



Foliose lichens along the trails of Casaroro Falls and Pulangbato Falls in Valencia, Negros Oriental, Philippines

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Abstract

Lichens are abundant and highly diverse in tropical areas such as the Philippines due to its climate and geographical features. However, several regions of the country remained underexplored or unexplored and many species remained undiscovered in the country's many unique habitats. This study determines the occurrence of foliose lichens in Casaroro Falls and Pulangbato Falls in Valencia, Negros Oriental, Philippines. The lichen morphologies were characterized using available taxonomic keys. Among the 26 lichen samples collected from the two falls, 23 specimens were identified based on their morphological and biochemical characteristics. Of these, 8 species were specific to Casaroro Falls and 13 species to Pulangbato Falls, with only 2 species of lichens found on both waterfalls. Interestingly, 17 species are new records for the Philippines.

Key words – foliose – lichen identification – Negros Oriental – new records – Philippines – tropics

Introduction

Lichens, a mutualism of algae or cyanobacteria (photobiont) and fungi (mycobiont) are abundant in tropical areas such as the Philippines, which shows a wide array of lichen diversity due to its climatic conditions and geographical features (Bawingan et al. 2017). With its tropical climate are various forest ecosystems including lowland rainforest, montane-mossy forests, pine forest, and coastal or mangrove forests where various lichen species could thrive. Although the ideal climatic conditions and geographic isolation of the country resulted in high endemism among its flora and fauna (Catibog-Sinha & Heaney 2006), the country is also classified as one of the most threatened ecosystems in the planet. Though known as a megahotspot of biodiversity, the Philippines' vast majority of lichens remained unexplored. So far, the most comprehensive listing of lichens for the country was done by Gruezo (1979) where he noted 1,108 taxa distributed in 137 genera, 789 species, 3 subspecies, 153 varieties, 28 formae and 1 subforma. Although in recent years, lichenology in the Philippines has progress beyond species list to diversity, biomonitoring and bioactivities (Santiago et al. 2010, 2013, de Jesus et al. 2016, Gazo et al. 2019), several regions of the country remained underexplored or unexplored and many species remained undiscovered in many of its unique habitats. This necessitates an urgent assessment of the country's biodiversity including its poorly documented lichen species. Thus, this paper looks at the occurrence of lichen species in Casaroro Falls and Pulangbato Falls in Valencia, Negros Oriental, Philippines.

Materials and Methods

Collection Sites

Casaroro Falls (9°16'46"N, 123°12'53"E) and Pulangbato Falls (9°19'49"N, 123°11'94"E) are both found in the municipality of Valencia, which is located 9 kilometers west of Dumaguete City. Valencia was voted in 2007 as "the greenest and cleanest" town in the Negros Oriental province. The municipality occupies an area of 14,749 hectares, 65% are mountainous with elevations ranging from 200 to 500 meters above sea level. It has a cooler climate than the average of the other municipalities because of its higher elevation.

Lichen Collection

Two waterfalls in the municipality of Valencia, i.e. Casaroro Falls and Pulangbato Falls, were explored for the lichens with help of personnel from the Department of Environment and Natural Resources (DENR). Foliose lichens collected along the trails leading to the waterfalls were placed in brown paper bags, air-dried and then stored in dry wooden cabinets. Storage of voucher specimens were done at the UST Central Laboratories, University of Santo Tomas in Manila, Philippines.

Identification of the Lichens

Morphological characters and reproductive structures including sections of the thallus and ascocarps were examined using compound and dissecting microscopes. The chemistry of the lichens was determined using the spot test reagents such as potassium hydroxide (K test), iodine (I test), and sodium hypochlorite (C test) as described in Galinato et al. (2017). Based on the observed morpho-anatomic features and lichen chemistry, the specimens were identified with the help of available taxonomic keys and various references, e.g. Gruezo 1979, Goward et al. 1994, Malcolm et al. 2011, Santiago et al. 2013, McCarthy 2015.

Results

The collected foliose lichens

A total of 26 foliose lichen specimens were collected from the two waterfalls, Casaroro Falls and Pulangbato Falls. Rocks served as the substratum for the specimens collected in the two sampling locations. Following comparison of their morphological and biochemical characteristics with published reference lichens, 23 specimens in this study were identified and confirmed up to the species level. Three specimens could not be identified with certainty, and thus, were not reported here. The species in bold are new records for the Philippines.

Collema crispum (Huds.) Weber ex F.H. Wigg. (Collemataceae)

= ***Blennothallia crispa*** (Weber ex F.H. Wigg.) Otálora, P.M. Jørg. & Wedin

Specimens examined: Casaroro Falls, Valencia 9°16'43"N, 123°12'20"E, 470 masl; Pulangbato Falls, Valencia 9°19'20"N, 123°11'39"E, 400masl.

Collema flaccidum (Ach.) Ach. (Collemataceae)

Specimen examined: Pulangbato Falls, Valencia 9°19'16"N, 123°11'32"E, 430 masl.

Collema rugosum Kremp. (Collemataceae)

Specimen examined: Pulangbato Falls, Valencia 9°19'16"N, 123°11'32"E, 430 masl.

Collema texanum Tuck. (Collemataceae)

Specimen examined: Pulangbato Falls, Valencia 9°19'20"N, 123°11'39"E, 400 masl.

Dermatocarpon miniatum (L.) W. Mann (Verrucariaceae)

- = *Dermatocarpon miniatum* var. *miniatum* (L.) W. Mann
Specimens examined: Casaroro Falls, Valencia 9°16'43"N, 123°12'20"E, 470 masl.
- Dermatocarpon moulinsii* (Mont.) Zahlbr (Verrucariaceae)
Specimen examined: Casaroro Falls, Valencia 9°16'44"N, 123°12'21"E, 600 masl. Pulangbato Falls, Valencia 9°19'16"N, 123°11'32"E, 430 masl.
- Dermatocarpon rivulorum* (Arnold) Dalla Torre & Sarnth. (Verrucariaceae)
Specimen examined: Pulangbato Falls, Valencia 9°19'16"N, 123°11'32"E, 430masl.
- Leioderma solediatum* D.J. Galloway & P.M. Jørg. (Pannariaceae)
Specimen examined: Pulangbato Falls, Valencia 9°19'20"N, 123°11'39"E, 400masl.
- Leptogium adpressum* Nyl. (Collemataceae)
Specimens examined: Casaroro Falls, Valencia 9°16'44"N, 123° 12'21"E, 600 masl.
- Leptogium brebissonii* Mont. (Collemataceae)
Specimens examined: Casaroro Falls, Valencia 9°16'44"N, 123° 12'21"E, 600 masl.
- Leptogium californicum* Tuck. (Collemataceae)
Specimen examined: Casaroro Falls, Valencia 9°16'43"N 123°12'20"E, 470masl.
- Leptogium corticola* (Taylor) Tuck. (Collemataceae)
Specimens examined: Casaroro Falls, Valencia 9°16'44"N 123° 12'21"E, 600masl.
- Leptogium cyanescens* (Rabenh.) Körb. (Collemataceae)
Specimens examined: Casaroro Falls, Valencia 9°16'44"N 123° 12'21"E, 600 masl.
- Leptogium subaridum* P.M. Jørg. & Goward (Collemataceae)
Specimens examined: Pulangbato Falls, Valencia 9°19'16"N 123°11'32"E, 430 masl.
- Nephroma isidiosum* (Nyl.) Gyeln. (Nephromataceae)
Specimen examined: Casaroro Falls, Valencia 9°16'43"N 123°12'20"E, 470 masl.
- Pannaria lurida* (Mont.) Nyl. (Pannariaceae)
Specimens examined: Pulangbato Falls, Valencia 9°19'16"N 123°11'32"E, 430 masl.
- Pannaria maritima* P.M. Jørg. (Pannariaceae)
Specimens examined: Casaroro Falls, Valencia 9°16'44"N 123° 12'21"E, 600 masl.
- Parmotrema saccatilobum* (Taylor) Hale (Parmeliaceae)
Specimens examined: Pulangbato Falls, Valencia 9°19'16"N 123°11'32"E, 430 masl.
- Physcia clementei* (Turner) Lyng (Physciaceae)
Specimens examined: Pulangbato Falls, Valencia 9°19'20"N 123°11'39"E, 400 masl.
- Physcia grisea* (Lam.) Zahlbr. (Physciaceae)
Specimens examined: Pulangbato Falls, Valencia 9°19'16"N 123°11'32"E, 430 masl.
- Pyxine cylindrica* Kashiw. (Caliciaceae)
Specimens examined: Pulangbato Falls, Valencia 9°19'16"N 123°11'32"E, 430 masl.

Pyxine keralensis D.D. Awasthi (Caliciaceae)

Specimens examined: Pulangbato Falls, Valencia 9°19'16''N 123°11'32''E, 430 masl.

Pyxine philippina Vain. (Caliciaceae)

Specimens examined: Pulangbato Falls, Dumaguete City 9°19'16''N 123°11'32''E, 430masl.

Discussion

The thalli of the identified foliose lichens in Fig. 1 were collected from both Casaroro and Pulangbato Falls. These lichen thalli included those taxa from the genera *Collema*, *Dermatocarpon*, *Leptogium*, and *Pannaria*. Only *Collema crispum* was identified from Casaroro Falls while 4 species of *Collema* including *C. texanum*, *C. crispum*, *C. flaccidum*, and *C. rugosum* were recorded in Pulangbato Falls. *Dermatocarpon moulinsii* and *Collema crispum* were present in the two sites. *Leptogium* species including *L. adressum*, *L. brebissonii*, *L. californicum*, *L. corticola*, and *L. cyanescens* were numerous in Casaroro Falls, i.e. at least half of the identified foliose lichens in that site. *Leptogium subaridum* was recorded in Pulangbato falls. *Pannaria maritima* was noted in Casaroro Falls while *Pannaria lurida* was from Pulangbato Falls. The only unique lichen recorded in Casaroro Falls was *Nephroma isidiosum*, while species of *Pyxine*, i.e., *P. cylindrica*, *P. keralensis*, *P. philippina*, *P. grisea*, *P. clementei*, and *Parmotrema saccatilobum* and *Leioderma solediatum* were solely identified in Pulangbato Falls. The species observed here were also previously reported in other Asian countries, e.g. *Collema crispum* in China, *Dermatocarpon miniatum* in Japan (Harada 1993), *Leioderma solediatum* in India and Thailand (Jørgensen 2002), *Leptogium cyanescens* in South Korea (Jayalal et al. 2014) and Thailand (Wolseley et al. 2002), *Parmotrema saccatilobum* in Thailand (Wolseley et al. 2002), *Pyxine keralensis* in Sri Lanka (Weerakoon & Aptroot 2016), and *Pyxine cylindrica* in India (Nayaka & Upreti 2005). Fig. 2 shows the distribution of the collected lichens on the two sampling localities.

Lichens differ remarkably from higher plants. Due to their poikilohydrous nature, lichens tend to be susceptible to various environmental factors which results to changes in genetic, individual, population and community levels (Shukla et al. 2014). For instance, the microclimatic conditions of an area, e.g., precipitation, light, humidity and dryness, air quality and wind currents, play an important role in the successful colonization of lichens (Shukla et al. 2014). In this study, the abundance of foliose lichens in both Casaroro and Pulangbato Falls can be attributed to the clean air and moist environment in the sampling localities. The moist environment enhances the growth and development of lichens (Armstrong 2015). Clean air also contributed to their abundant growth, as lichens tend to absorb harmful chemicals through their cortex. Between the two collecting sites, Casaroro Falls had the most number of *Leptogium* species, perhaps because of the humidity in the area, which is essential for *Leptogium* species to survive (Armstrong 2015).

Altitude could also influence the occurrence of lichen species in a community (Armstrong 2015), which means that, “the higher the elevation, the more diverse the lichen species are”. As inferred from this study, five *Leptogium* species were found in Casaroro Falls at 600 meters in elevation as compared to one species of *Leptogium* in Pulangbato Falls at 400 meters. However, more species of *Collema* were collected in Pulangbato Falls. A high number of foliose lichens were also noted for Pulangbato Falls, e.g. *Pyxine*, *Physcia*, *Parmotrema*, and *Leioderma*, which may be due to favorable temperature, humidity and light intensity. Lesser number of taxa in Casaroro Falls may also be attributed to some man-made activities, as the area is slightly disturbed due to ecotourism. According to Newsome and Hughes (2016), potential negative impacts of tourism on biodiversity often interact with wider landscape-level impacts that compromise biodiversity conservation.

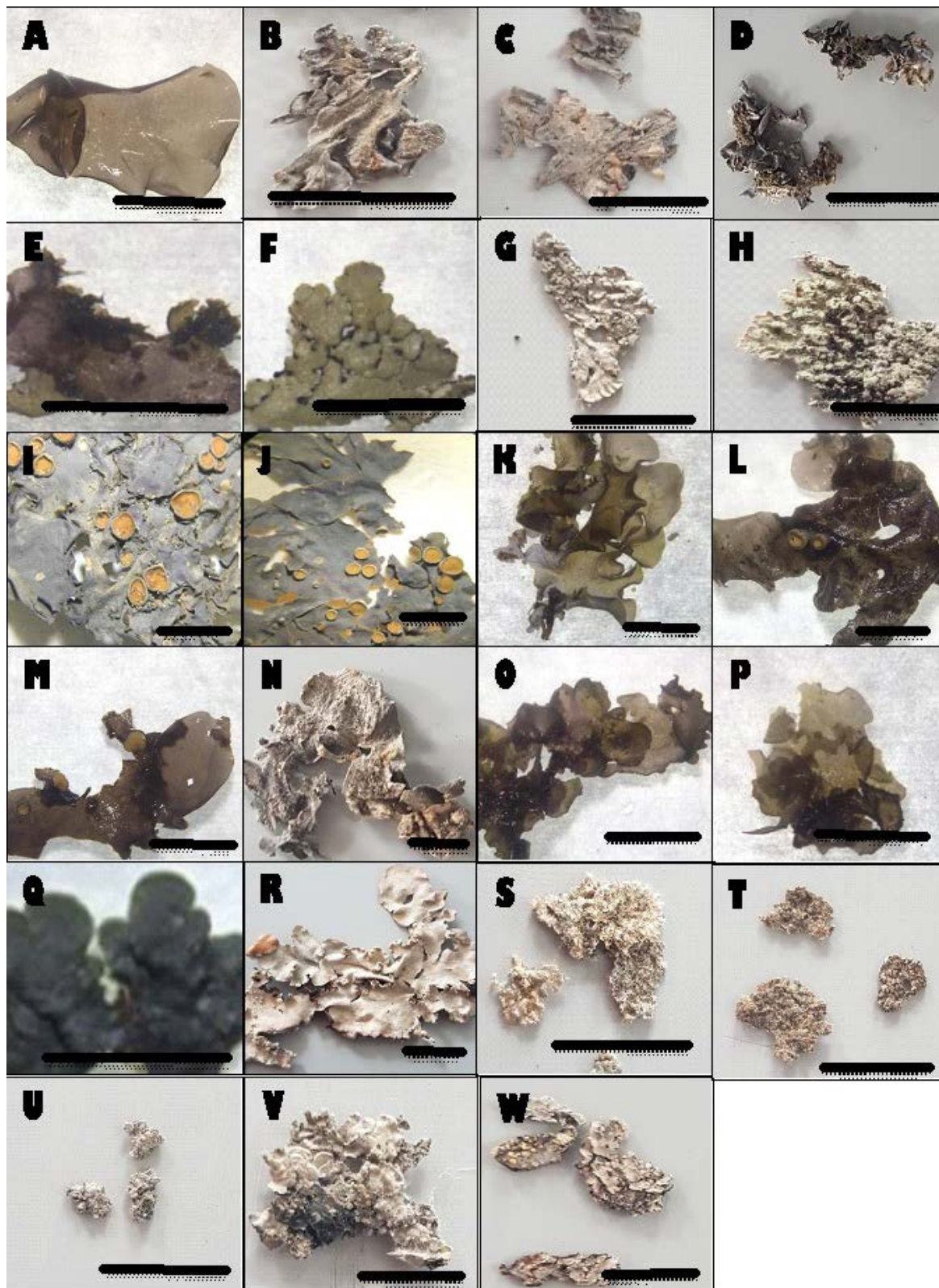


Fig. 1 – Thallus of identified foliose lichens from Casaroro Falls and PulangBato Falls. A *Collema crispum*. B *Collema flaccidum*. C *Collema rugosum*. D *Collema texanum*. E *Dermatocarpon miniatum*. F *Dermatocarpon moulinsii*. G *Dermatocarpon rivulorum*. H *Leioderma solediatum*. I *Leptogium adpressum*. J *Leptogium brebissonii*. K *Leptogium californicum*. L *Leptogium corticola*. M *Leptogium cyanescens*. N *Leptogium subaridum*. O *Nephroma isidiosum*. P *Pannaria lurida*. Q *Pannaria maritime*. R *Parmotrema saccatilobum*. S *Physcia clementei*. T *Physcia grisea*. U *Pyxine cylindrical*. V *Pyxine keralensis*. W *Pyxine philippina*. Scale Bars: A-W=5 mm.

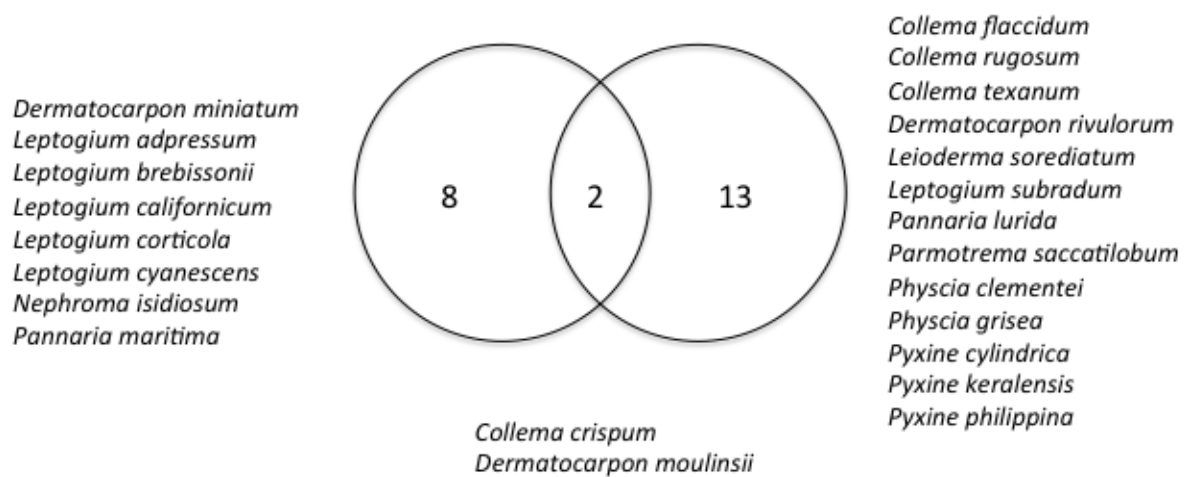


Fig. 2 – Distribution of lichen species in Casaroro and Pulang Bato Falls in Valencia, Negros Oriental.

Conclusions

Of the 23 lichen taxa identified in this study, 17 species are new records for the Philippines. The identification of new records as exemplified in this study highlighted the importance of conducting species survey for documenting the hidden diversity in any given area. This study is also the first report of lichens in the municipality of Valencia.

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Disclosure Statement

There is NO potential conflict of interest that was reported by the authors.

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