

# Updates to the species list of Estonian bryophytes

Tiiu Kupper<sup>1,2</sup>, Kai Vellak<sup>1,3</sup>, Loore Ehrlich<sup>4</sup>, Leiti Kannukene<sup>2</sup>, Mare Leis<sup>5</sup> & Nele Ingerpuu<sup>3</sup>

<sup>1</sup>University of Tartu, Natural History Museum and Botanical Garden, Vanemuise Str. 46, 51003 Tartu, Estonia  
E-mail: tiiu.kupper@ut.ee

<sup>2</sup>Tallinn Botanic Garden, Kloostrimetsa Str. 52, 11913, Tallinn, Estonia

<sup>3</sup>Institute of Ecology and Earth Sciences, University of Tartu, J. Liivi Str. 2, 50409, Tartu, Estonia

<sup>4</sup>Estonian Museum of Natural History, Lai 29A, 10133, Tallinn, Estonia

<sup>5</sup>Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, Fr. R. Kreutzwaldi 5, 51006, Tartu, Estonia

**Abstract:** Six species are new to the flora of Estonian bryophytes since the last additions: *Bryum ruderale*, *Entosthodon fascicularis* and *Plenogemma phyllantha* have been found during recent fieldworks; *Encalypta driva* is a newly described species and *Lewinskya fastigiata* is a new taxonomical combination. *Moerckia flotoviana* replaces the species *Moerckia hibernica* since all herbaria specimens are re-identified. After additions and re-arrangements, the number of bryophyte species known from Estonia has risen to 618. For all new species, Estonian names are given, and they are evaluated against IUCN criteria. Two of the species were included in category DD, because of shortage of data; *Lewinskya fastigiata* was evaluated as LC, and *Encalypta driva* and *Plenogemma phyllantha* as VU. The IUCN category of *Moerckia flotoviana* remained as it was for *Moerckia hibernica* (LC).

**Keywords:** bryophytes, distribution, new species, voucher specimen

## INTRODUCTION

The last checklist of Estonian bryophytes was published in 2015 (Vellak et al., 2015). Since then several additions have been published, the last one in 2022 (Ingerpuu et al., 2022). Although the human activity has made the populations of several bryophyte species to decline or even vanish from the aboveground vegetation, the total number of species has been constantly rising in Estonia. During the last seven years 24 species have been added to the flora. A similar trend is seen in Latvia where 53 new taxa were reported during 14-year period (Āboliņa et al., 2015). Even in such well investigated areas as British Isles the number of bryophyte species increased by 59 species in 20 years (Blockeel et al., 2014). Many bryophytes may disperse easily, use small microhabitats and can establish from the diaspore bank if favourable conditions arrive. Thus, besides recording new species, it is important to monitor whether they are able to persist at the newly discovered sites. Printed reports of new species give data for such studies in future. Lists of species for different countries give information for the global distribution of species. However, published lists are not so common anymore. Therefore, regularly updated

on-line lists on webpages are of great value. The aim of this study is to update the list for Estonian bryophytes and make it available over web, and present localities and voucher specimens of the new species.

## MATERIAL AND METHODS

A table with species names in Latin and Estonian, their intraspecific taxa, most recent synonyms, IUCN categories, state protection categories, and voucher specimen numbers was compiled on the basis of earlier and contemporary information in Estonian herbaria, database PlutoF, and list of European bryophytes (Hodgetts et al., 2020). Only taxa with voucher specimen kept in official herbaria are included in the list.

For newly described species and new taxonomic approach of some species, all bryological collections of TAA, TALL, TAM and TU were inspected to seek new species from our collections. Altogether 37 specimens of *Moerckia hibernica*, more than 100 specimens of *Orthotrichum affine* s.l., and 56 specimens of *Encalypta vulgaris* s.l. were revised to ascertain if they included other species.

Voucher specimens were selected for the new species, and they were evaluated against IUCN categories. Species' names in Estonian were approved by the Estonian Committee of Botanical Terminology and are given in parentheses.

## RESULTS AND DISCUSSION

The List of Estonian bryophytes is compatible with the latest list of European bryophytes (Hodgetts et al., 2020) with one exception – *Plagiothecium angusticellum* G.J.Wolski & P.Nowicka-Krawczyk – which was described in the same year (Wolski & Nowicka-Krawczyk, 2020), but is missing from that list. The updated list of Estonian bryophytes is available now from the webpage: <https://sisu.ut.ee/samblasober/eesti-sammalde-nimestik>.

In total 648 taxa, among them 618 species and 30 intraspecific taxa are listed. Here we report six new taxa for the List of Estonian bryophytes.

### New and rejected taxa due to taxonomic re-evaluations

MOERCKIA FLOTOVIANA (Nees) Schiffn. [Flotovi mörkia]

Voucher specimen: TU168520, Valga Co., Otepää NP, in a quaking mire on western part of Lake Päästjärve, on a sedge tussock (coord.: 58.04028° N; 26.31500° E). Leg. K. Vellak, 23 Nov. 2011, det. N. Ingerpuu, Feb. 2012, ver. N. Ingerpuu and K. Vellak, 17 Feb. 2023.

The misinterpretation of *Moerckia flotoviana* as *Moerckia hibernica* was pointed out by Crandall-Stotler and Stotler in 2007, and it was supported to be a different species also by DNA-analyses (Mamontov et al., 2015). In Estonian herbaria we have in total 37 specimens identified as *Moerckia hibernica*. All these specimens were re-identified as *Moerckia flotoviana* and therefore *Moerckia hibernica* should be excluded from Estonian bryoflora. *Moerckia flotoviana* has a wider distribution compared to *Moerckia hibernica*, distribution of which is unsolved in Europe yet (Hodgetts & Lockhart, 2020).

LEWINSKYA FASTIGIATA (Bruch ex Brid.) Vigalondo, F.Lara & Garilleti [madal-suurtutik]

Voucher specimen: TU158857, Saare Co., Loode oak forest, on trunk of the oak, at 3 m high

(coord.: 58.21667° N; 22.43333° E). Leg. M. Leis, 19 June 2003, det. T. Kupper, M. Leis, 21 March 2022.

Based on DNA analyses *Orthotrichum affine* var. *fastigiatum* (Bruch ex Brid.) Huebener is treated as an independent species (Vigalondo et al., 2019). Both *Orthotrichum affine* and *Orthotrichum fastigiatum* were moved to the genus *Lewinskya* (Vigalondo et al., 2020). The first specimens identified as *O. fastigiatum* from Estonia are dated to the beginning of the 20th century, and are in Mikutowicz' collection "*Bryotheca Baltica*" (no 348a and 348d). According to the taxonomical treatment used then, these specimens were treated as *O. affine* (Ingerpuu et al., 1994). One of these specimens (348a, TAM0131564, collected in 1907) was validated as *Lewinskya fastigiata*, while the second one (348d, TU171113, collected in 1909) was re-identified as *Lewinskya affinis*. For now, *Lewinskya fastigata* has 19 localities over the whole country. It occurs in different types of habitats, growing on tree trunks in forest as well in towns, no decline of these habitats could be projected. Therefore, it is evaluated as least concern (LC) in Estonia. This species is widespread in Europe, growing on broadleaved and coniferous trees and is evaluated as LC in Europe (Hodgetts & Lockhart, 2020).

### New records for Estonia

BRYUM RUDERALE Crundw. & Nyholm [lillakas pungsamal]

Voucher specimen: TALL D026448, Harju Co., Tallinn, Lasnamäe, in an abandoned limestone quarry (alvar-like grassland), on the ground (coord.: 59.45263° N; 24.81457° E). Leg. T. Kupper, 10 May 2022, det. T. Kupper, 22 Aug. 2022, ver. C. Berg, 24 Oct. 2022. Duplicate in TU (TU154754).

*Bryum ruderale* is widespread in Europe, but seems to be introduced in other regions (Holyoak, 2021). In Scandinavia *B. ruderale* grows on bare slightly acidic to basic soils in open habitats (Hallingbäck et al., 2008). *Bryum ruderale* is very similar to *Bryum violaceum*, a species more widely spread in Europe, but not yet found in Estonia. Both species have violet to purple rhizoids and spherical rhizoidal tubers, but *Bryum ruderale* has densely papillose rhizoids and larger tubers. Due to variety of habitats it

is evaluated as LC in Europe. In a few countries, it is evaluated as DD, since it could be overlooked in some regions. From our neighbouring countries, it is known from Lithuania and Latvia (Hodgetts & Lockhart, 2020; Holyoak, 2021). Due to lack of real distribution data in Estonia, *Bryum ruderales* is evaluated as DD at present.

ENCALYPTA DRIVA K.Hassel & Høitomt [pisi-tanukas]

Voucher specimen: TAA5005528, Lääne Co., Vormsi Island, village Hullo, on the wall near church (coord.: 59.00091° N; 23.22997° E). Leg. M. Leis, 23 June 1993, det. M. Leis, 07 Feb. 2023, ver. N. Ingerpuu 20 March 2023.

*Encalypta driva* was described as a new species in 2022 (Hassel et al., 2022). The species is described based on material collected from Norway. It has been found to grow on calcareous soils and seems to be favoured by slight disturbance. In Estonia *Encalypta driva* occurs on limestone outcrops and on stones. Since it is morphologically close to *Encalypta vulgaris* we checked all samples of it collected from Estonia. Among them we found four specimens that matched to the characteristics of *Encalypta driva*. The species is easily identified according to the size of spores and cells at capsule mouth. Vegetative specimens are more difficult to distinguish. According to the low number of locations it is evaluated as vulnerable (VU D2) in Estonia.

ENTOSTHODON FASCICULARIS (Hedw.) Müll.Hal. [hambutu loodhellig]

Voucher specimen: TALL D026548, Saare Co., Laidu Island, in grazed dry alvar grassland, on the ground (coord.: 58.52046° N; 22.28186° E). Leg. T. Kupper, 24 July 2022, det. N. Ingerpuu, K. Vellak, 24 Oct. 2022. Duplicate in TU (TU154753). One more specimen nearby from Laidu Island: TALL D026549.a.

Two species from the genus *Entosthodon* have been found recently new for Estonia, the previous species in 2020 (Vellak et al., 2021). They are characterised as short-lived shuttle species promoted by small disturbances (Dierßen, 2001). These species are easily distinguished from each other by capsule characters, in *Entosthodon fascicularis* the capsule is without or with rudimentary peristome, while peristome of *Entosthodon muhlenbergii* is double (Hallingbäck et al., 2006).

*Entosthodon fascicularis* grows in open habitats on bare calcareous soils on arable fields, trails and roadsides (Blockeel et al., 2014). In Estonia, the single finding is from dry grazed alvar. It is widely distributed species in Europe (Hallingbäck et al., 2006) and is evaluated as LC (Hodgetts & Lockhart, 2020). In our neighbouring countries it is evaluated as near threatened (NT) in Sweden and as critically endangered (CR) in Finland (Hodgetts & Lockhart, 2020). According to the single finding it is difficult to evaluate the real distribution range of *Entosthodon fascicularis* in Estonia. Due to its' ephemeral life-strategy it might be overlooked, and thus it is evaluated as DD in Estonia.

PLENOGEMMA PHYLLANTHA (Brid.) Sawicki, Plášek & Ochyra [randsäbrik]

Voucher specimen: TALL D026607, Saare Co., Vahase Island, near the coastline on a big granite stone (coord.: 58.14319° N; 22.47527° E). Leg. T. Kupper, 22 July 2022, det. T. Kupper, 13 Oct. 2022. Duplicate in TU (TU154755).

*Plenogemma phyllantha* has been recently separated from genus *Ulota* and is a single species in this genus (Plášek et al., 2015).

*Plenogemma phyllantha* distribution area reaches from Atlantic coast of Europe to Iceland, but it is rarer along the Baltic coast of Fennoscandia (Blockeel et al., 2014). In North-Europe, it is predominantly a coastal species, growing typically on cliffs and stones near the sea, but also inhabiting trees or shrubs (Hallingbäck et al., 2008; Blockeel et al., 2014).

In Europe *Plenogemma phyllantha* is evaluated as LC, in Finland as VU (Hodgetts & Lockhart, 2020). This species is not known from Latvia or Lithuania. From Estonia it is known only from three boulders on a small island. According to the IUCN definition (IUCN, 2012), these localities form two different locations and this species is evaluated in Estonia as VU according to D2 criterion.

## ACKNOWLEDGEMENTS

The authors are grateful to Dr. C. Berg for verifying the specimens of *Bryum ruderales*. This work has been supported by grants (KOGU-302) financed by Estonian Ministry of Education and

Research, by institutional research grants (PRG1121, PRG609) of the Estonian Research Council, and project T210052PKKK (18509) by Environmental Investment Centre.

## REFERENCES

- Aboliņa, A., Piterāns, A. & Bambe, B. 2015. Lichens and bryophytes in Latvia: checklist. Daugavpils Universitātes Akadēmiskais apgāds „Saule“; Latvijas Valsts mežzinātnes institūts „Silava“.
- Blockeel, T.L., Bosanquet, S.D.S., Hill, M.O. & Preston, C.D. (eds). 2014. Atlas of British and Irish Bryophytes 2. Newbury, Pisces Publications. 652 pp.
- Crandall-Stotler, B.J. & Stotler, R.E. 2007. On the identity of *Moerckia hibernica* (Hook.) Gottsche (*Moerckiaceae* fam. nov, *Marchantiophyta*). *Nova Hedwigia* (Suppl 131): 41–59.
- Dierßen, K. 2001. Distribution, ecological amplitude and phytosociological characterization of European bryophytes. *Bryophytorum Bibliotheca* 56: 3–289.
- Hallingbäck, T., Lönnell, N., Weibull, H., Hedenäs, L. & von Knorring, P. 2006. Nationalnyckeln till Sveriges flora och fauna. Bladmossor: Sköldmossor – blåmossor. *Bryophyta: Buxbaumia – Leucobryum*. ArtDatabanken, SLU, Uppsala. 416 pp.
- Hallingbäck, T., Lönnell, N., Weibull, H., von Knorring, P., Korotynska, M., Reisborg, C. & Birgersson, M. 2008. Nationalnyckeln till Sveriges flora och fauna. Bladmossor: Kompaktmossor – kapmossor. *Bryophyta: Anoetangium – Orthodontium*. ArtDatabanken, SLU, Uppsala. 504 pp.
- Hassel, K., Falahati-Anbaran, M. & Høitomt, T. 2022. *Encalypta driva* (sp. nov.) and its relationship to *E. vulgaris* in Scandinavia. *Lindbergia* 45: 1–18. <https://doi.org/10.25227/linbg.01115>
- Hodgetts, N. & Lockhart, N. 2020. Checklist and country status of European bryophytes – Update 2020. *Irish Wildlife Manuals* 123: 1–95.
- 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://doi.org/10.1080/03736687.2019.1694329>
- Holyoak, D.T. 2021. European *Bryaceae*. A guide to the species of the moss family *Bryaceae* in Western & Central Europe and Macaronesia. UK, Gomer Press Ltd, 344 pp.
- Ingerpuu, N., Kalda, A., Kannukene, L., Krall, H., Leis, M. & Vellak, K. 1994. Eesti sammalde nimestik. List of the Estonian bryophytes. *Abiks Loodu-sevaatlejale* 94: 1–175.
- Ingerpuu, N., Ehrlich, L., Leis, M., Kupper, T., Kannukene, L. & Vellak, K. 2022. Additions and changes to the species list of Estonian bryophytes. *Folia Cryptogamica Estonica* 59: 23–25. <https://doi.org/10.12697/fce.2022.59.05>
- IUCN. 2012. IUCN Red List Categories and Criteria: version 3.1. second edition. Gland, Switzerland and Cambridge, UK: IUCN iv+32 pp. <https://www.iucn.org/resources/publication/iucn-red-list-categories-and-criteria-version-31> (accessed 01.04.2023).
- Mamontov, Y.S., Konstantinova, N.A., Vilnet, A.A. & Bakalin, V.A. 2015. On the phylogeny and taxonomy of *Pallaviciniales* (*Marchantiophyta*), with overview of Russian species. *Arctoa* 24(1): 98–123. <https://doi.org/10.15298/arctoa.24.12>
- Plášek, V., Sawicki, J., Ochyra, J., Szczecińska, M. & Kulik, T. 2015. New taxonomical arrangement of the traditionally conceived genera *Orthotrichum* and *Ulota* (*Orthotrichaceae*, *Bryophyta*). *Acta Musei Silesiae, Scientiae Naturales* 64(2): 169–174. <https://doi.org/10.1515/cszma-2015-0024>
- Vellak, K., Ingerpuu, N., Leis, M. & Ehrlich, L. 2015. Annotated checklist of Estonian bryophytes. *Folia Cryptogamica Estonica* 52: 109–127. <https://doi.org/10.12697/fce.2015.52.14>
- Vellak, K., Ehrlich, L., Leis, M., Kupper, T., Kannukene, L. & Ingerpuu, N. 2021. Additions to the Estonian Bryoflora 2019–2021: Liverworts and Mosses. *Folia Cryptogamica Estonica* 58: 93–97. <https://doi.org/10.12697/fce.2021.58.12>
- Vigalondo, B., Draper, I., Mazimpaka, V., Calleja, J., Lara, F. & Garilleti, R. 2020. The *Lewinskya affinis* complex (*Orthotrichaceae*) revisited: species description and differentiation. *The Bryologist* 123: 454–481. <https://doi.org/10.1639/0007-2745-123.3.454>
- Vigalondo, B., Garilleti, R., Vanderpoorten, A., Patiño, J., Draper, I., Calleja, J.A., Mazimpaka, V. & Lara, F. 2019. Do mosses really exhibit so large distribution ranges? Insights from the integrative taxonomic study of the *Lewinskya affinis* complex (*Orthotrichaceae*, *Bryopsida*). *Molecular Phylogenetics and Evolution* 140(2): 106598. <https://doi.org/10.1016/j.ympev.2019.106598>
- Wolski, G.J. & Nowicka-Krawczyk, P. 2020. Resurrection of the *Plagiothecium longisetum* Lindb. and proposal of the new species – *P. angusticellum*. *PLoS ONE* 15(3): e0230237. <https://doi.org/10.1371/journal.pone.0230237>