

Research Article

Bryophytes Flora of Maidan Valley, Dir Lower, Khyber Pakhtunkhwa, Pakistan

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Abstract | The present research study was conducted through integrated field survey and laboratory analysis from March to June 2025, to explore the Bryoflora of Maidan Valley, Dir Lower, Khyber Pakhtunkhwa, Pakistan. A total of 50 bryophytes species were collected from different altitudes of the study area, out of which 38 belong to mosses, distributed in 16 families and 25 genera. Among the mosses 28 species, (73.68%) were acrocarpic while the remaining 10 species (26.31%) were Pleurocarpic. Bryaceae was the largest family of mosses represented by 3 genera and 7 species followed by Grimmiaceae having 3 genera and 5 species. While Fissidentaceae was represented by one genus and 3 species. Moreover, 12 liverworts species, were also reported from research site, belonging to 7 families and 10 genera. Among the liverworts, Marchantiaceae was the largest family consisting of 2 genera and 4 species. For the first time, some new species were collected from the District Dir Lower, such as *Mnium hornum*, *Climacium dendroides*, *Ptilium crista castrensis*, *Thuidium furfurosum*, *Pohlia cruda*, *Bryum argentum*, *Riccia cavernosa*, and *Lejeunea flava*. This research will be providing a base for other researchers to discuss in more detail other aspect of Bryophytes in this area.

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Keywords | Bryophytes, Maidan Valley, Pleurocarpic, Acrocarpic, Documentation, Habitat relationship



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Introduction

al. (2013).

The term bryophyta is the combination of two Greek words, Bryon means Mosses and Phytion means plant. This term was first time introduced by Robert Brown in 1864. It includes fungi, algae, lichens, and mosses. But recently this term has been used only for the non-vascular cryptogams, Sathish *et*

Bryophytes were the first avascular plants on the earth that grew in humid and wet places, Rao and Deepika (2013). About 470-551 million years ago, bryophytes completely migrated from aquatic habitats to landforms. The plant body is gametophyte (Dominant generation) which is relatively small in

size, ranging from 2cm to 20cm long. They linked the tracheophytes (vascular plants) to their algal ancestors. These are the colonizers of the land vegetation [Borkatakya et al. \(2022\)](#). Muscophyta (Mosses), Marchantiophyta (Liverworts) and Anthocerotophyta (Hornworts) are the main three divisions of bryophytes, [Islam \(2018\)](#). Evolutionarily, they fill the gap between algae and Pteridophytes, [Chimyang et al. \(2021\)](#). These are small herbaceous plants that grow like a mat in various habitats. They mostly occur as mats on rocks, poles, wet soil, dead plant bodies, and epiphytic on plants. The different microhabitats are provided by humid evergreen forests. They favor specific habitats for the occurrence due to their innate adaptive capacity i.e. species of sphagnum can gather nutrients directly from surroundings in their cells, [Khatri et al. \(2022\)](#). These are small in size and lack vascular systems therefore ignored in biodiversity surveys, [Liu et al. \(2024\)](#).

These are the second most diverse group of land plants after the angiosperm and composed of 15,000 to 25,000 species throughout the world, [Khali et al. \(2022\)](#). The Bryoflora of Pakistan mostly occur in northern parts like (Malakand, Chitral, Hazara and Gilgit-Baltistan), Islamabad, Kashmir, and southern Punjab, [Gruber and Peer \(2010\)](#). The Bryoflora of Balochistan and Sindh (southwestern Pakistan) is almost unknown, [Higuchi and Nishimura, \(2003\)](#). Among the *Pleurocarpic mosses*, Hypnaceae is one the largest and most diverse family, representing 1,000 species and 60 genera worldwide. However, in Pakistan, only 15 species and 8 genera are present, [Khan et al. \(2020\)](#).

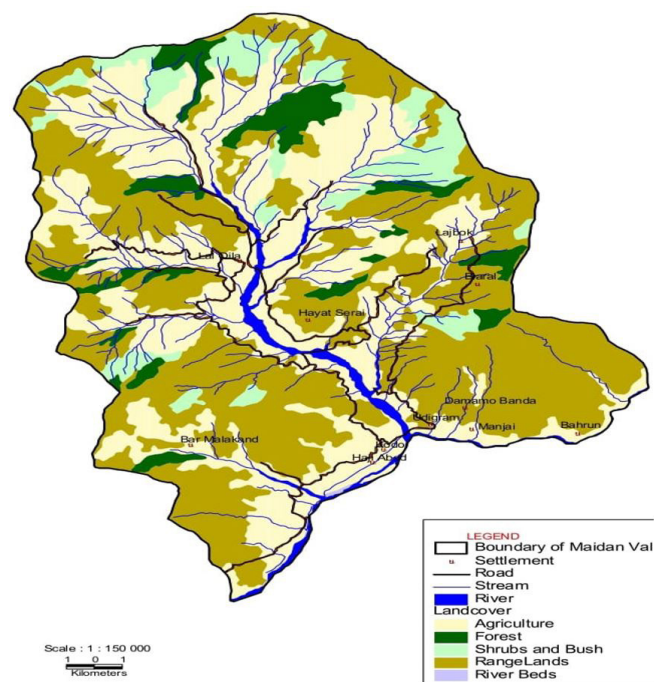
Bryophytes play the most important ecological roles such as nitrogen cycling, nitrogen fixation, restoring habitat, and controlling soil erosion. Although bryophytes play great ecological roles, they are often undervalued and ignored due to their small size, complex taxonomy, and unknown economic importance. However, some plant of Bryophytes has the potential to treat different diseases such as cancer, insect bites, common cold, gastritis, and microbial infections, [Chimyang *et al.* \(2021\)](#). Further, they are used as an important marker and predictor of past environmental conditions and climatic changes to verify climate patterns and have the ability to indicate global warming, [Azuelo *et al.* \(2011\)](#). The main objectives of this study are to explore and document the bryophytes flora of selected study area.

Materials and Methods

The present research was conducted through an integrated field survey and laboratory analysis from March to June 2025, for this purpose the study was carried out as follows.

Study area

Maidan Valley which is located in Dir (L) Khyber Pakhtunkhwa, Pakistan, situated at 71° 31' to 72° 14' E longitudes and 34° 37' to 35° 07' N latitudes. Maidan Valley covers a total of 300 km² area which is encircled by a chain of Hinduraj mountains. These mountains have various altitudes, ranging from 1000 meter to 4012 meter. Out of the total area, 15664 hectares are cultivable while 2622-hectare area is covered by woods, [Fazalullah and Ali \(2014\)](#). The population of Maidan Valley is 219,067 ([Census Report, 2017](#)).



Study area map.

The climatic condition of Maidan valley is highly favorable for the development and growth of Bryophytes, [Din \(2006\)](#). This is a mostly rainy area. Soil moisture has a significant effect on bryophytes diversity. Due to favorable climatic condition, Maidan valley has a very high Bryophytes diversity.

Collection of bryophytes

Bryophytes were collected during the spring season when the level of moisture was high. For this purpose, 14 to 16 trips, spanning over 3 months, were conducted

to collect specimens from different areas and various habitats like moist places, banks of streams, forests, and shady places (Figure 1).

Identification and labeling

The collected specimens were examined in the laboratory. The main parts of the specimen (like gametophytes and sporophytes) were studied

thoroughly by using a stereoscope and a simple microscope. Different keys such as (Handbook of Mosses of Iberian Peninsula and the Balearic Islands, BBS-Field-Guide-Field-Key) and various research papers were used for the identification of plants. The identified species were preserved and labeled with specific species names and were kept at the Laboratory of Botany, Govt. Postgraduate college Timergara.

Table 1: List of mosses species along with families and substrate.

S. No	Family	Species	DR	WR	DSS	WHS	WMS	Pleuro	Acro
1	Bryaceae	<i>Rhodobryum roseum</i> (Hedw.) Limper.	-	-	-	+	-	-	+
		<i>Bryum argenteum</i> Hedw.	-	+	-	-	-	-	+
		<i>Bryum algovicum</i> Sendth.ex Mull. Hal.	-	+	-	-	-	-	+
		<i>Bryum caespitium</i> Hedwig.	-	+	-	-	-	-	+
		<i>Bryum pallens</i> Sw.	-	-	-	+	-	-	+
		<i>Pohlia cruda</i> Hedwig.	-	-	-	+	-	-	+
		<i>Bryum capillare</i> Hedw.	-	-	-	+	-	-	+
2	Fissidentaceae	<i>Fissidens taxifolius</i> Hedw.	-	-	-	+	-	-	+
		<i>Fissidens grandifrons</i> Brid.	-	-	-	+	-	-	+
		<i>Fissidens bryoides</i> Hedw.	-	-	-	+	-	-	+
3	Grimmiaceae	<i>Grimmia funalis</i> (Schwaegr.) Bruch & Schimp.	+	-	-	-	-	-	+
		<i>Grimmia alpestris</i> (Web. & Mohr) Schleich. Ex Nees.	+	-	-	-	-	-	+
		<i>Grimmia ovalis</i> (Hedw.) Lindb.	+	-	-	-	-	-	+
		<i>Grimmia pulvinata</i> Hedw) Sm.	+	-	-	-	-	-	+
4	Brachytheciaceae	<i>Homalothecium sericeum</i> Hedwig.	-	+	-	-	-	+	-
		<i>Brachythecium velutinum</i> (Hedw) Ignatov & Huttunen	-	-	-	+	-	+	-
		<i>Brachythecium rutabulum</i> (Hedw.) Schimp.	-	-	-	+	-	+	-
5	Pottiaceae	<i>Didymodon vinealis</i> (Brid.) R.H Zander	-	-	+	-	-	-	+
		<i>Tortula muralis</i> Hedw.	-	-	+	-	-	-	+
		<i>Barbula unguiculata</i> Hedwig	-	-	+	-	-	-	+
		<i>Barbula convoluta</i> Hedwig	-	-	+	-	-	-	+
6	Polytrichaceae	<i>Atrichum undulatum</i> (Hedw.) P. Beauv. var. flaissetum Mitt.	-	-	-	+	-	-	+
		<i>Polytrichum commune</i> Hedw.	-	-	-	+	-	-	+
7	Bartramiaceae	<i>Philonotis fontana</i> (Hedwig) Bridel	-	-	-	+	-	-	+
8	Mniaceae	<i>Mnium hornum</i> Hedwig, Sp. Musc.	-	-	-	+	-	+	-
		<i>Mnium stellare</i> Reichard ex Hedw.	-	-	-	+	-	+	-
9	Climaciaceae	<i>Climacium dendroides</i> (Hedw.) F. Weber & D. Mohr.	-	-	-	+	-	-	+
10	Thuidiaceae	<i>Thuidium furfursum</i> (Hook.f.& Wilson)	-	-	-	-	+	+	-
11	Hypnaceae	<i>Hypnum cupressiformes</i> Hedwig	-	-	-	+	-	+	-
		<i>Taxiphyllum taxirameum</i> Mitt.) M. Fleish.	-	-	-	+	-	+	-
		<i>Ptilium crista castrensis</i> (Hedw.)	-	-	-	-	+	+	-
12	Hedwigiaceae	<i>Hedwigia ciliata</i> (Hedwig) Spruce.	-	-	-	+	-	-	+
13	Orthotrichaceae	<i>Orthotrichum anomalum</i> Hedw.	-	+	-	-	-	+	-
		<i>Orthotrichum pulchellum</i> Brunt.	-	+	-	-	-	+	-
14	Funariaceae	<i>Funaria hygrometrica</i> Hedw.	-	-	-	+	-	-	+
		<i>Physcomitrium pyriforme</i> (Hedw.)	-	-	-	+	-	-	+
15	Amblystegiaceae	<i>Cratoneuron filicinum</i> (Hedw.) Spruce.	-	-	-	+	-	-	+
16	Bryoxiphiaceae	<i>Bryoxiphium norvegicum</i>	-	-	-	+	-	-	+

DR= Dry rock, WR= Wet rock, DSS= Dry sandy rock, WHS= Wet humus soil, WMS= Wet muddy soil. Pleuro= Pleurocarpus moss Acro= Acrocarpus moss Presence = + Absence = -

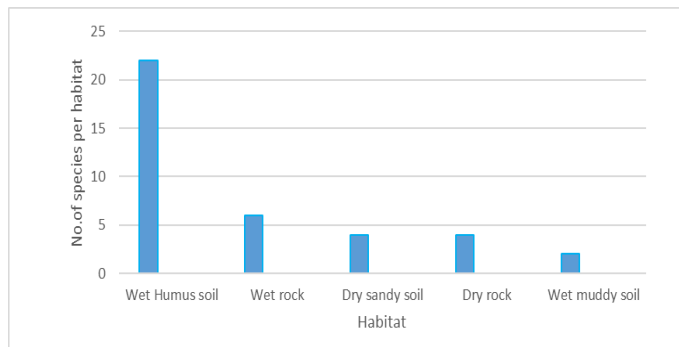


Figure 1: *Habitat wise distribution of Bryophytes.*

Results

During this research study, a total of 50 species of bryophytes were collected from different altitudes of the study area, out of them, 38 belong to mosses, distributed in 16 families and 25 genera (Table 1, Figures 2, 3). Among the mosses, 28 species (73.68%) were acrocarpic while the remaining 10 species (26.31%) were Pleurocarpic. Bryaceae was the largest family of mosses; containing 3 genera and 7 species followed by Grimmiaceae family having 3 genera and 5 species. While Fissidentaceae family consists of one genus and 3 species (Figures 2, 3). Moreover, 12 liverworts species were also reported from the study area, belonging to 7 families and 10 genera (Table 2, Figure 4). Among the liverworts, Marchantiaceae was the largest family consisting of 2 genera and 4 species.

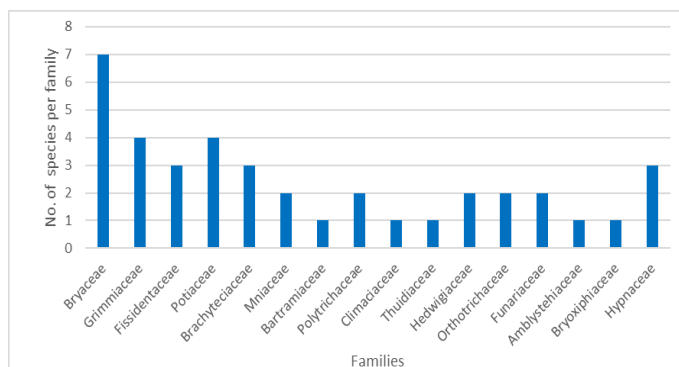


Figure 2: *Family wise distribution of Mosses.*

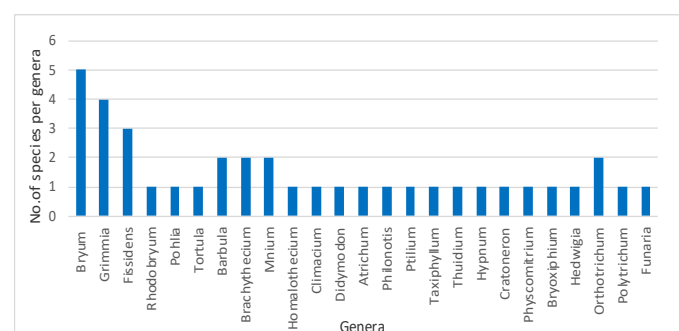


Figure 3: *Genera wise distribution of Mosses.*

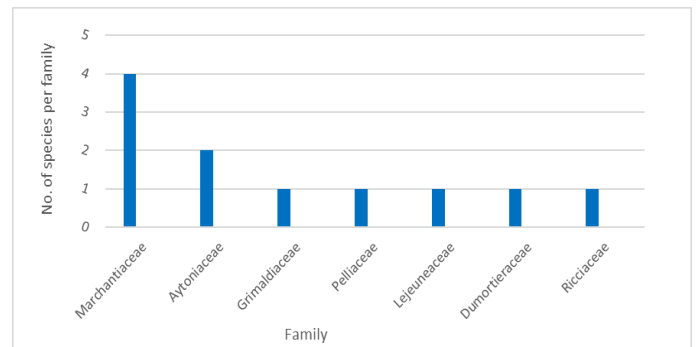


Figure 4: *Genera wise distribution of liverworts.*

Table 2: *Species diversity of liverworts in the study area.*

S. Family	Species
1 Marchantiaceae	<i>Marchantia polymorpha</i> L. <i>Marchantia nepalensis</i> L. <i>Marchantia palmata</i> Nees. <i>Preissia quadrata</i> Nees.
2 Aytoniaceae	<i>Fimbraria mussuriensis</i> Kashyap <i>Plagiochasma appendiculatum</i> L. et L. Pug. <i>Reboulia hemisphaerica</i> Raddi.
3 Grimaldiaceae	<i>Grimaldia indica</i> St.
4 Pelliaceae	<i>Pellia endiviifolia</i> (Dick) Dum.
5 Lejeuneaceae	<i>Lejeunea flava</i> (SW.) Nees.
6 Dumortieraceae	<i>Dumortiera hirsuta</i> Reinw.
7 Ricciaceae	<i>Riccia cavernosa</i> Hoffm.



Figure 5: *Fissidens taxifolius* Hedw (A). Stereo microscopic view (B).

Discussion

The study aimed to explore the Bryoflora of Maidan Valley and determined their relationship with substrate. Bryophytes are small-sized plants that mostly occur in moist habitats, and evade direct exposure to sunlight, Vanderpoorten *et al.* (2010). They are the second most diverse group of land plants after the Angiosperm composed of 15,000 to

25,000 species worldwide, [Khali et al. \(2022\)](#). These are widely distributed in the world and are found in more than one continent. Some are found all over the world; therefore, bryophytes were distributed more widely than tracheophytes. About 20,000 species of bryophytes which were distributed in 960 genera are found all over the world. Various scientists worked on the taxonomy, distribution, and features of bryophytes during the 19th and 20th centuries, [Thoker and Patel \(2019\)](#). The Bryoflora of Pakistan mostly occurs in northern parts like (Malakand, Chitral, Hazara, and Gilgit-Baltistan), Islamabad, Kashmir, and southern Punjab, [Gruber and Peer \(2010\)](#). The Bryophytes of Balochistan and Sindh (Southwestern Pakistan) are almost unknown, [Higuchi and Nishimura \(2003\)](#).

were Pleurocarpic. Moreover, 12 liverworts were also reported from the research site, belonging to 7 families and 10 genera.



Figure 8: *Mnium hornum* Hedwig, Sp. Musc (A), Stereo microscopic view (B).



Figure 9: *Mnium stellare* Reichard ex Hedw (A), Stereo microscopic view (B).



Figure 10: *Bryum argenteum* Hedw. (A), Stereo microscopic view (B).



Figure 6: *Fissidens bryoides* Hedw (A), Stereo microscopic view (B).



Figure 7: *Rhodobryum roseum* (Hedw) (A), Limper. Stereo microscopic view (B).

During the present research, 50 species of bryophytes were collected from the research site, out of which 38 belong to mosses, distributed in 25 genera and 16 families. Among these mosses, 28 species (73.68%) were Acrocarpic, while the remaining 10 (26.31%)

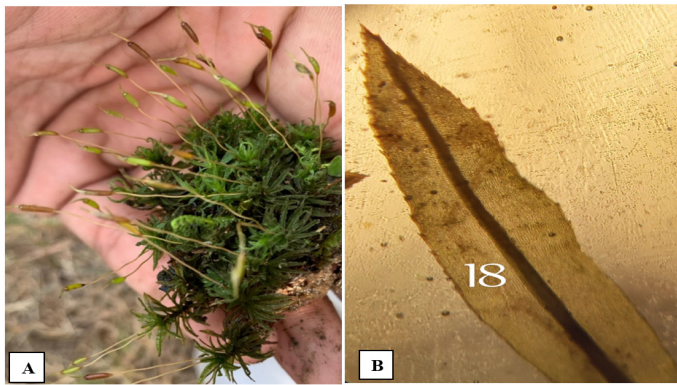


Figure 11: *Atrichum undulatum* Stereo microscopic view (A), (Hedw.) P. Beauv. Var. *flaisetum* Mitt. (B).

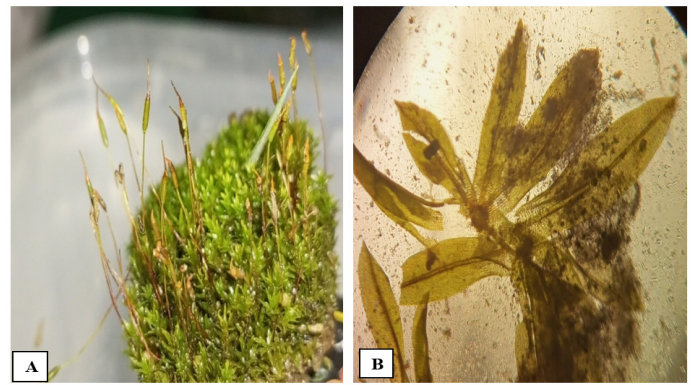


Figure 15: *Barbula unguiculata* Hedwig (A), Stereo microscopic view (B).

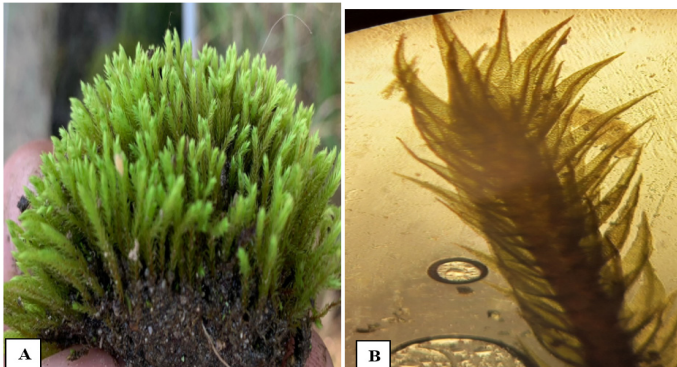


Figure 12: *Philonotis fontana* (Hedwig) Bridel. (A), Stereo microscopic view (B).

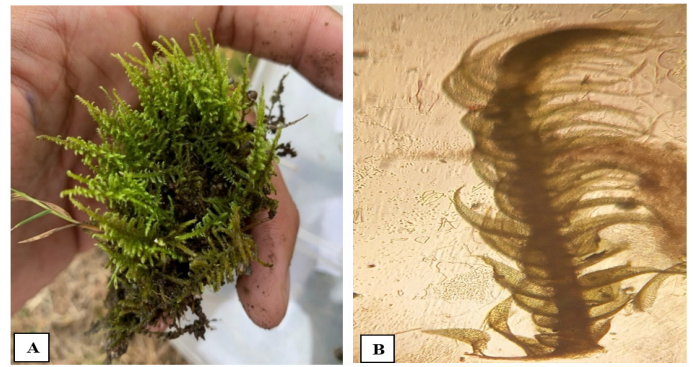


Figure 16: *Ptilium crista castrensis* (Hedw.) (A), Stereo microscopic view (B).

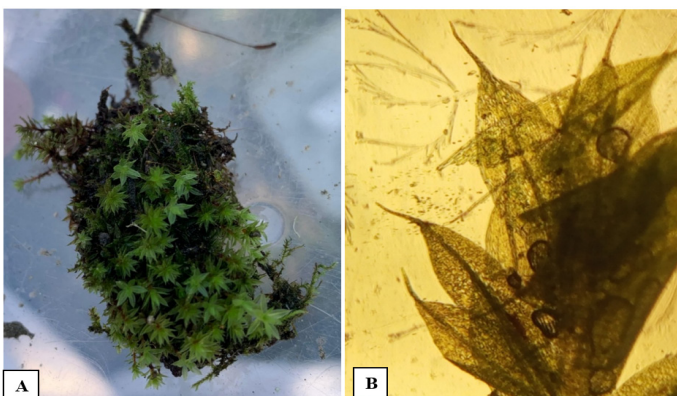


Figure 13: *Pohlia cruda* Hedwig (A), Stereo microscopic view (B).

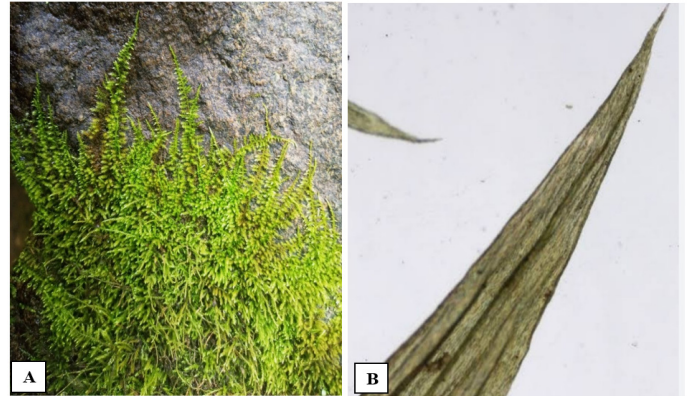


Figure 17: *Homalothecium sericeum* Hedwig (A), Stereo microscopic view (B)

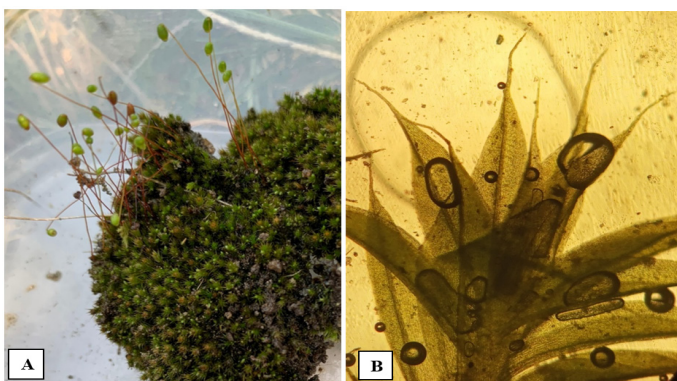


Figure 14: *Bryum caespitium* Hedwig (A), Stereo microscopic view (B).



Figure 18: *Physcomitrium pyriforme* (Hedw.) (A), Stereo microscopic view (B).

Hazrat *et al.* (2020) collected a total of 45 species, out of which 27 were mosses, 16 liverworts, and 2 species of hornworts from Sheringal Dir Upper. Similarly, Ahmad *et al.* (2018) also studied the diverse group of bryophytes Chimyang *et al.*, 2021 and collected a total of 32 species of mosses from, District Lower Dir of Pakistan. The reported species belong to 10 acrocarpic and 3 Pleurocarpic families. Similarly, 3 genera and one family were reported for the first time from Pakistan. While Din (2006) collected 43 bryophytes from the Maidan valley.

Homalothecium sericeum (Figure 17) is the member of Brachytheciaceae family having an average size body with yellow to greenish-yellow color. The stem is regularly or irregularly pinnately branched with Creeping growth. The species are mostly found in shaded soil, such as wet rock, or at the base of trees and rotten logs. Khan *et al.* (2021) also documented such species from the Western Himalayas.

The ability to tolerate desiccation is a survival strategy observed in many bryophytes, including representatives genera, such as *Tortula* and *Syntrichia* of the family Pottiaceae collected from dry habitats in the City of Novi Sad (Serbia), Milovanović *et al.* (2023). Likewise, during the present study, *Tortula* of the family Pottiaceae were also reported from open dry rock and sandy soil. Bryaceae, Pottiaceae, Grimmiaceae, and Brachytheciaceae are diverse families in the study area. Milovanović *et al.* (2023), also documented such families from the City of Novi Sad (Serbia).

mostly occur in dry conditions with less developed and erect gametophytes. *Funaria* and *Bryum* (Figure 14) are small-sized with erect gametophytes and adapted to muddy soil conditions Hazrat *et al.* (2020), also collected these species from such types of habitats in Sheringal Valley.



Figure 20: *Lejeunea flava* (SW.) Nees.



Figure 21: *Plagiochasma appendiculatum* L. et. L. Pug.

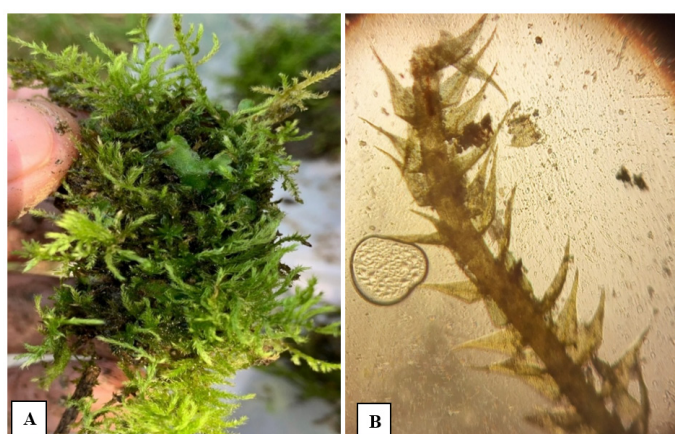


Figure 19: *Brachythecium velutinum* (Hedw.) (A), Ignatov and Huttunen. Stereo microscopic view (B).

Brachythecium rutabulum (Figure 19) was collected from wet soil and *Brachythecium velutinum* from the bank of the stream. *Grimmia* and *Barbula* species

Orthotrichum anomalum mostly occurs on wet rock, the trunk of the tree with exerted and cylindrical capsule. This species was also collected by [Schafer-Verwimp and Gruber \(2002\)](#), from Pakistan. *Polytrichum commune* (Figure 8), *Atrichum undulatum* (Figure 11), *Mnium stellare* (Figure 11), *Mnium hornum*, and *Cratoneuron filicinum* (Figure 12) are present in moist soil, along

the streams. *Philonotis fontana*, *Funaria hygrometrica*, and *Fissidens grandifrons* were present on submerged rocks in streams and moist shady places. Two species of Hypnaceae such as *Taxiphyllum taxirameum*, and *Hypnum cupressiformes* were collected from wet muddy soil along the stream. [Islam \(2018\)](#) also collected these species from the district, of Masuhara.



Figure 22: *Dumortiera hirsuta* Reinw.



Figure 24: *Marchantia palmata* Nees.



Figure 23: *Riccia Cavernosa* Hoffm.



Figure 25: *Marchantia nepalensis* L.

Conclusions

During the present study, 50 species of bryophytes were collected from the research site. Out of the total collected species, 38 belong to mosses and 12 liverworts. Bryaceae was the largest family represented by 3 genera and 7 species followed by Grimmiaceae having 3 genera and 5 species. Some species such as *Mnium hornum*, *Climacium dendroides*, *Ptilium crista castrensis*, *Thuidium furfursum*, *Pohlia cruda* (Figure 10), *Bryum argentum* (Figure 13), *Riccia cavernosa* (Figure 23), and *Lejeunea flava* (Figure 23) were collected for the first time from District Dir Lower. This research will provide a base for other researchers to discuss in more detail other aspect of Bryophytes in this area.

Acknowledgment

Alhamdulillah (All praises and Gratefulness is due to Allah). I also pay our respect to the Holy Prophet Muhammad (P.B.U.H) and his companions, who guide us with their teachings. I would also like to express my deepest gratitude to my research supervisor, Mr. Sajad Hussain, and co-authors for their precious guidance, support and encouragement throughout this research study.

Novelty Statement

This research study documents the bryophyte flora of Maidan Valley, District Dir Lower, KPK. It reports for the first-time a collection of numerous bryophyte species, including several new species, recorded for the first time in the study area. The research provides baseline taxonomic data to support future researches, particularly in bryology.

Author's Contribution

Khaliq Ur Rahman, Shahid Khan, and Wahid Ullah carried out the research by collecting data and conducting fieldwork. The project was organized by Inam Ullah, and the collected data were identified under the kind supervision of Sajad Hussain. Muhammad Zamir performed the data analysis, while Tufail Ahmad Zeb provided the research methodology. Fawad Khan conducted the literature review necessary for writing the manuscript and Abbas Khan provided grammatical support in research paper writing.

Generative AI and AI-assisted technology statement

The authors declare that no generative AI or AI-assisted technologies were used in the writing, analysis, or preparation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

References

- Ahmad, I., Alam, J. and Karim, S., 2018. Mosses diversity of district Lower Dir, Pakistan.
- Azuelo, A.G., Sariana, L.G. and Pabualan, M.P., 2011. Some medicinal bryophytes: their ethnobotanical uses and morphology. Asian J. Biodiv., 2(1): 49-80. <https://doi.org/10.7828/ajob.v2i1.92>
- Borkatak, M., Nasrin, T. and Bora, D., 2022. Diversity of Bryophytes in India-Special Reference to North-east India. <https://doi.org/10.53550/EEC.2022.v28i04s.033>
- Chimyang, N., Mossang, P., Shankar, V. and Evelin, H., 2021. Bryoflora of north-east India. Bioresources and Sustainable Livelihood of Rural India Mittal Publications, New Delhi. 2021: 241-62.
- Din, S.U., 2006. Plants and plant resources of Maidan valley Dir, Northern Pakistan: Quaid-i-Azam University Islamabad, Pakistan.
- Fazalullah, A.U. and Ali, U., 2014. Pteridophytic flora of Maidan Valley Dir (L) Khyber Pakhtunkhwa, Pakistan. Int. J. Biol. Biotechnol., 11(4): 649-653.
- Gruber, J.P. and Peer, T., 2010. A contribution to the knowledge of the bryophyte flora of the mountains of North Pakistan (Autonomous Region of Gilgit-Baltistan). Herzogia, 2010; 25(2): 271-285. <https://doi.org/10.13158/heia.25.2.2010.271>
- Hazrat, A., Ali, Q., Nisar, M., Sher, K., Jan, T. and Ullah, A., 2020. Bryophytes flora of Sheringal Valley Dir Upper Khyber Pakhtunkhwa Pakistan. Pak. J. Weed Sci. Res., 26(1). <https://doi.org/10.28941/pjwsr.v26i1.822>
- Higuchi, M. and Nishimura, N., 2003. Mosses of Pakistan. J. Hattori Botan. Lab., 93: 273-291.
- Islam, M.U., 2018. A checklist of mosses of district Mansehra. Sci. Int. (Lahore), 28(3): 2569-2575.
- Khan, A.S., Ahmad, M., Gilani, S.A.A., Zafar, M., Butt M.A., Lubna, Birjees, M., Akhtar, W., Waheed, A. and Kaleem, M., 2021.

- Taxonomic implications of macro and micromorphological characters in the genus *Brachythecium* (Brachytheciaceae, Bryopsida) from the Western Himalayas: A combined light and scanning electron microscopic analysis. *Microsc. Res. Techn.*, 84(12): 3000-22. <https://doi.org/10.1002/jemt.23859>
- Khan, A.S., Ahmad, M., Zafar, M., Athar, M., Ozdemir, F.A., Gilani, S.A.A., Sultana, S., Ahmad, S., Butt, M.A., Majeed, S. and Khan, S.K., 2020. Morphological characterization of Hypnaceae (Bryopsida, Hypnales): Investigating four genera from Western Himalayas by using LM and SEM techniques. *Microsc. Res. Techn.*, 83(6): 676-690. <https://doi.org/10.1002/jemt.23458>
- Khatri, S., Pant, D.R. and Joshi, G.P., 2022. Floristic composition of bryophytes in disturbed habitats of two different elevations in Chandragiri Hill, central Nepal. *J. Natl. Hist. Mus.*, 32(1): 49-64. <https://doi.org/10.3126/jnhm.v32i1.49952>
- Liu, Y., He, Y., Tian, Y., Zhao, Z., 2024. Bryophyte flora in alpine grasslands of the Qinghai-Tibet Plateau based on plot sampling. *Diversity*, 16(3): 143. <https://doi.org/10.3390/d16030143>
- Milovanović, A., Vukov, D., Igić, R., Šikuljak, T., Ćuk, M., Ilić, M., 2023. Bryophyte flora of cemeteries in the City of Novi Sad (Serbia). *Biol. Serbica*, 45(2).
- Rao, G.N. and Deepika, D.S., 2013. Short communication diversity and species composition of bryophytes at Simhachalam Hills, Visakhapatnam, Eastern Ghats of India. 1(5): 198-199.
- Sathish, S.S., Kavitha, R. and Kumar, S.S., 2013. Bryophytes in India-the current status. *Int. J. Res. Eng. Biosci.*, 1(4): 23.
- Schafer-Verwimp, A. and Gruber, J.P., 2002. *Orthotrichum* (Orthotrichaceae, Bryopsida) in Pakistan, *Trop. Bryol.*, 2002: 1-10.
- Thoker, S. and Patel, S., 2019. Bryophyte diversity of Jammu and Kashmir State, India. *Int. Res. J. Biol. Sci.*, 8(5): 21-8.
- Vanderpoorten, A., Gradstein, S.R., Carine, M.A. and Devos, N., 2010. The ghosts of Gondwana and Laurasia in modern liverwort distributions. *Biol. Rev.*, 85(3): 471-487. <https://doi.org/10.1111/j.1469-185X.2009.00111.x>