already appeared on species rank. It is known from the Balkans territories, except Bulgaria, Kosovo, North Macedonia and the European part of Turkey (Hodgetts and Lockhart, 2020).

Morphologically, it is similar to *O. pumilum*, but it can be distinguished by its ovoid capsule with short neck suddenly narrowed to seta and orange coloured peristome teeth with the ornamentation of tall papillae in the upper part (Lara et al., 2014).

Discussion

Bryophyte flora of North Macedonia is far from well documented and novel investigations are needed, especially considering rapid climatic changes. With these new records, the bryophyte flora of North Macedonia counts 1 hornwort, 106 liverwort and 478 moss species. However, many of these need taxonomic revision or reconfirmation with recent records considering very old previous reports without vouchers available. We believe that, with intensification of bryological field researches, further bryophyte records new for the country are expected, and a better documentation of bryophyte species distribution within the country as well.

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References

Ellis, L.T., Afonina, O.M., Alia, M.H.B., Burghardt, M., Cabezudo, B., Cano, M.J., Cottet, A.C., Csiky, J., Deme, J., Erzberger, P., Evangelista, M., Glazkova, E.A., Gomez-Gonzalez, D., Guerra, J., Jimenez, J.A., Kuzmina, E.Y., Liksakova, N.S., Messuti, M.I., Natcheva, R., Norhazrina, N., Pantović, J.P., Papp, B., Potemkin, A.D., Rodriguez-Quiel, E., Sabovljević, M.S., Spitale, D., Stefanut, S., Syazwana, N., Tossou, M.G., & Vilnet, A.A. (2022). New national and regional bryophyte records, 70. Journal of Bryology, *44*(2), 175–183. https://www.doi.org/10.1080/03736687.2022.2095145

Frey, W., Frahm, J.-P., Fischer, E., & Lobin W. (1995). *Die Moos- und Farnpflanzen Europas*., Kleine Kryptogamenflora Bd. IV. G. Fischer, Stuttgart, Jena, New York, 426 pp.

Gaston, K. J. & David, R. (1994). Hotspots across Europe. *Biodiversity Letters,* 2, 108–116. https://www.doi.org/10.2307/2999714

Hill, M.O., Bell, N., Bruggeman-Nannenga, M.A., Brugués, M., Cano, M.J., Enroth, J., Flatberg, K.I., Frahm, J.-P., Gallego, M.T., Garilleti, R., Guerra, J., Hedenäs, L., Holyoak, D.T., Hyvönen, J., Ignatov, M.S., Lara, F., Mazimpaka, V., Muñoz, J., & Södertsröm L. (2006). An annotated checklist of the mosses of Europe and Macaronesia. *Journal of Bryology*, 28(3), 198–267. https://www.doi.org/10.1179/174328206X119998

Hodgetts, N., & Lockhart, N. (2020). *Checklist and country status of European bryophytes – update 2020.*, Irish Wildlife Manuals, No. 123. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland, 217 pp.

Hodgetts, N.G., Söderström, L., Blockeel, T.L., Caspari, S., Ignatov, M.S., Konstantinova, N.A., Lockhart, N., Papp, B., Schröck, C., Sim-Sim, M., Bell, D., Bell, N.E., Blom, H.H., Bruggeman-Nannenga, M.A., Brugués, M., Enroth, J., Flatberg, K.I., Garilleti, R., Hedenäs, L., Holyoak, D. T., Hugonnot, V., Kariyawasam, I., Köckinger, H., Kučera, J., Lara, F., & Porley, R.D. (2020). An annotated checklist of bryophytes of Europe, Macaronesia and Cyprus. *Journal of Bryology*, *42*(1), 1–116. https://www.doi.org/10.1080/03736687.2019.1694329

Lara, F., Garilleti, R., Mazimpaka, V., & Guerra, J. (2014). *Orthotrichum*. In J. Guerra, M.J. Cano, & M. Brugués (Eds.). Flora Briofítica Iberica Vol. 5. p. 50–135.

Martinčič, A. (2009). Contribution of bryophyte flora of Republic of Macedonia. *Hacquetia*, *8*(2), 97–114. https://www.doi.org/10.2478/v10028-009-0008-9

Mihajlov, L., Trajkova, F., Ylatkovski, V., & Hristova, E. (2011). Biodiversity in the Republic of Macedonia. *Journal of Life Sciences* 5: 873–877.

Orgaz, J.D., Cano, M.J., & Guerra, J. (2010). *Brachytheciastrum dieckii* (Röll) Ignatov & Huttunen (Brachytheciaceae) in the eastern Mediterranean area and the Middle East. *Nova Hedwigia*, 90, 257–261. https://www.doi.org/10.1127/0029-5053/2010/0090-0257

Orgaz, J.D., Cano, M.J., & Guerra, J. (2013). Taxonomic revision of *Brachytheciastrum* (Brachyteciaceae, Bryophyta) from the Mediterranean region. *Systematic Botany*, *38*(2), 283–294. https://www.doi.org/10.1600/036364413X666697

Sabovljević, M. (2004). Comparison of the bryophyte flora of the three southern European mainlands: the Iberian, the Apennine and the Balkan peninsulas. *Braun-Blanquetia,* 34, 21–28.

Sabovljević, M., Ganeva, A., Tsakiri, E., & Ştefanut, S. (2001). Bryology and bryophyte protection in the south-eastern Europe. *Biological Conservation*, 101, 73–84. https://www.doi.org/10.1016/S0006-3207(01)00043-X

Sabovljević, M., Alegro, A., Sabovljević, A., Marka, J., & Vujičić, M. (2011). An insight into diversity of the Balkan Peninsula bryophyte flora in the European background. *Revue d'* Écologie *(Terre et Vie)*, 66, 399–413.

Sabovljević, M.S., Tomović, G., Pantović, J.P., Djurović, S.Z., Buzurović, U., Denchev, T.T., Denchev, C.M., Boycheva, P., Dimitrova, T., Marković, A., Sabovljević, A.D., Stefanut, S., Birsan, C.C., Sabanović, E., Djordjević, V., Niketic, M., Sovran, S., Masic, E., Stoykov, D., Papp, B., Assyov, B., & Slavova, M. (2022). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 9. *Botanica Serbica, 46*(2), 311–320. https://www.doi.org/10.2298/BOTSERB2202311S

Sabovljević, M.S., Tomović, G., Niketić, M., Denchev, T.T., Denchev, C.M., Sabovljević, A.D., Stefanut, S., Tamas, G., Szelag, Z., Assyov, B., Savić, D., Janosik, L., Dudas, M., Kolarčik, V., Veljković, M., Djordjević, V., Sovran, S., Knežević, A., Dimitrov, D., Papp, B., Pantović, J., Lazarević, P., Kabaš, E., Kutnar, L., & Kermavnar, J. (2023a). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 11. *Botanica Serbica, 47*(1), 163–172. https://www.doi.org/10.2298/BOTSERB2301163S

Sabovljević, M.S., Tomović, G., Kunev, G., Taskin, H., Bozok, F., Sovran, S., Knezević, A., Lobnik Cimerman, Ž, Strgulc Krajšek, S., Kuzmanović, N., Lazarević, P., Assyov, B., Stoykov, D., Szelag, Z., Vladimirov, V., Rakonjac, A.B., Simić, S.B., Sabovljević, A.D., Papp, B., Pantović, J., & Stanković, M. (2023b). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 13. *Botanica Serbica, 47*(1), 183–194. https://www.doi.org/10.2298/BOTSERB2301183S

Sabovljević, M.S., Tomović, G., Taskin, H., Assyov, B., Skondrić, S., Perić, R., Sabovljević, A.D., Dragićević, S., Marković, A., Knežević, J., Lobnik Cimerman, Ž., Strgulc Krajšek, S., Djordjević, V., Krdžić, S., Ilchev, I., Stoykov, D., Alvarado, P., Djurović, S.Z., Buzurović, U., Stanković, M., Kasom, G., Papp, B., Pantović, J., Stefanut, S., Stefanut, M.M., Trbojević, I., Romanov, R., Schmidt, D., & Korda, M. (2023c). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 15. *Botanica Serbica*, *47*(2), 361–374. https://www.doi.org/10.2298/BOTSERB2302361S

Schäfer-Verwimp, A. (2001). *Orthotrichum.* In M. Nebel & G. Philippi, G. (Eds): *Die Moose Baden-Württembergs, Band 2.* (pp. 170–197). Ulmer, Stuttgart,

Spirovska, M. (ed.). (2003). Country Study for Biodiversity of the Republic of Macedonia: (First National Report). Ministry of Environment and Physical Planning, Skopje. http://www.moepp.gov. mk/wp-content/uploads/2014/12/Study-for-biodiversity-of-theRM.pdf. Accessed on 14 December 2021

Tomović, G., Sabovljević, M.S., Irimia, I, Taskin, H., Zupan, E., Boycheva, P., Ivanov, D., Papp, B., Marković, A., Djurovic, S.Z., Buzurović, U., Sovran, S., Masić, E., Stefanut, S., Denchev, T.T., Denchev, C.M., Sabanović, E., Djordjević, V., Stoykov, D., Niketić, M., Slavova, M., & Assyov, B. (2022). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 10. *Botanica Serbica, 46*(2), 321–330. https://www.doi.org/10.2298/BOTSERB2202321T

Tomović, G., Sabovljević, M.S., Assyov, B., Kutnar, L., Boycheva, P., Ivanov, D., Papp, B., Pantović, J., Sabovljević, A.D., Sabanović, E., Jovanović, F., Sovran, S., Knežević, A., Aleksić, G.R., Niketić, M., Shivarov, V.V., Yaneva, G., Stefanut, S., Birsan, C.C., Szelag, Z., Djordjević, V., Kabas, E., Dudaš, M., & Kolarčik, V. (2023a). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 12. *Botanica Serbica*, *47*(1), 173–182. https://www.doi.org/10.2298/BOTSERB2301173T

Tomović, G., Sabovljević, M.S., Shivarov, V.V., Assyov, B., Bozok, F., Tamas, G., Stefanut, S., Perić, R., Knežević, J., Skondrić, S., Trbojević, I., Milovanović, V., Vidaković, D., Krizmanić, J., Stoykov, D., Strgulc Krajšek, S., Trcak, B., Djordjević, V., Djurović, S.Z., Buzurović, U., Sabanović, E., Knežević, A., Sovran, S., Papp, B., Pantović, J., & Sabovljević, A.D. (2023b). New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 14. *Botanica Serbica*, *47*(2), 347–359. https://www.doi.org/10.2298/BOTSERB230234T