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**Original Research Article**

# Annotated List of Bryophytes and Lichens from Mainit Hot Spring Protected Landscape, Nabunturan, Compostela Valley, Mindanao, Philippines

**Willen Joy Molina Domingo[1], Milton Norman Dejadena Medina[2]* and Emmanuel Pacheco Leano[2]**

[1]Assumption College of Nabunturan, Nabunturan, Compostela Valley Philippines
[2]Math and Science Department, University of Mindanao, Davao City Philippines
[3]Department of Biology, College of Arts and Sciences, Central Mindanao University, University Town, Musuan, Bukidnon 8710 Philippines

**Corresponding author.*

**A b s t r a c t**

In the framework of the 'Rapid Biodiversity Survey of Mainit Hot Spring Protected Landscape' by the Research and Development Center of Assumption College of Nabunturan an annotated lists of Bryophytes with 54 species representing 41 genera and 26 families and thirty (30) species of Lichens under 16 genera and 12 families were documented from nine sites surveyed during the months of December 2011 and March 2012. All records represent the baseline data for Mainit Hot Spring Protected Landscape. This present list showed the surviving species of mosses and lichens despite of varying human activities inside the protected landscape.

**K e y w o r d s**

Baseline data
Bryophytes
Conservation
Hot spring
Lichens

## Introduction

Mainit Hot Spring Protected Landscape (MHSPL) is situated between latitude 7°30'00" and longitude 125°59'00" with a total area of 1,775 hectares at Nabunturan, Compostela Valley Province (Fig. 1). Its gradient ranges from 0 to 18% and higher with its highest peak at 1200 masl. The soil components composed of silty, sandy loam, and clay-to-clay loam texture. It has a marked wet season from the months of May to October and dry season of the remaining months. Its flora is composed mainly of 50% woods such as yemane and falcata, and the rest are brush woods and shrubs. A variety of faunal species are also present in the area such as birds, mammals and reptiles. Indigenous groups include, Mandaya, Mansaka, Manobo, and ethnic groups Cebuano, Ilongo, Leyteno, Boholano, and Dabaweno. Several hot springs and cold springs scattered but threatened to destruction due to small scale mining, increasing population, conversion of the park into agroecosystem and timber harvesting (Philippine House Clearing Mechanism for Biodiversity, 2011).

Mosses and lichens are good indicators of environmental pollution and degradation. Mosses are very sensitive to air pollution (Conrad, 2010) while lichens are sensitive to environmental alterations (Nabors, 2005). Hence, a dwindling population of mosses and lichens may indicate the extent of environmental destruction in an area and ecological restoration is needed. The present

paper presents the existing mosses and lichens in Mainit Hot Spring Protected Landscape.

## Materials and methods

Nine (9) sites in Mainit Hot Spring Protected Landscape (MHSPL), Nabunturan, Compostela Valley Province, Philippines (Fig. 1) were surveyed between the months of December 2011 and March 2012. The identified sites include hot springs in Barangay Bukal, alongside Manat River, Sitio New Bohol, Sitio Puting Bato, Sitio Pagtulian, Saraban 1 and 2, Sitio Matagdungan, and Tindalo (Fig. 2). Opportunistic sampling was employed in all sampling sites. Bryophytes and lichens were collected from trees, mostly from coconut barks, coffee, lanzones, others from dipterocarp trees. A number of samples were also collected from wet soils, rocks, rotten logs, and areas near the streams, creeks, and waterfalls.

**Fig. 1: Map of the Philippines (A) showing the province of Compostela Valley (B) showing the location of the Municipality of Nabunturan and the MHSPL, the study area (d).**

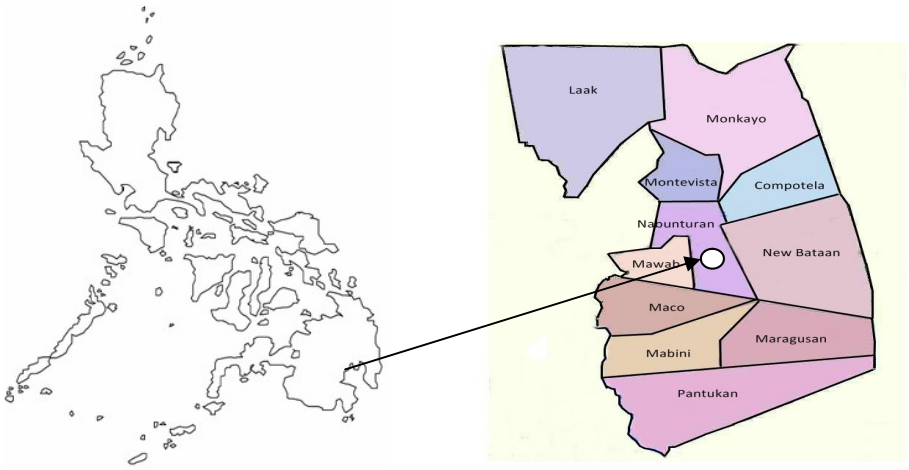



**Fig. 2: Identified survey sites in MHSPL: Hot springs in Barangay Bukal (a), Sitio New Bohol (b), Sitio Matagdungan (c), Saraban 2 (d), Sitio Pagtulian (e), and Sitio Tindalo (f).**


Preliminary identification of some specimens were conducted at the University Museum, Central Mindanao University (CMU), Musuan, Bukidnon through matching the collected specimens with the preserved specimens of the University Museum and verified through actual examination by Dr. Andrea G. Azuelo (Bryologist and lichen expert from the Department of Biology, Central Mindanao University, Musuan

Bukidnon). The rest of the specimens using high resolution photos were sent and identified by Virgilio Linis (Bryologist from the Philippine National Museum). Collected samples were air dried, preserved in paper pockets, and kept in the ACN Biology Laboratory Room. The taxonomic details of each species were identified using Zipecodezoo.com available at www.zipecodezoo.com. The conservation status of collected lichens and mosses was assessed using the International Union for Conservation of Nature (IUCN) Red List version available at http://www.iucnredlist.org.

## Results

A total of fifty-five (55) species under forty-one (41) genera and twenty-six (26) families of Bryophytes were identified. Thirty (30) species under sixteen (16) genera under twelve (12) families of lichens are compiled. Twenty-nine mosses and twelve lichens species are yet to be identified. All records represent the first for Mainit Hot Spring Protected Landscape (MHSPL).

## Annotated lists of species

## Bryophytes

Aneuraceae

1. *Aneura pinguis*, PB, 12.18.11
2. *Riccardia graeffei*, S1, 1.22-24.12

Bartramiaceae

3. *Philonotis hastata*, S1, 1.22-24.12

Brachytheciaceae

4. *Rhynchostegium celebicum*, NB, PB, 12.18.11; 1.22-24.12

Bryaceae

5. *Brachymenium coarcta* (Bosch & Lac.), NB, 12.18.11
6. *Brachymenium sp.* NB, 12.18.11

Calymperiaceae

7. *Calymperes serratum*, NB, 12.18.11
8. *Calymperes sp.* NB, 12.18.11
9. *Calymperes taitense* S1, 1.22-24.12
10. *Exostratum blumei* PB, 12.19.11

Colojeuneaceae

11. *Cololejeunea sp.* NB, 12.18.11

Daltoniaceae

12. *Distichophyllum mittenii* (Bosch & Lac) S2, 1.22-24.12
13. *Distichophyllum sp.* S1, 1.22.12

Entodontaceae

14. *Entosthodon buseanus* NB, 12.18.11
15. *Mesonodon flavescens* S1, 1.22-24.12

Fissidentaceae

16. *Fissidens crenulatus* var. Elmeri (Mitt) NB, 12.18.11
17. *Fissidens zollingeri* S1, 1.22-24.12

Hypnaceae

18. *Ectropothecium ferrugineum* var. Jaeg (C. Mull) S2, 1.24.12
19. *Ectropothecium sp*. NB, 12.18.11
20. *Vesicularia montagnei* S1, 1.22-24.12

Hypopterygiaceae

21. *Lopidium struthiopteris* S2, 1.22-24.12

Lejeuniaceae

22. *Acrolejeunea fertilis* NB, 12.18-19.11
23. *Dendrolejeunea fruticosa* NB, 12.18-19.11
24. *Lejeunia sp.* PB, 12.18.11
25. *Microlejeunea ulicina* PB, 12.18-19.11

Leucobryaceae

26. *Leucobryum bouringii* (Mitt) NB, 12.18.11
27. *Leucophanes angustifolium* (Ren & Carol), S1, 1.22-24.12
28. *Octoblepharum albidum* (Hedw) NB, 12.18.11

Marchantiaceae

29. *Marchantia emarginata* 12.18-21.11

**Fig. 3: Mosses from Mainit Hot Spring Protected Landscape, Nabunturan, Compostela Valley, Philippines [Area collected: New Bohol (NB), Puting Bato (PB), Saraban 1 (S1), Saraban 2 (S2), along Manat River (MR), along Hot Springs (HS), Matagdungan (M), Pagtulian (P), and Tindalo (T)].**

**(A)** ***Aneura pinguis,*** **PB, 12.20.11**

**(B)** ***Riccardia graeffei,*** **S1, 1.20.11**

**(C)** ***Rhynchostegium celebicum,*****NB, PB, 12.18.11; 1.22-24.12**


**(D) Fig. 6** ***Brachymenium sp.*** **NB, 12.18.11**

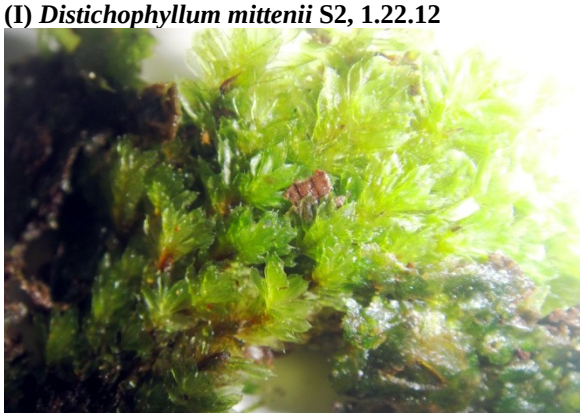
**(E)** ***Brachymenium coarcta*** **Bosch & Lac.**


**(F)** ***Calymperes serratum*****, NB, 12.18.11**

**(G)** ***Calymperes taitense*** **S1, 1.22-24.12**

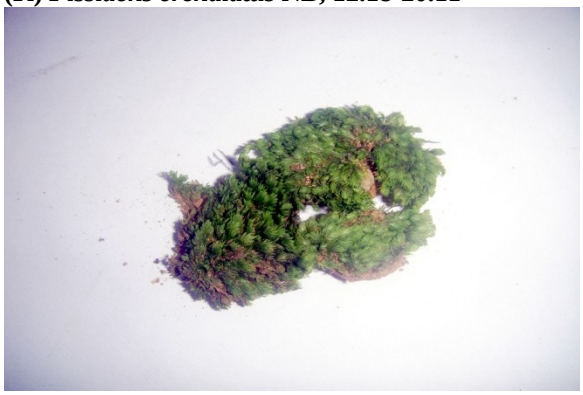
**(H)** ***Exostratum blumei*** **PB, 12.20.11**

**(I)** ***Distichophyllum mittenii*** **S2, 1.22.12**



**(J)** ***Distichophyllum sp.*** **S1, 1.22-24.12**

**(K)** ***Fissidens crenalatus*** **NB, 12.18-20.11**



**(L)** ***Fissidens zollingeri*** **S1, 1.22-24.12**

**(M)** ***Ectropothecium sp.*** **NB, 12.20.11**

**(N)** ***Ectropothecium ferrugeneum*** **S2, 1.22-24.12**

**(O)** ***Lejeunia sp.*** **PB, 12.18-20.12**

**(P)** ***Acrolejeunea fertilis*** **NB, 12.18-20.12**

**(Q)** ***Dendrolejeunea fruticosa*** **PB, 12.18-20.12**

**(R)** ***Microlejeunea ulicina*** **NB, 12.18-20.12**

**(S)** ***Leucobryum bouringii*** **PB, 12.18-20.12**

**(T)** ***Leucobryum bouringii*** **NB, 12.18-20.12**

**(U)** ***Leucophanes angustifolium*** **S1, 1.22-24.12**

**(V)** ***Octoblepharum albidum*** **NB, 12.18-20.12**

**(W)** ***Marchantia emarginata*** **NB, 12.18-20.11**

**(X)** ***Barbella macroblasta*** **NB, 12.18-20.11**

Meteoriaceae

30. *Barbella macroblasta* (Broth.) NB, 12.18-19.11
31. *Barbella sp.* NB, 12.18.11
32. *Floribundaria floribunda* (Dozy & Molk) PB, 1.22.12

Mniaceae

33. *Plagiomnium succulentum* S1, 1.22-24.12

Neckeriaceae

34. *Himantocladium cyclophyllum* (C. Mull) S1, 1.22-24.12
35. *Homaliodendron exiguum* (Bosch & Lac.) NB, 12.18.11
36. *Neckeropsis lepineana* (Mont.) S1, 1.22-24.12

Orthotricaceae

37. *Macromitrium semperi* (C. Mull) NB, 12.18.11

Pilotrichaceae

38. *Callicostella papillata* NB, 12.18.11

Plagochilaceae

39. *Plagiochila sp.*1 PB, 12.18-19.11; S1, 1.22.12
40. *Plagiochila sp.* 2 PB, 12.18-19.11
41. *Plagiochila sp.* 3 PB, 12.18-19.11
42. *Plagiochila sp.*4 S1, 1.22.12; S2, 1.24.12

Pottiaceae

43. *Hyophila involuta* NB, 12.19.11; PB, 12.18.11

Pylaisiadelphaceae

44. *Taxithelium sp.* NB, 12.19.11

Ricciaceae

45. *Riccia treubiana* NB, 12.19.11

Sematophyllaceae

46. *Acroporium sp.* NB, 12.19.11; S1, 1.22-24.12
47. *Acroporium stramenium* (Reinw. & Hornsch) S1, 1.22-24.12
48. *Isocladiella surcularis* S1, 1.22-24.12
49. *Radulina hamata* (Dozy & Molk) S1, 1.22-24.12
50. *Radulina hamatum* (C. Mull) S1, 1.22-24.12
51. *Trismegistia sp.*1 NB, 12.19.11
52. *Trismegistia sp.*2 PB, 12.18.11
53. *Trismegistia sp.*3 NB, 12.19.11; PB, 12.18.11

Thuidiaceae

54. *Thuidium cymbifolium* (Dozy & Molk.) NB, 12.19.11

Trachylomataceae

55. *Trachyloma indicum* (Mitt.) NB, 12.19.11

## Lichens

Coenogoniaceae

1. *Coenogonium linkii Ehrenb* NB, 12.19.11
2. *Coenogonium sp.* NB, 12.19.11; T, 2.18.12

Collemataceae

3. *Collema sp.* HS, 2.18.12
4. *Leptogium sp.* NB, 12.19.11
5. *Leptogium sp.1* HS, 2.18.12

Crocyniaceae

6. *Crocynia sp.* T, 2.18.12

Graphidaceae

7. *Graphina sp.*NB, S1, S2, MR, 12.19.11; 2.18.12
8. *Graphina sp.2* MR, 2.18.19
9. *Graphina sp.3* MR, 2.18-19.12

Micareaceae

10. *Psilolechia lucida* NB,

Monoblastiaceae

11. *Anisomeridium sp.* MR, 2.18.12
12. *Anisomeridium sp.2* S2, 1.22-24.12
13. *Anisomeridium sp.3* HS, 2.18.12
14. *Anisomeridium sp.4* HS, 2.18.12
15. *Anisomeridium sp.5* HS, 2.19.12

Ocellulariaceae

16. *Ocellularia sp.*S2, 1.22.12

Parmeliaceae

17. *Parmeliopsis hyperopta* NB, 12.19.11
18. *Parmeliopsis sp.* NB, 12.19.11
19. *Parmotrema reticulatum* NB, 12.19.11
20. *Parmotrema sp*. NB, 12.19.11
21. *Physconia perisidiosa* NB, 12.19.11
22. *Usnea sp.* NB, 12.19.11

Pertusariaceae

23. *Pertusaria albescens* NB, 12.19.11
24. *Pertusaria coralline* NB, 12.19.11
25. *Pertusaria hemisphaerica* NB, 12.19.11
26. *Pertusaria sp.* NB, 12.19.11

Physciaceae

27. *Physcia sp.* NB, 12.19.11

Stereocaulaceae

28. *Stereocaulon sp.* NB, 12.19.11; T, 2.18.12

Strigulaceae

29. *Strigula smaragdula* S1, 1.22-24.12
30. *Strigula sp.* S1, 1.22-24.12; S2, 1.22.12

**Fig. 4: Lichens of Mainit Hot Spring Protected Landscape, Nabunturan, Compostela Valley, Philippines [Area collected: New Bohol (NB), Puting Bato (PB), Saraban 1 (S1), Saraban 2 (S2), along Manat River (MR), along Hot Springs (HS), Matagdungan (M), Pagtulian (P), and Tindalo (T)].**

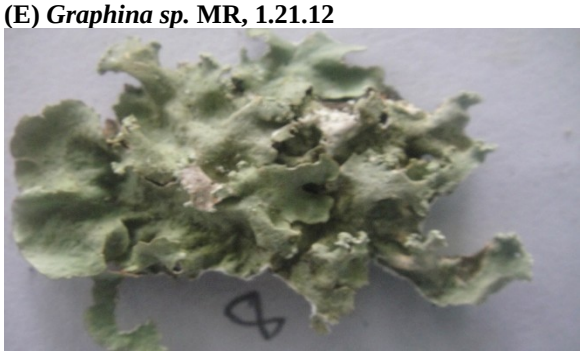
**(A) *Collema sp.* NB, 12.20.11**

**(B) *Leptogium sp.* B, 1.22.12**

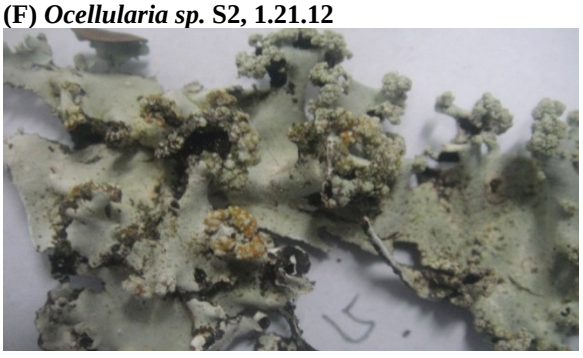
**(C) *Psilolechia lucida,* NB, 1.18-19.11**

**(D) *Anisomeridium sp.* MR, 1.21.12**

**(E) *Graphina sp.* MR, 1.21.12**

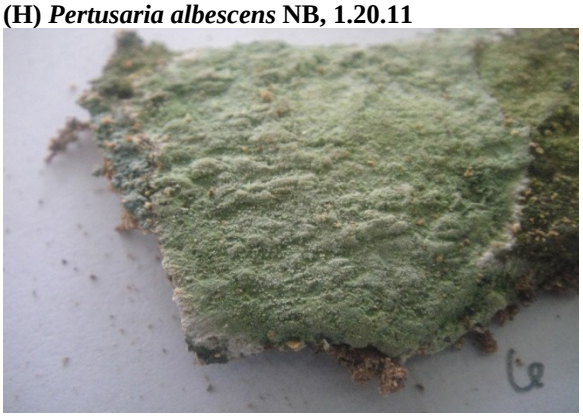


**(F) *Ocellularia sp.* S2, 1.21.12**



**(G) *Usnea sp.* NB, 1.20.11**

**(H) *Pertusaria albescens* NB, 1.20.11**



**(I) *Stereocaulon sp.*T, 2.3.12**

**(J) *Strigula smaragdula*, 1.22.12**

## Discussion

The present list represents the first compilation of lichens and mosses in Mainit Hot Spring Protected Landscape and the first in Compostela Valley Province. Majority of the samples were collected from Sitio Puting Bato, Sitio New Bohol, and Saraban 1 while few samples collected near the hot springs at Purok 3, Bukal, Saraban 2, and alongside Manat River.

The relatively high number of collection in the upper Sitio New Bohol, Sitio Puting Bato, and Saraban 1 could be accounted to its relatively undisturbed environment (Nabors, 2005; Conrad, 2010). These areas are still dominated with relatively thick vegetation with fragments of secondary dipterocarp forests still thriving suitable habitat for lichens and mosses. Studies showed that undisturbed areas are the favourite habitat for these sensitive species (Lubos, 2007). Alteration in the environment such as timber harvesting, mining, and pollution have grave impact to the species composition of lichens and mosses (Nabors, 2005) making these species as efficient environmental indicators (Linis, 2006; Lubos, 2007).

The minimal number of species collection from Purok 3, Saraban 2, and alongside Manat River, could be accounted to its relatively destructed environment. Hot springs are dumped with garbage visibly styrofoams and plastics scattered in the area. The former Mt. Angelo which was visited by many local and international tourists before was transformed into slaughter house for nearby villagers where they cleaned butchered hogs and other animals for food. The hot springs particularly in Purok 3 provided them with easy access on hot water for cleaning their animal butchers. Several tunnels without proper tilling ponds were the wastes emptied directly to Manat River causing immediate pollution and contaminate nearby plant habitats of lichens and mosses. Numerous households in the vicinity of Hot springs in Purok 3, stream in Saraban 2, and along Manat River do not have proper solid waste management.

The increasing human population inside the MHSPL is one of the major threats to moss and lichens diversity (Conrad, 2009, 2010; Lubos, 2007). Increasing solid wastes from households and liquid wastes from the mining activities inside the park would greatly affect lichens and mosses diversity since these species are very sensitive to environmental degradation (Nabors, 2005).

Furthermore, another devastating threat is the rampant timber harvesting inside the park (Campbell, 1996; Heaney and Regalado, 1998). However, the diversity of collected samples from MHSPL showed the surviving population of lichens and mosses that greatly needs conservation, ecological restoration and preservation efforts (Sert et al., 2011; Linis, 2006).

Although the species record of MHSPL is minimal compared to the lichens and bryophytes in Mt. Kalatungan, Bukidnon and Mt. Matutum, South Cotabato (Lubos, 2007) it is impressive enough for a protected area having dwindling number of lichens and mosses greatly inhabited, extensively mined, and rampantly harvested forest cover craving for environmental restoration (Linis, 2006).

## Recommendation

Due to the limited time and resources, twenty-nine species of mosses and twelve species of lichens are yet to be identified. Identification of these species would further increase this baseline list of lichens and mosses for MHSPL.

## Acknowledgement

We are indebted to the Assumption College of Nabunturan through its Research and Development Centre and the Nabunturan Balik-Kinaiyahan Foundation Incorporated for the funding. We thank Dr. Winnie Maglana for the accommodation and food service throughout the venture; To the Biology students of ACN batch 2011-2012 for helping us in the collection of specimens; To Sir Victor Amoroso for allowing us to have access in the University Museum of Central Mindanao University; To Dr. Andrea Azuelo for the identification of some specimens, and the CMU research assistants for the assistance; To Sir Virgilio Linis for the identification of the photographed specimens; and most of all to the Almighty Creator Who is the source of all.

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