

# Taxonomic Study on Some Bryophytes from Southern Shan State

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## Abstract

Bryophytes from Southern Shan State were collected and studied in 2012. Ten species belong to 9 genera and 8 families of mosses from Bryophytes were found as tufts on damp soil, rocks, tree trunks, old walls, hardly calcareous soil. They are *Philonotis rigida* Brid., *Bryum argenteum* var. *argenteum* Hedw., *B. caespiticium* var. *caespiticium* Hedw., *Octoblepharum albidum* Hedwig, *Funaria fascicularis* (Hedw.) Lindb., *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg., *Pterogonium gracile* (Hedw.) Sm., *Pogonatum urnigerum* (Hedw.) P. Beauv., *Desmatodon cernuus* (Hiib.) Br., and *Weissia controversa* var. *controversa* Hedw. The artificial key to the species were constructed and their diagnostic characters of study species were described.

**Key words:** Bryophytes, Taxonomy, Southern Shan State

## Introduction

Bryophytes are small “leafy” or flat plants that most often grow in moist locations in temperate and tropical forests or along the edges of wetlands and streams. (Raven *et al.* 2005). Bryophytes include liverworts, hornworts and mosses. They are a very ancient group of land plants that first migrated and colonized bare land around 450 million years ago. They are non-vascular plants that have neither flowers nor fruits, and they disperse by spores, instead of seeds. Today, the bryophytes are estimated to be more than 18,000 species worldwide. Estimated to consist of well over 10,000 species, mosses are the second largest plant group of land plants today after the flowering plants. About 2000 species of mosses occur in Southern Asia (Tan and Boon-Chuan 2008).

Bryophytes are amphibians of the kingdom plantae. Plants grow in two well defined habitats called the amphibious zone (Vashishta 1963). Mosses, liverworts, and hornworts are superficially very similar. However, there are several ways to describe the three groups apart. Mosses have leaves that are spirally arranged along the stem and a vein (or costa) that runs at least part way along the middle of each leaf. (Bjorkman 2008).

Bryophytes contribute significantly to plant biodiversity and are also important in some parts of the world for the large amounts of carbon they store, thereby playing a significant role in the global carbon cycle (Raven *et al.* 2005).

Southern Shan State is situated in the eastern part of Myanmar. Southern Shan State lies between the latitudes of 19° 23' and 22° 15' north and between the longitudes 96° 13' and 98° 36' east. The present study areas are Taunggyi Township, Pindaya Township, and Paunglong Township of Southern Shan State.

In 1981, Hla Hla Ko studied 53 species from 27 genera of mosses of Yangon and 20 species belonging to 14 genera from 8 orders of mosses of Mandalay Region have been described by Kin Maung Win 1994.

Only a few researchers studied the bryophytes of Myanmar. Because of the small size of plants and the identification characters are mainly basing on very thin small leaves and sporophytes, the study on mosses faces with much difficulties. However, no bodies studied on that lower plant group in Southern Shan State and the valuable information will be partially fulfilled for the Flora of Shan State.

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The aims and objectives of the present research works were to identify and classify the bryophytes from Southern Shan State, to record the identification characters and to partially fulfill the accomplished information of bryophytes from Shan State.

### Materials and Methods

Specimens were collected during the field exploration months of June to October in 2012. The 10 species of bryophytes from Southern Shan State have been collected, identified, classified and described in the present study. Photographic record and data collection were taken to know precise localities, and external features of the collected species. The literature that have been used for identification are followed to Smith (1978), Meinunger and Schroder (2007), Zander (2007), Tan and Boon-Chuan (2008), Gudino *et al.* (2011).

### Results

The bryophytes growing in Southern Shan State were collected, studied, classified, and described their taxonomic characteristics. Totally 10 species belonging to 8 families of 7 orders are recorded in study area. List of the collected mosses species is stated in Table 1. The artificial key to the all collected mosses species were constructed and the diagnostic characteristics were also described as follows:

**Table 1. List of the collected species of Mosses**

Order	Family	Species	Location
1.Polytrichales	1.Polytrichaceae	1. <i>Pogonatum urnigerum</i> (Hedw.) P. Beauv.	Taunggyi, Shwe Phone Pwint Pagoda
2.Pottiales	2.Pottiaceae	2. <i>Desmatodon cernuus</i> (Hiib.) Br.	Taunggyi, Sularmuni Pagoda
		3. <i>Weissia controversa</i> var. <i>controversa</i> Hedw.	Pindaya
3.Funariales	3.Funariaceae	4. <i>Funaria fascicularis</i> (Hedw.) Lindb.	Taunggyi, Taungchun
4.Bryales	4.Bryaceae	5. <i>Bryum argenteum</i> var. <i>argenteum</i> Hedw.	Panglong
		6. <i>Bryum caespiticium</i> var. <i>caespiticium</i> Hedw.	Taunggyi, Sularmuni Pagoda
	5.Bartramiaceae	7. <i>Philonotis rigida</i> Brid.	Taunggyi, Taungchun
5.Dicranales	6.Calymperaceae	8. <i>Octoblepharum albidum</i> Hedwig	Taunggyi, Shwe Phone Pwint Pagoda
6.Isobryales	7.Leucodontaceae	9. <i>Pterogonium gracile</i> (Hedw.) Sm.	Taunggyi University Campus
7.Hypnobryales	8.Plagiotheciaceae	10. <i>Taxiphyllum wissgrillii</i> (Garov.) Wijk & Marg.	Taunggyi, Taungchun

### An artificial key to the studied species

1. Plants erect.....3.
1. Plants prostrate ..... 2.
  2. Leaves broadly ovate ; nerve absent .....9. *Pterogonium gracile*
  2. Leaves ovate to oblong-lanceolate ; nerve about quarter way up leaf.10. *Taxiphyllum wissgrillii*
3. Nerve present; calyptra absent or no short.....4.
3. Nerve absent; calyptra short..... 8. *Octoblepharum albidum*
  4. Calyptra absent or cucullate.....5.
  4. Calyptra long or hairy.....8.
5. Lid convex.....6.
5. Lid mamillate.....7.
  6. Leaves lanceolate-spathulate to oblanceolate-spathulate; nerve below the apex; capsule obovoid symmetrical or shortly pyriform.....4. *Funaria fascicularis*
  6. Leaves lanceolate; nerve strongly excurrent; capsule globose.....7. *Philonotis rigida*
7. Leaves ovate to broadly ovate; nerve below the apex.....5. *Bryum argenteum var. argenteum*
7. Leaves ovate to ovate-oblong; nerve excurrent .....6. *Bryum caespiticium var. caespiticium*
  8. Nerve excurrent; lid rostrate or mamillate.....9.
  8. Nerve percurrent; lid longly rostrate.....3. *Weissia controversa var. controversa*
9. Leaves lanceolate to narrowly lanceolate; calyptra hairy.....1. *Pogonatum urnigerum*
9. Leaves oblanceolate-spathulate; calyptra long ..... 2. *Desmatodon cernuus*

#### 1. *Pogonatum urnigerum* (Hedw.) P. Beauv., Prodr., 1805.

Plants dioecious, erect. Leaves lanceolate to narrowly lanceolate, acute at the apex, margin plane with coarse spinose teeth; nerve excurrent; basal cells rectangular, and above cells rounded, papillose, rectangular, sinuose. Seta red; capsule erect, shortly cylindrical; rostellate, yellowish green; peristome recurved, pale red; calyptra as a bird, ending at the base of capsule with hairs, yellow (Figure 1 A-D).

This species was found scattered plants on banks, crevices of walls.

Specimens investigated: Taunggyi, Shwe Phone Pwint Pagoda; 20 .10. 12; Win Win Aye # 21.

#### 2. *Desmatodon cernuus* (Hueb.) Br. & Schimp., Bryol. Eur. 2: 58. 1843

Plants autoecious, erect. Leaves oblanceolate-spathulate, acuminate at the apex, margin bordered, denticulate; nerve excurrent; basal cells rectangular - hexagonal, some cells hyaline, narrower at margin, above cells variable in shape and size, marginal rows longer and narrower. Seta reddish at the base; capsule erect to horizontal, some inclined, ovoid, mamillate, reddish; peristome teeth more or less straight; calyptra ending at the middle of capsule, pale green (Figure 1. E-H).

This species was found on tree trunks.

Specimens investigated: Taunggyi, Sularmuni Pagoda; 2 .8. 12; Win Win Aye # 8.

**3. *Weissia controversa* var. *controversa* Hedw., Sp. Musc., 1801.**

Plants autoecious, erect. Leaves oblong-lanceolate; basal part abruptly narrowed to linear-lanceolate upper part, apex acute, margin plane, entire; nerve ending at the apex; basal cells rectangular, hyaline, above cells quadrate. Seta yellowish; capsule erect or slightly inclined, ovoid to narrowly ellipsoid, pale green or yellow, reddish brown when mature; longly rostrate; peristome present or poorly developed; calyptra long, ending at the almost middle of capsule, pale green (Figure 1. I-L).

This species was found on roadsides and cliffs.

Specimens investigated: Pindaya; 21 .8. 12; Win Win Aye # 13.

**4. *Funaria fascicularis* (Hedw.) Lindb., Ofv. K.V.A. Forh. 1865.**

Plants autoecious, erect. Leaves lanceolate-spathulate to oblanceolate-spathulate, acuminate at the apex, toothed towards the middle; nerve ending below the apex; cells rectangular, but above cells slightly hexagonal. Seta straight, brown; capsule erect, obovoid symmetrical or shortly pyriform; convex, without an apiculous, brown; peristome absent; calyptra cucullate, ending at the apex of capsule, brown (Figure 2. A-C).

This species was found on moist soil.

Specimens investigated: Taunggyi, Taungchun; 20.10.12; Win Win Aye # 27.

**5. *Bryum argenteum* var. *argenteum* Hedw., Sp. Musc., 1801.**

Plants dioecious, erect. Leaves ovate to broadly ovate, acuminate at the apex, base decurrent, margin entire; basal cells rhomboid-hexagonal, above cells rhomboid, cells in upper part of leaf pellucid with colourless walls. Seta reddish brown; capsule small, pendulous, ellipsoid, green; mamillate; peristome double, long, outer teeth yellow and inner white; calyptra cucullate, ending at the apex of capsule, reddish (Figure 2. D-G).

This species was found on damp soil.

Specimens investigated: Taunggyi, Panglong; 20.9.12; Win Win Aye # 20.

**6. *Bryum caespitium* var. *caespitium* Hedw., Sp. Musc., 1801.**

Plants dioecious, erect. Upper leaves ovate to ovate-oblong, acuminate at the apex, widest below middle, margin more or less entire; nerve excurrent, yellowish to reddish-brown; basal cells shortly rectangular, above cells narrowly hexagonal. Seta reddish brown basally; capsule pendulous, narrowly pyriform, striate, green, wide-mouthed, dehiscing by apical pores, reddish brown; lid mamillate, reddish; peristome teeth long; calyptra cucullate, ending at the apex of capsule, reddish brown (Figure 2. H-K).

This species was found on tree trunks.

Specimens investigated: Taunggyi, Sularmuni Pagoda; 2.8.12; Win Win Aye # 9.

**7. *Philonotis rigida* Brid., Br Univ., 1827.**

Plants autoecious, erect. Leaves lanceolate, acuminate to subulate at the apex, margin plane, toothed; nerve stout, strongly excurrent; basal cells rectangular, above cells narrowly rectangular to linear, mamillate. Seta red; capsule globose, striate, brownish; lid convex, brown; peristome double, teeth long; calyptra absent (Figure 3. A-D).

This species was found on moist soil.

Specimens investigated: Taunggyi, Taungchun; 20.10.12; Win Win Aye # 22.

**8. *Octoblepharum albidum*** Hedwig, Sp. Musc. Frond. 50. 1801.

Plants autoecious, erect, glossy. Leaves ligulate to lanceolate, apiculate at the apex, margin entire; nerve absent; chlorophyllose cells in a single layer, above cells hexagonal except margin, basal cells longly rectangular. Seta yellow; capsule erect, ovoid - cylindrical, reddish brown; lid obliquely rostrate, reddish; peristome teeth triangular; calyptra short, ending at the apex of capsule, reddish (Figure 3. E-H).

This species was found spreading branches on tree trunks.

Specimens investigated: Taunggyi, Shwe Phone Pwint Pagoda; 10.6.12; Win Win Aye # 3.

**9. *Pterogonium gracile*** (Hedw.) Sm., Eng. Bot. 1802.

Plants dioecious prostrate. Leaves broadly ovate; nerve absent; cells linear - rhomboidal, alar cells numerous, strongly differentiated, extending almost halfway of leaf. Seta reddish; capsule exserted, erect, cylindrical, brown when mature; lid conical to rostrate, reddish basally; peristome double; calyptra long, ending at the middle of capsule, pale yellow (Figure 3. I-L).

This species was found at the base of big trees and branches.

Specimens investigated: Taunggyi, Taunggyi University Campus; 2.8.12; Win Win Aye # 11.

**10. *Taxiphyllum wissgrillii*** (Garov.) Wijk & Marg., Taxon, 9: 191. 1960.

Plants dioecious prostrate. Leaves ovate to oblong lanceolate, acute at the apex, margin denticulate above to middle; nerve double, ending about quarter way up leaf; cells more or less linear, angular cells shortly rectangular. Seta reddish; capsule erect, inclined, cylindrical, green; lid rostrate, yellow, reddish when mature; peristome long, double; calyptra cucullate, ending at the almost base of capsule, yellow (Figure 4.A-D).

This species was found on bark of tree trunks.

Specimens investigated: Taunggyi, Taungchun; 20.10.12; Win Win Aye # 25.

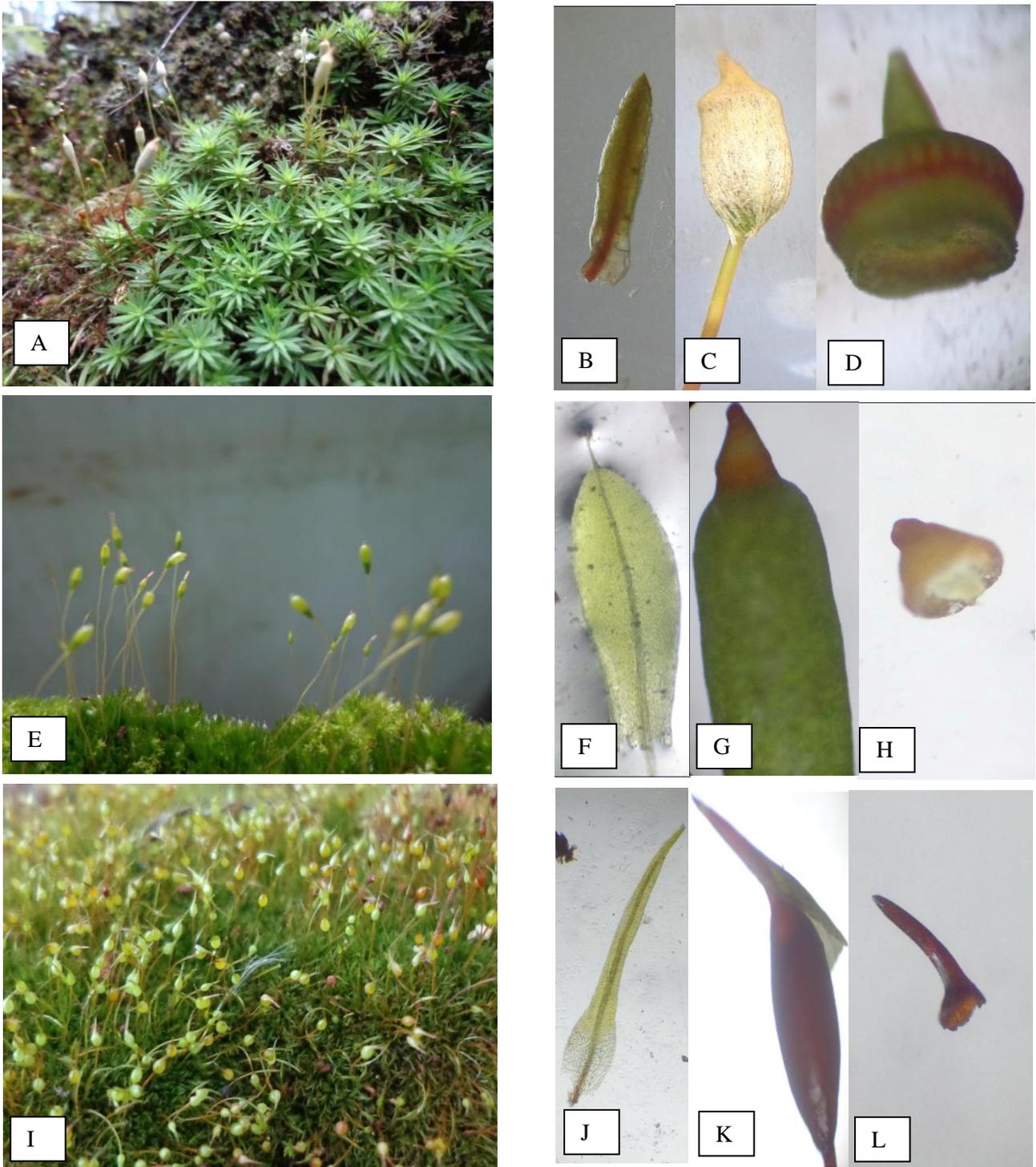


Figure 1. A. Habit, B. Leaf, C. Capsule & D. Lid of *Pogonatum urnigerum* (Hedw.) P. Beauv. E. Habit, F. Leaf, G. Capsule & H. Lid of *Desmatodon cernuus* (Hiib.) Br. I. Habit, J. Leaf, K. Capsule & L. Lid of *Weissia controversa* var. *controversa* Hedw.

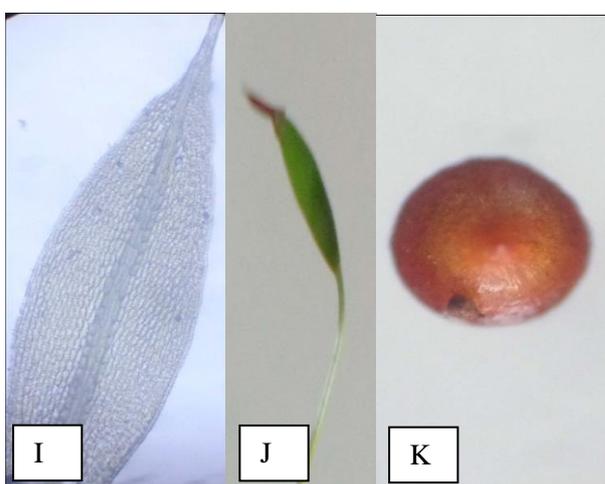
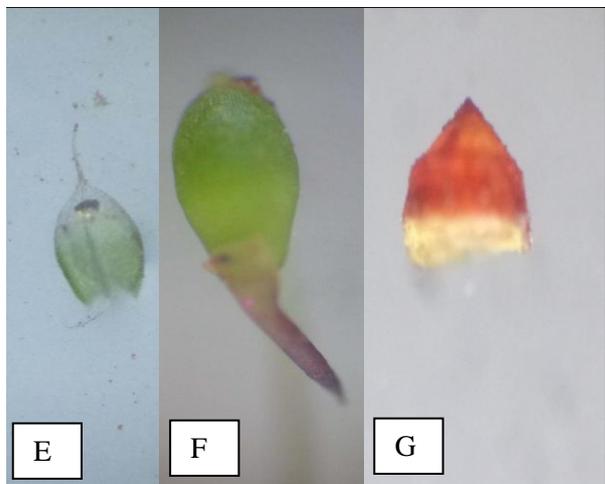
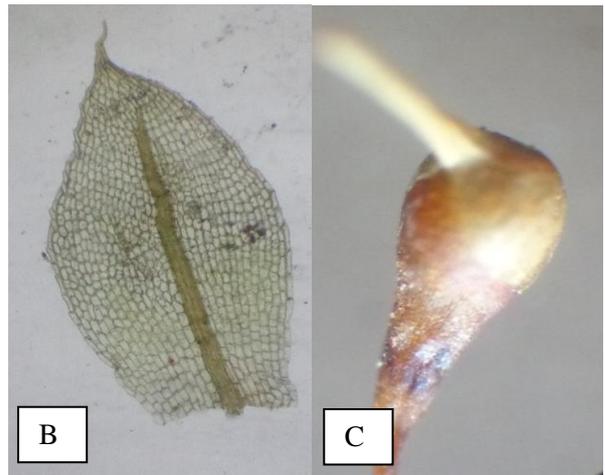


Figure 2. A. Habit, B. Leaf, C. Capsule of *Funaria fascicularis* (Hedw.) Lindb. D. Habit, E. Leaf, F. Capsule & G. Lid of *Bryum argenteum* var. *argenteum* Hedw. H. Habit, I. Leaf, J. Capsule & K. Lid of *Bryum caespiticium* var. *caespiticium* Hedw.

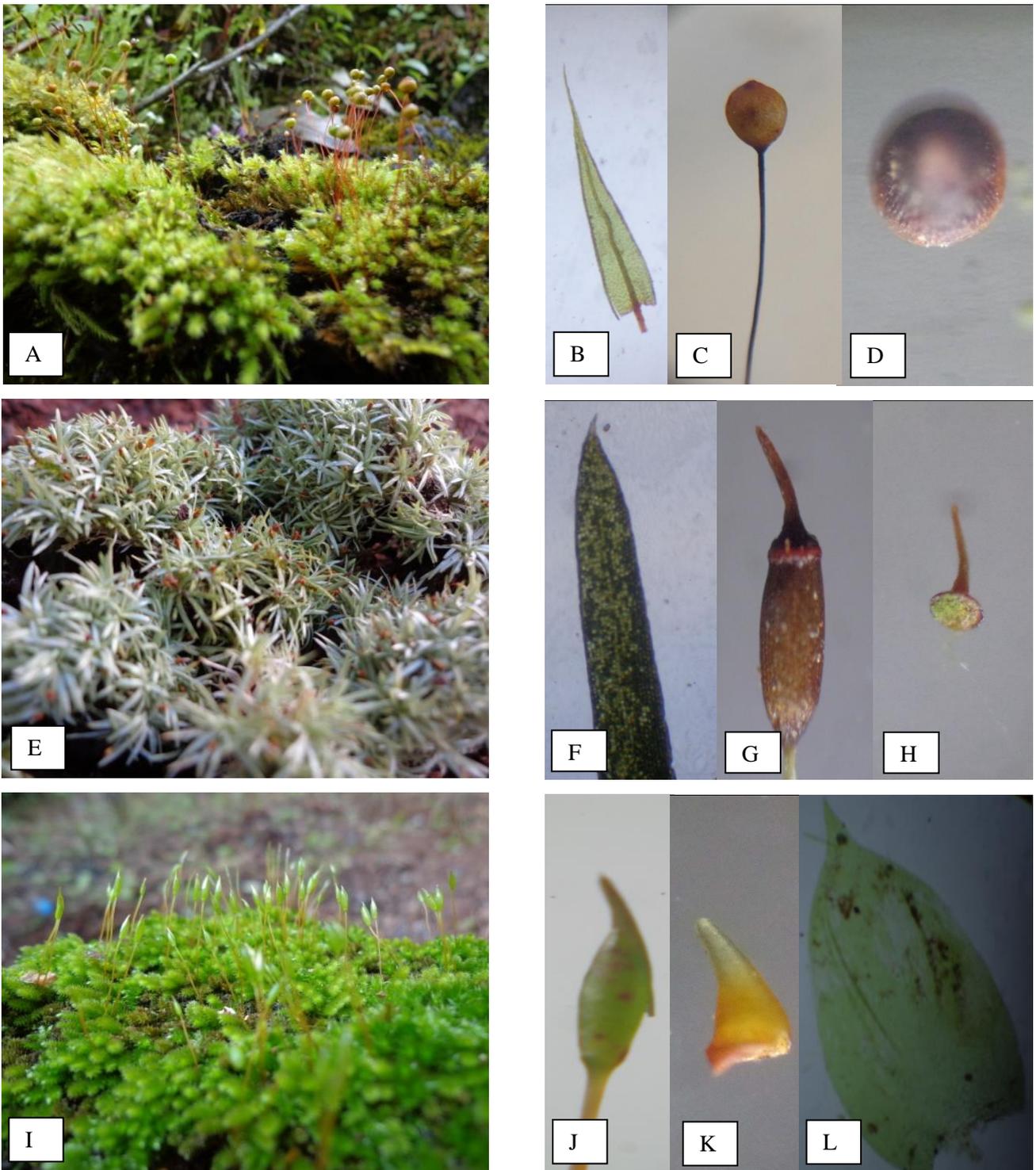
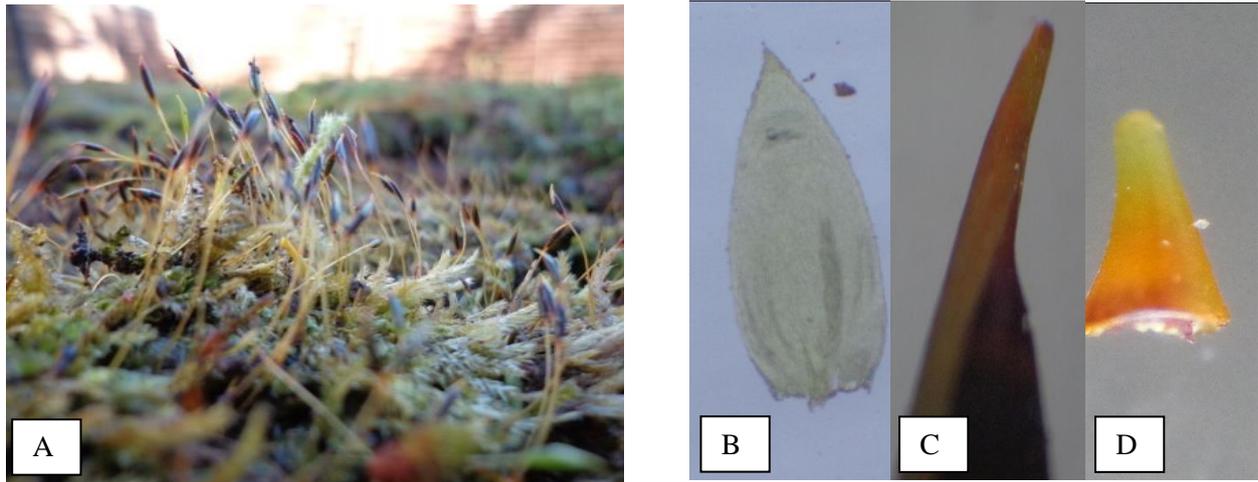


Figure 3. A. Habit, B. Leaf, C. Capsule & D. Lid of *Philonotis rigida* Brid. E. Habit, F. Leaf, G. Capsule & H. Lid of *Octoblepharum albidum* Hedwig I. Habit, J. Leaf, K. Capsule & L. Lid of *Pterogonium gracile* (Hedw.) Sm.



**Figure 4.** A. Habit, B. Leaf, C. Capsule & D. Lid of *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg.

### Discussion and Conclusion

The present research work deals with taxonomic study on bryophytes growing in Taunggyi Township, Pindaya Township, and Panglong Township of Southern Shan State. In the present work, as a first attempt, by extending the field collection to 2012, 10 species belong to 9 genera of 8 families and 7 order under class Bryopsida were identified and described.

In the study area mosses are abundantly occur as epiphytes are *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg., *Desmatodon cernuus* (Hiib.) Br. and *Bryum caespiticium* var. *caespiticium* Hedw. *Funaria fascicularis* (Hedw.) Lindb., *Bryum argenteum* var. *argenteum* Hedw., *Philonotis rigida* Brid., are grown on moist soil. *Pogonatum urnigerum* (Hedw.) P. Beauv. and *Weissia controversa* var. *controversa* Hedw., and are grown on banks, on crevices of wall. Most of the plants are erect and *Pterogonium gracile* (Hedw.) Sm. and *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg. are prostrate.

The nature and shapes of the leaves are variously occur as oblong - lanceolate, oblong - spatulate, linear - lanceolate, ovate, ligulate etc. The ending of the nerves of leaves are also found as a very useful character. It was ending below the apex in *Funaria fascicularis* (Hedw.) Lindb. and *Bryum argenteum* var. *argenteum* Hedw., absent in *Octoblepharum albidum* Hedwig and *Pterogonium gracile* (Hedw.) Sm.; percurrent in *Weissia controversa* var. *controversa* Hedw.; excurrent in *Pogonatum urnigerum* (Hedw.) P. Beauv., *Desmatodon cernuus* (Hiib.) Br., *Bryum caespiticium* var. *caespiticium* Hedw. and *Philonotis rigida* Brid.

The shapes of the capsules are found as cylindrical in *Pogonatum urnigerum* (Hedw.) P. Beauv., *Octoblepharum albidum* Hedwig, *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg.; ovoid in *Desmatodon cernuus* (Hiib.) Br.; narrowly ellipsoid on *Weissia controversa* var. *controversa* Hedw. and *Bryum argenteum* var. *argenteum* Hedw., obovoid in *Funaria fascicularis* (Hedw.) Lindb., pyriform in *Funaria fascicularis* (Hedw.) Lindb. and *Bryum caespiticium* var. *caespiticium* Hedw., ellipsoid in *Bryum argenteum* var. *argenteum* Hedw., globose in *Philonotis rigida* Brid.

The shapes of the opercula are rostrate in *Octoblepharum albidum* Hedwig, *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg.; rostellate *Pogonatum urnigerum* (Hedw.) P. Beauv.; mamillate in *Desmatodon cernuus* (Hiib.) Br., *Bryum argenteum* var. *argenteum*

Hedw., *B. caespitium* var. *caespitium* Hedw.; convex in *Funaria fascicularis* (Hedw.) Lindb. and *Philonotis rigida* Brid.

The calyptras are large in *Desmatodon cernuus* (Hiib.) Br., *Weissia controversa* var. *controversa* Hedw., *Pterogonium gracile* (Hedw.) Sm.; hairy in *Pogonatum urnigerum* (Hedw.) P. Beauv.; cucullate in *Funaria fascicularis* (Hedw.) Lindb., *Bryum argenteum* var. *argenteum* Hedw., *B. caespitium* var. *caespitium* Hedw., *Philonotis rigida* Brid. and *Taxiphyllum wissgrillii* (Garov.) Wijk & Marg., short in *Octoblepharum albidum* Hedwig, and absent in *Philonotis rigida* Brid.

According to the previous studies, *Pogonatum urnigerum* was recorded in Mandalay Region (Khin Maung Win, 1994). This species was also found in Southern Shan State area.

The morphological characteristics of the species are variable among the studied species. The most distinguished characters are habit of the plants, shapes of the leaves with their margin, nerve, cell-shape, the characters of capsule, operculum, calyptra, peristome and spore. The identification of the species were also based on the characters of nerve, operculum, leaves shape and cells shape.

Although the higher vascular plants were taxonomically studied by many researchers in Myanmar, the taxonomic characterization on mosses is still rare. Therefore, the present study partially fulfilled the valuable information of bryophytes for Myanmar.

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