



RESEARCH COMMUNICATION

Bryophytes of the Western-Zerafshan Ridge (Uzbekistan)

Kholmurod Zhalov & Farrux Abdirasulov

Department of Botany, Samarkand State University, University Blv. 15, Samarkand 140104, Uzbekistan

*Email: zhalov_kholmurod@rambler.ru

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Abstract

A historical overview of bryological studies in Uzbekistan and a list of 80 known species of mosses from the Republic of Uzbekistan, compiled from well-known publications, collections stored in the herbaria of Samarkand State University and the Beijing Botanical Institute of the Chinese Academy of Sciences, and our data are presented. *Hygroamblystegium tenax* Hedw., *Lewinskya affinis* (Schrader) ex Brid F. Lara Garilletei & Goffinet, *Pseudeskeella papillosa* (Lindb.) Kindb., *Encalypta trachymitria* Ripart and *Orthotrichum hallii* Sullivant & Lesquereux are reported for the first time in Uzbekistan.

Keywords

species, mosses, endemic, flora, Pamir-Alai, Zerafshan, Uzbekistan, Central Asia.

Introduction

The native bryological flora and vegetation of Central Asia have long attracted the attention of botanists. The first researchers who visited Central Asia in 1859 and collected bryological material were Fedchenko and Fedchenko. They collected and prepared more than 100 herbarium sheets of moss from the vicinity of Samarkand and Penjikent (1). Subsequently, in different areas of the Pamir-Alai and Tien Shan Mountains, mosses were collected during botanical and geographical research in 1870–1900 by Regel, Komarov, Lipsky, Korzhinsky and Fedchenko. These botanists' moss collections totaling more than 300 sheets have been preserved in the Herbarium of the Botanical Institute named after Komarova, Academy of Sciences of the USSR (2).

The works of V.F. Brotherus and Filiber, which describe the distribution of more than 40 species and provide descriptions of species new to science such as *Tortula grandiretis* Br., *T. thianschanica* Br., *Bryum pamirense* Ph ex Br., and *B. teptoglyphodon* add authors, are the most significant among those reflecting the study of the moss flora of this region (3). Of the greatest importance of this period's works was the publication of exsiccata, "Musciturkestanici", which includes mosses collected by Brotherus in the Tien Shan, and Pamir-Alai Mountains and in other parts of Central Asia. The materials of more than 100 species of mosses from 15 families were cited in only two editions of this exsiccata. In 1896, a large botanical expedition was conducted to study Central Asia, where Fedchenko worked for three months. Brotherus had a large collection of mosses, approximately 3000 herbarium sheets from Central Asia. According to the expedition's materials, Brotherus and Filiber described more than 30 new species for science, as well as the genus *Indusiella*, confirming the originality of the Central Asian

bryoflora and richness of endemic plants in it (1).

The Central Asian bryoflora in the pre-revolutionary period is described in the more extensive works of Brotherus, Vislouha, Elenkina, Fedchenko and others. Some of these works, included lists, comprising of more than 40 species of mosses in the Pamir-Alai. The work of Brotherus, published in the Flora of Asian Russia, edited by Fedchenko, was extremely important for understanding mosses in the Pamir-Alai and Central Asia (4). It describes 44 species of mosses from the families Andreaceae and Dicranaceae and provides a table to determine the genera and families of the order Bryales in Asian Russia. According to Fedchenko (3): “The work of Brotherus served as an excellent first guide for learning about the mosses that play such an important role in the natural-historical conditions of the country”.

Following the Great October Socialist Revolution, the study of Central Asian bryoflora became more intense. During this period, there was a radical change in the study of flora, including the bryoflora of Central Asia. Brotherus and Lazarenko created a series of works dedicated to the bryoflora of Central Asia and Asian Russia. In the Pamir-Alai and Tien Shan Mountains, Brotherus (5) identified more than 50 species, three of which were reported for the first time (*Molendoo seravschanica*, *Tortula subtmontana*, *T. trachyphylla*). Lazarenko, after processing the collection of mosses obtained by Ovchinnikov and Afanasyev from the Pamir-Alai, published a work describing 126 species of Central Asian mosses and nine species new to science (6). His work, “Materials to the Bryoflora of Central Asia”, has not yet lost its systematic value and remains the only guide to the moss flora of Central Asia (7).

The work of O.F. Gaze, dedicated to the bryophytes of the Zerafshan Valley, identified 47 species of bryophytes including 41 species of leaf-stemmed and six species of hepatic mosses from this region (8).

In the 1960s systematic studies of bryoflora were launched by Rakhmatulina, Godvinsky, Akibaev, Abramova, Abramov in Uzbekistan, Kazakhstan and Kyrgyzstan (6). Among the later publications devoted to the mosses of Central Asia, the works of Muzafarova, Abramova, Abramova, Abramova, Tyvel, Kozlova, Godvinsky, Lazarenko, Lesnyak *et al.*, Savich - Lyubitskaya, Mamatkulova, Boboradzhabova and others, provide interesting information on the flora and ecology of mosses in certain regions of Central Asia. During this period, the works of N.V. Samsel and A.S. Lazarenko were devoted to describing new genera and species in the Central Asian flora (9, 15, 16).

Expeditionary studies to identify the species composition of bryophytes were carried out in the following regions of Central Asia: The Pamir-Alai Mountains, the Tien Shan Mountains, the Kopetdag Mountains and the Altai Mountains of Kazakhstan (10).

Materials and Methods

The collection of bryophytes herbarium material was carried out during the 2019-2021 research year. A combination of route, sta-

tionary and semi-stationary research methodologies, as well as the method of laying out ecological profiles were used to gather data (11). Based on these studies, the author compiled a preliminary list of bryophyte species. Identification of the herbarium materials was carried out with the traditional anatomical and morphological method using an OPTIKA XD-3 trinocular microscope and using relevant literature (12).

Recently, the list of bryophytes in Zaamin National Natural Park has been significantly revised. As a result, approximately 1300 samples of bryophytes were collected in the territory of Zaamin National Natural Park (E 68.490861. N 39.626242) (Zhalov, Abdirasulov). All of the samples were kept in the Samarkand State University Herbarium (SamSU).

When processing systematic groupings, we sought advice from experts at the Institute of Botany of the Chinese Academy of Sciences State Key Laboratory of Systematic and Evolutionary Botany. The taxonomy of bryophytes is classified according to the system developed in the Checklist of mosses of East Europa and North Asia (13).

The nomenclature of the bryophyte taxa corresponded to that accepted in the bryological literature.

Results and Discussion

The studies were carried out in 2019-2021 in the flat part of Uzbekistan and in the area of the middle course of the Zerafshan River. In 2018, information on some new bioflora species in Uzbekistan (1, 2) was also published (14). Eighty species of bryophytes have been recognized on Uzbekistan's bryofloralist. This is partly due to the very limited possibilities of field research. At the same time, the discovery of a considerable number of new moss species for Uzbekistan suggests that the country's moss species diversity has not yet been fully explored (Fig. 1).

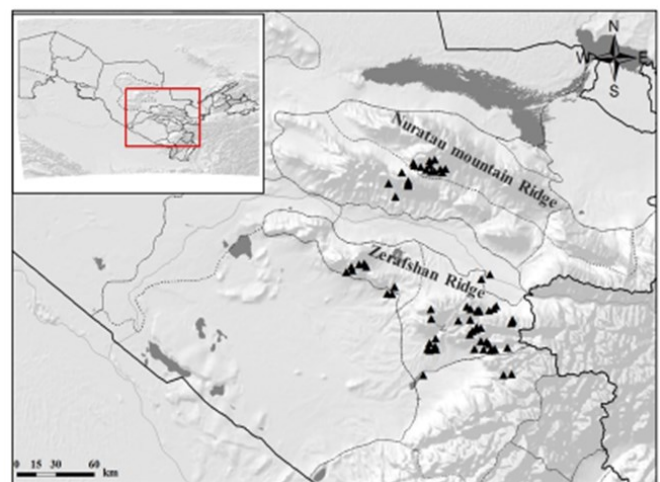


Fig. 1. The map showing the distribution of bryophytes in the study site (ArcGIS 10.3.1).

This article attempts to summarize the data available on mosses in central part of Uzbekistan. The names of the mosses are given in accordance with the latest list of mosses from Eastern Europe and North Asia (13). The herbarium numbers of samples are stored in the herbarium of SamDU and the herbarium of the Beijing Botanical Institute of the Chinese Academy of Sciences.

The list of species is given below:

Phylum: Marchantiophyta (Liverworts)

Class: Marchantiopsida

Family: Ricciaceae

Genus: *Ricciocarpos* Corda.

1. *Ricciocarpos natans* (L.) Corda. (= *Riccianatans* L.) - N. 39.64.336712°. E 066. 93.5500

Family: Conocephalaceae

Genus: *Conocephalum* Hill.

2. *Conocephalum conicum* (L.) Dumort. (= *Marchantia conica* L.) - N. 39.677120. E 066. 946,200

Family: Marchantiaceae

Genus: *Marchantia* L.

3. *Marchantia polymorpha* L. - N. 39.434400. E 066. 974420

Family: Pelliaceae

Genus: *Pellia* Raddi.

4. *Pellia epiphylla* (L.) Corda(= *Jungermannia epiphylla* L.) - N. 39.330860. E 066. 967540

Phylum: Bryophyta

Class: Bryopsida

Family: Pottiaceae

Genus: *Tortula* Hedw.

5. *Tortula muralis* Hedw. - N. 39.33086°. E 066. 96754°

6. *T. inermis* (Brid.) Mont. (= *Syntrichia inermis* (Brid.) Bruch) - N. 39.39 42°. E 065. 59 00 °

7. *T. mucronifolia* Schwaegr. (= *Syntrichia mucronifolia* (Schwaegr.) Brid.) - N. 39.18148°. E. 067.17710°

8. *T. obtusifolia* (Schleich.) Mathieu - N. 39.43572°. E 066. 98414°

9. *T. revolutifolia* Laz. - N. 39.188 35°. E 067. 12 485 °

10. *T. trachyphylla* Broth. - N. 39.33 28°. E 066. 04 16 °

11. *T. subulata* Hedw. (= *Syntrichia subulata* (L.) Web. et Mohr.) - N. 39.33 28°. E 066. 04 16 °

Genus: *Barbula* Hedw.

12. *Barbula enderesii* Garov. (= *Streblotrichum enderesii* (Garov.) Loeske) - N. 39.11067°. E. 067.41353°

13. *B. unguiculata* (Hedw.) (= *Tortula unguiculata* (Hedw.) Roth.) - N. 39.11067°. E. 067.41353°

Genus: *Syntrichia* Brid.

14. *Syntrichia caninervis* Mitt. - N. 39.11067°. E. 067.41353°

15. *S. princeps* Mitt. - N. 39.46563°. E 067. 14679°

16. *S. laevipila* Brid. - N. 39.18335°. E 067. 12485°

Genus: *Molendoa* Lindb.

17. *Molendoa seravschanica* Broth. & I.Györfy. - N. 39.67712°. E 066. 946 20°

Genus: *Gymnostomum* Nees & Hornsch.

18. *Gymnostomum calcareum* Nees & Hornsch. (= *Mollia calcarea* Nees & Hornsch.) - N. 39.43549°. E. 066.98890°

Genus: *Pterygoneurum* Jur.

19. *Pterygoneurum subsessile* (Brid.) Jur. - N. 39.43549°. E. 066.98890°

Genus: *Crossidium* Jur.

20. *Crossidium squamiferum* (Viv.) Jur. (= *Barbulamem branifolia* (Hook.) Schultz.) - N. 39.18076°. E 067. 09006°

Family: Bryaceae

Genus: *Bryum* Hedw.

21. *Bryum elegans* Nees. (= *Ptychostomum elegans* (Nees) D.Bell & Holyoak) - N. 39.39 42°. E 065. 59 00°

22. *B. caespiticum* Hedw. - N. 39.56.353°. E 066. 03.856 °

23. *B. argenteum* Hedw. - N. 42.01.069°. E. 063.44034°

24. *B. Schleicheri* Schwaegr. (= *Ptychostomum schleicheri* (Schwaegr.) J. R. Spence) - N. 39.46563°. E 067. 14679°

25. *B. Bimum* (Schreb.) Turner. - N. 39.31470°. E 066. 96256°

26. *B. Funckii* Schwägr. - N. 39.43549°. E. 066.98890°

27. *B. lonchocaulon* Müll. Hal. - N. 45.21.380°. E. 073.55.075°

28. *B. pseudotriquetrum* (Hedw.) P. Gaertn., B. Mey. & Scherb. - N. 39.18076°. E 067. 09006°

29. *B. terskeiense* Paris. - N. 39.18076°. E 067. 09006°

Family: Brachytheciaceae

Genus: *Brachythecium* Schimp.

30. *Brachythecium albicans* (Hedw.) Schimp. (= *Hypnum albicans* Hedw.) - N. 39.19319°. E 067. 24194 °

31. *B. buchananii* (Hook.) A. Jaeger R. Br. Bis (= *B. abakanense* Kaal.) - N. 39.19319°. E 067. 24194 °.

32. *Brachytheciastrum velutinum* (Hedw.) Ignatov et Huttunen. (= *Hypnum velutinum* Hedw.) - N. 39.188 35°. E 067. 12 485 °

33. *B. salebrosum* W. P. Schimper. (= *Hypnum salebrosum* Hoffm.) - N. 39.188 35°. E 067. 12 485 °

34. *B. Rivulare* W.P.Schim. (= *Hypnum rivulare* (Schimp.) Bruch.) - N. 39.19319°. E. 067.24194°

Genus: *Rhynchostegium* Bruch & Schimp.

35. *Rhynchostegium riparioides* (Hedw.) Cardot. - N. 39.19319°. E. 067.24194°

Genus: *Eurhynchium* Bruch & Schimp.

36. *Eurhynchium savatieri* Schimp. ex Besch. - N. 39.30251°. E 066. 92722°

Family: Grimmiaceae

Genus: *Grimmia* Hedw.

37. *Grimmia donniana* Sm. (= *G. obtuse* Schwägr., *G. bohemicum* Schwägr.) - N. 39.33086°. E 066. 96754°

38. *G. montana* Bruch & Schimp. (= *Guembelia montana* Bruch & W. P. Schimper) - N. 40.38.642°. E 066. 41.259 °

39. *G. pulvinata* (Hedw.) Sm. (= *Fissidens pulvinatus* Hedw.) - N. 39.44703°. E 066. 91515°

- 40.** *G. orbicularis* Bruch ex Wilson - N. 39.013 71⁰. E 067. 20 461⁰
- 41.** *G. anodon* Bruch & W. P. Schim. - N. 39.46 396⁰. E 066. 882 38⁰
- 42.** *G. longirostris* W. J. Hook. - . N. 39.46 396⁰. E 066. 882 38⁰
- 43.** *G. laevigata* (Brid.) Brid. (= *Campylopus laevigatus* Brid., *G. campestris* Burchell ex Hook.) - N. 39.19319⁰. E 067. 24194⁰
- 44.** *G. capilata* De Not. (= *G. mesopotamica* Schiffner) - N.39.3942⁰. E 065.5900⁰
- Genus: *Schistidium* Brid.
- 45.** *Schistidium apocarpum* (Hedw.) Bruch et Schimp. (= *G. strigosa* Brid.) - N. 39.19319⁰. E. 067.24194⁰
- Family: Fissidentaceae
- Genus: *Fissidens* Hedw.
- 46.** *Fissidens grandifrons* Brid. - N. 39.44703⁰. E 066. 91515⁰
- Family: Encalyptaceae
- Genus: *Encalypta* Hedw.
- 47.** *Encalypta vulgaris* Hedw. - N. 39.37 356⁰. E 066. 80243⁰
- 48.** *E. rhapsocarpa* Schwaegr. - . N. 39.17985⁰. E. 067.29182⁰
- 49.** *E. trachymitria* Ripart.
- Family: Funariaceae
- Genus: *Funaria* Hedw.
- 50.** *Funaria hygrometrica* Hedw. - N. 39.67712⁰. E 066. 946 20⁰
- Family: Orthotrichaceae
- Genus: *Orthotrichum* Hedw.
- 51.** *Orthotrichum obtusifolium* Brid. - N. 39.22725⁰. E 067. 02494⁰
- 52.** *O. cupulatum* G. F. Hoffmann ex Bridel. (= *Dorcadion cupulatum* G. F. Hoffmann ex Bridel.) - N. 39.43440⁰. E 066. 97442⁰
- 53.** *O. anomalum* Hedw. (= *Dorcadion anomalum* Lindb.) - N. 39.30251⁰. E 066. 92722⁰
- 54.** *O. hallii* Sullivant & Lesquereux
- Genus: *Lewinskya* F. Lara, Garilleti & Goffinet
- 55.** *L. affinis* (Schrad. ex Brid.) F. Lara, Garilleti & Goffinet
- Family: Bartramiaceae
- Genus: *Philonotis* Brid.
- 56.** *Philonotis seriata* Mitt. (= *Bartramia seriata* Hobk., *P. fontana* var. *seriata* (Mitt.) Kindb.) - N. 39.31470⁰. E 066. 96256⁰
- 57.** *P. fontana* (Hedw.) Brid. (= *Mnium fontanum* L.) - N. 39.44703⁰. E 066.91515⁰.
- Family: Ditrichaceae
- Genus: *Distichium* Bruch & Schimp.
- 58.** *Distichium capillaceum* Bruch & W. P. Schim. (= *D. montanum* I. Hagen.) - N. 39.44703⁰. E 066.91515⁰
- 59.** *D. inclinatum* (Hedw.) Bruch & Schimp.(= *Swartziaia clinata* Ehrh.) - N. 39.46563⁰. E 067. 14679⁰
- Family: Hylocomiaceae (Broth.) M. Fleish.
- Genus: *Pleurozium* Mitt.
- 60.** *Pleurozium schreberi* (Willd. ex Brid.) Mitt. - N. 39.17985⁰. E. 067.29182⁰
- Family: Fontinalaceae
- Genus: *Fontinalis* Hedw.
- 61.** *Fontinalis antipyretica* Hedw. - N. 39.43549⁰. E. 066.98890⁰
- Family: Amblystegiaceae
- Genus: *Palustriella* Ochyra.
- 62.** *Palustriella commutate* (Hedw.) Ochyra. (= *Cratoneuron commutatum* Broth.) - N. 39.28347⁰. E 066. 90665⁰
- Genus: *Hygroam blystegium* Loeske.
- 63.** *Hygroam blystegium tenax* (Hedw.)
- Genus: *Cratoneuron* (Sull.) Spruce
- 64.** *Cratoneuron filicinum* (Hedw.) Spruce. - N. 40.42.978⁰. E 065. 46.022⁰
- 65.** *C. curvicaule* (Jur.) G.Roth. (= *Callialaria curvicaulis* (Juz.) Ochyra.) - N. 40.42.978⁰. E 065. 46. 022⁰
- Genus: *Hygrohypnum* Lindb.
- 66.** *Hygrohypnum luridum* (Hedw.) Jenn. - N. 40.38.642⁰. E 066. 41.259⁰
- Family: Polytrichaceae
- Genus: *Polytrichum* Hedw.
- 67.** *Polytrichum juniperinum* Hedw. - N. 40.29.032⁰. E 068. 17.330⁰
- Family: Lembophyllaceae
- Genus: *Isothecium* Brid.
- 68.** *Isothecium alopecuroides* (Lam. ex Dubois) Isov. - N. 39.62.353⁰. E 066. 03.852⁰
- Family: Leskeaceae
- Genus: *Pseudoleskeella* Kindb.
- 69.** *Pseudoleskeella papillosa* (Lindb.) Kindb.-N. 40.31.743⁰. E 068. 26.516⁰
- Family: Dicranaceae
- Genus: *Dicranum* Hedw.
- 70.** *Dicranum elongatum* Schleich. ex Schwaegr. - N. 39.21.372⁰. E 067. 31.077⁰
- 71.** *D. brevifolium* Lindb. - N. 39.19.319⁰. E 067. 24.194⁰
- 72.** *D. muehlenbeckii* Bruch & Schimp.- N. 40.12.328⁰. E 067. 41.054⁰
- Genus: *Anisothecium* Mitt.
- 73.** *Anisothecium varium* (Hedw.) Mitt. (= *Dicranum varium* Hedw.) - N. 39.46.563⁰. E 067. 14.679⁰
- Genus: *Dicranella* (Müll. Hal.) Schimp.
- 74.** *Dicranella heteromalla* (Hedw.) Schimp. - N. 39.18735⁰. E 066. 946 20⁰

75. *D. subulata* (Hedw.) Schimp. - N. 39.30251⁰. E 066. 92722⁰

76. *D. varia* (Hedw.) Schimp. - N. 39.18076⁰. E 067. 09006⁰

Family: Seligeriaceae

Genus: *Seligeria* Bruch & Schimp.

77. *Seligeria pusilla* (Hedw.) Bruch & Schimp. - N. 39.18076⁰. E 067. 09006⁰

78. *S. donniana* (Sm.) Müll. Hal. - N. 39.17985⁰. E. 067.29182⁰

Family: Mniaceae

Genus: *Plagiomnium* T. J. Kop.

79. *Plagiomnium mediumcurvatulum* T. J. Kop. (Lindb.) - N. 39.17985⁰. E. 067.29182⁰

Genus: *Pohlia* Hedw.

80. *Pohlia nutans* (Hedw.) Lindb. - (= *Webera nutans* Hedw.) - N. 39.67146⁰. E 067. 09170⁰

Conclusion

Thus, a list of 127 species of bryophytes for the territory of Uzbekistan has been compiled based on study and scientific literature, and authors have identified 80 of these species as a result of our research. In addition, according to Gaze, the remaining 47 species are housed in the herbarium of Samarkand State University in Uzbekistan.

Five new species for Uzbekistan have been added to the list of species, they are *Hygroamblystegium tenax* (Hedw.) *Lewinskya affinis* (Schrad. ex Brid.) F. Lara, Garilleti & Goffinet, *Pseudoleskeella papillosa* (Lindb.) Kindb, *Encalypta trachymitria* Ripart., *Orthotrichum hallii* Sullivant & Lesquereux). Another 43 species were listed in Mamatkulov's analysis of the Pamir-Alai bryoflora (1), and most of these species were described as "for all regions". Most of these species are likely to be found in Uzbekistan, although further floristic research is needed to confirm this.

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Authors contributions

KZ developed the herbarium materials and wrote the manuscript. FA interpreted the data and corrected the manuscript. All authors have read and approved the article.

Compliance with ethical standards

Conflict of interest: The author has no conflict of interest to declare.

Ethical issues: None.

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