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Notes on Liverwort Specimens from the Philippine Cordilleras in the Botanical Herbarium of the UPLB Museum of Natural History (CAHUP)

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Abstract

An account of liverwort specimens collected from the Philippine Cordilleras, particularly from the Cordillera Administrative Region (CAR), deposited and accessioned in the Botanical Herbarium of the University of the Philippines Los Baños Museum of Natural History (CAHUP) is provided. A total of 539 accessions from the region were recorded, comprising 23.89% of the overall liverwort and hornwort collection of CAHUP. This represents a total of 76 species distributed in 41 genera and 26 families. The families Lepidoziaceae with 179 accessions, Plagiochilaceae with 100 accessions, and Herbertaceae with 48 accessions make up the majority of the collections from the region. The oldest dated specimen from the CAR deposited in the herbarium was collected by H.H. Bartlett in 1935 and the bulk of accessioned specimens from the region were collected in the 1970s by M. Alvarez with A. Tandang and Saprid from Mt. Data (Mountain Province) and Mt. Pulag (Benguet Province), respectively. The geographic extent of liverwort collection in the CAR, as reflected by the accessioned specimens, is restricted to few localities in the provinces of Benguet, Ifugao, and Mountain Province. Locality information and distribution records for noteworthy species are reported, with 20 species new to the CAR; new localities are reported for another 18 species. With the current state of liverwort collection and research in the CAR, the processing and accessioning of approximately 15,000 bryophyte specimens from different parts of the country, conducting inventories and examination of herbarium specimens in other herbaria, and carrying out extensive and systematic collection work in areas of high conservation value are expected to contribute more information on the ecology, richness and diversity, and distribution of liverworts in the region.

KEYWORDS

herbarium
natural history collections
Philippine flora
bryophytes
liverworts

Introduction

Established in 1976, the University of the Philippines Los Baños Museum of Natural History (UPLB MNH) serves not only as a repository of biological specimens but also as a center of research in systematic biology, an information hub, and an institution for learning (Gapud & Tan, 1982). At present, the UPLB MNH caters approximately 200,000 specimens of flora and fauna, of which a sizable number are from the Philippines. The Botanical Herbarium (CAHUP following Thiers, 2015), one of the eight components of the UPLB MNH, serves as the repository of about 12,000 plant species represented by around 70,000 specimens; among these, about 3,600 species are bryophytes.

Studies on Philippine liverworts may be dated as early as 1833 with the description of *Jungermannia floccosa* by Profs. J.G.C. Lehmann and J.B.W. Lindenberg based on a material obtained from the leaf of a tree specimen collected from Sorsogon Province during the Malaspina Expedition in 1792-1793 (Lehmann, 1883; Tan & Engel, 1986). From the checklist of Philippine Hepaticae, Tan and Engel (1986) accounted a total of 504 species of liverworts in 94 genera and 32 families. It is evident, however, that the checklist needs to be updated in light of recent developments in liverwort taxonomy and systematics (e.g. Bakalin, 2013; Crandall-Stotler et al., 2009; Söderström et al., 2016; Sukkharak & Gradstein, 2014; Zhu et al., 2018). Additionally, Tan and Engel (1986) noted that past liverwort collections in the country focused on relatively few mountains and about 10% of the species reported in the country are without citation of a collection and locality.

In an effort to document the liverwort flora of the Philippines, an extensive review of pertinent literature as well as the examination of collections in different herbaria are considered of paramount importance. In this paper, we present an account of liverwort specimens from the Philippine Cordilleras, particularly within the geo-political unit known as the Cordillera Administrative Region in Luzon Island, deposited and accessioned in CAHUP as well as a number of new records for species with poorly known distributions within the Philippines.

Methodology

A database of accessions of liverwort specimens deposited in CAHUP was created using Microsoft Excel® (available upon request). Logbooks containing specimen accessions were used as reference and herbarium specimens were inventoried and examined. Entries for each accession include accession number, family, genus, species epithet, subspecies or variety, collector and collection number, date of collection, collection locality, person who identified the specimen and date of determination, and annotations or remarks. A survey of accessions of liverwort specimens collected from the Cordillera Administrative Region was carried out to determine the taxonomic composition of the collections and the extent of collection across this phytogeographically unique region. In light of developments in liverwort taxonomy and systematics, nomenclature and classification was updated following Söderström et al. (2016) and according to the online checklist The Plant List (2013). Published information on the geographical distribution of a number of noteworthy species were then reviewed and synthesized.

Results and Discussion

Account of Accessioned Specimens from the Philippine Cordilleras

The liverwort and hornwort collection of CAHUP consists of a total of 2,256 accessions– of which 539 (23.89%) are liverwort specimens from the CAR. This represents a total of 76 species distributed in 41 genera and 26 families (Table 1). The majority of the collections from the region are composed of Lepidoziaceae with 179 accessions, Plagiochilaceae with 100 accessions, and Herbertaceae with 48 accessions. Amongst these, Lepidoziaceae is the most represented family with 16 species, followed by Lejeuneaceae and Plagiochilaceae each with 12 species, and Frullaniaceae with 7 species. The families with the most number of genera are Lejeuneaceae with 10 genera and Adelanthaceae with three (3) genera.

The oldest dated material at CAHUP collected in the CAR is a specimen of *Frullania serrata*

Table 1

Liverwort specimens from the Cordillera Administrative Region deposited and accessioned in the Botanical Herbarium of the UPLB Museum of Natural History.

Families	Number of Accessions	Genera	Species
1. Adelanthaceae	19	3	3
2. Anastrophyllaceae	21	1	1
3. Aneuraceae	1	1	1
4. Aytoniaceae	1	1	1
5. Blepharostomataceae	2	1	1
6. Cephaloziaceae	1	1	1
7. Cephaloziellaceae	8	1	1
8. Frullaniaceae	15	1	7
9. Gymnomitriaceae	1	1	1
10. Herbertaceae	48	2	4
11. Jackiellaceae	8	1	1
12. Jungermanniaceae	13	2	2
13. Lejeuneaceae	43	10	12
14. Lepicoleaceae	5	1	1
15. Lophocoleaceae	1	1	1
16. Lepidoziaceae	179	2	16
17. Marchantiaceae	6	1	1
18. Mastigophoraceae	44	1	1
19. Metzgeriaceae	2	1	1
20. Plagiochilaceae	100	2	12
21. Pleuroziaceae	(accessioned in part)	1	1
22. Porellaceae	1	1	1
23. Scapaniaceae	6	1	1
24. Schistochilaceae	7	1	2
25. Solenostomataceae	5	1	1
26. Trichocoleaceae	2	1	1
Total	**539**	**41**	**76**

Gottsche (Frullaniaceae) collected by H.H. Bartlett on March 23, 1935 in Mt. Santo Tomas in the present-day Benguet Province (Figure 1). This material represents the only pre-war liverwort specimen from the CAR in the herbarium. In the post-war scenario, majority of the liverwort specimens from the region were collected in the 1970s by M. Alvarez with Saprid or A. Tandang from Mt. Pulag in Benguet Province (Alvarez & Saprid collections of 1978, 144 accessions) and Mt. Data in Mountain Province (Alvarez & Tandang collections of 1979, 329 accessions); other collections from this period are by B.C. Tan (1974-1975, four accessions), L. Co (1975, five accessions), B. Hernaez (1976, two accessions), S.R. Peñafiel (1977, one accession), B. Yabut (1978, three accessions), and F. Rodriguez (1978, one accession; refer to Figures 2 and 3). However, it should be noted that approximately 15,000 packets of bryophyte specimens are yet to be processed and accessioned; hence, the superficial decrease on the number of specimens added to the herbarium after the 1970s (Figure 2).

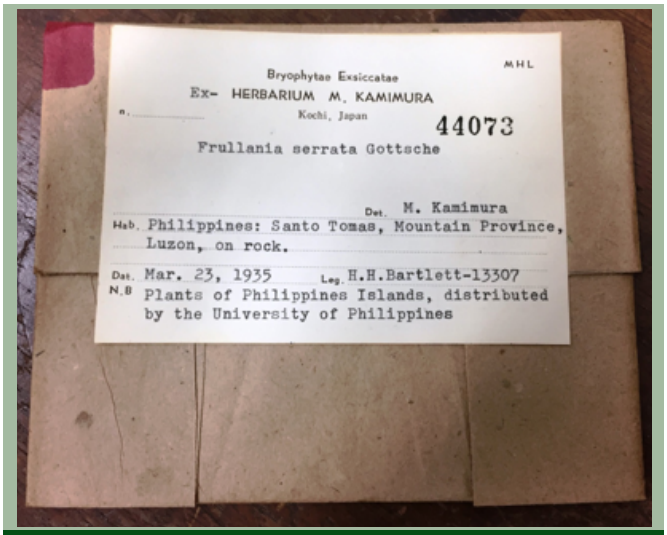

Figure 1. Herbarium label of *Frullania serrata* Gottsche (Frullaniaceae) specimen collected by H.H. Bartlett, the oldest dated collection at the Botanical Herbarium of the UPLB Museum of Natural History from the Cordillera Administrative Region.

Looking into the geographic distribution of the accessions, it is apparent that liverwort collections from the CAR in the herbarium is restricted to nine (9) localities with four (4) in Benguet, three (3) in Mountain Province, and two (2) in Ifugao (Figure 4). The majority of the collections are from Mt. Data in Mountain Province (338 accessions) and Mt. Pulag in Benguet Province (168 accessions). This reflects the extent of liverwort collection and research in the Philippines wherein liverwort collections are concentrated on relatively few mountains (see Tan & Engel, 1986). In spite of this, the examination of these collections revealed a number of new records for species with poorly known distributions within the country. Undoubtedly, additional collections from other poorly known mountains and localities in the region as well as the processing of the unaccessioned specimens would disclose more information on the ecology, richness and diversity, and distribution of liverworts in the country.

Locality and Distribution Records for Noteworthy Species

Restating, the examination of liverwort collections from the CAR deposited and accessioned in CAHUP revealed a number of new records for species with poorly known distributions within the country. Twenty (20) species are new records for the CAR and additional locality information are provided for another 18 species. Most of the determinations were done by M. Kamimura, R. Grolle, H. Inoue, N. Kitagawa, and S. Hattori. Specimens with unresolved identification were annotated accordingly. Species distribution records were checked with recent publications, including Tan and Engel (1986), So and Grolle (2000), So (2000; 2001a, b; 2003a, b), Juslén (2006), Katagiri et al. (2013), Long and Váňa (2007), Lee (2013), Sukkharak and Gradstein (2014), and Sukkharak (2015). The list of species is arranged in alphabetical order for ease of reference.

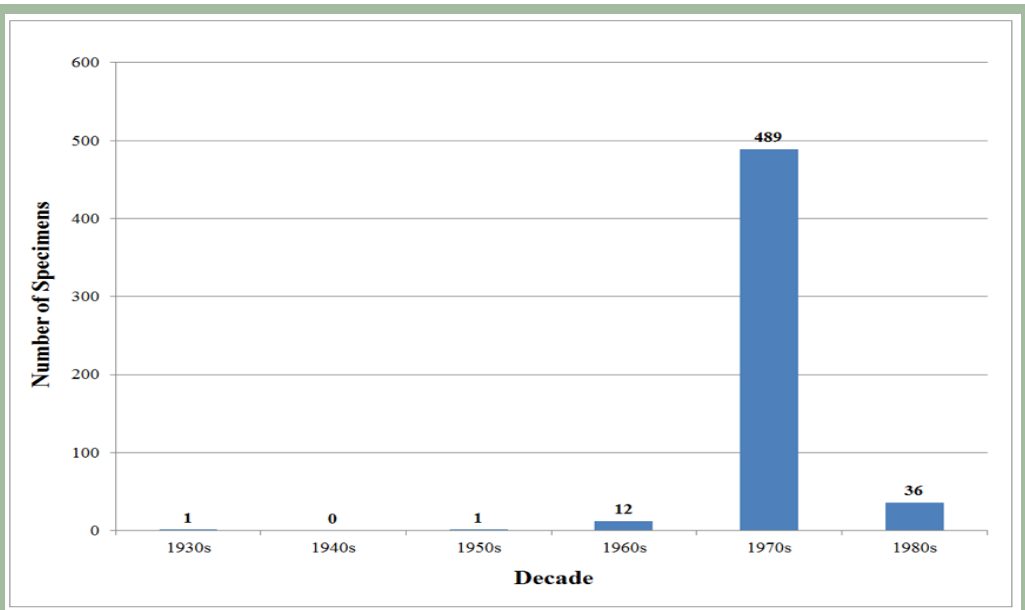

Figure 2. The number of specimens deposited and accessioned in the Botanical Herbarium of the UPLB Museum of Natural History collected in the Cordillera Administrative Region from the 1930s to 1980s. Cordillera Administrative Region.

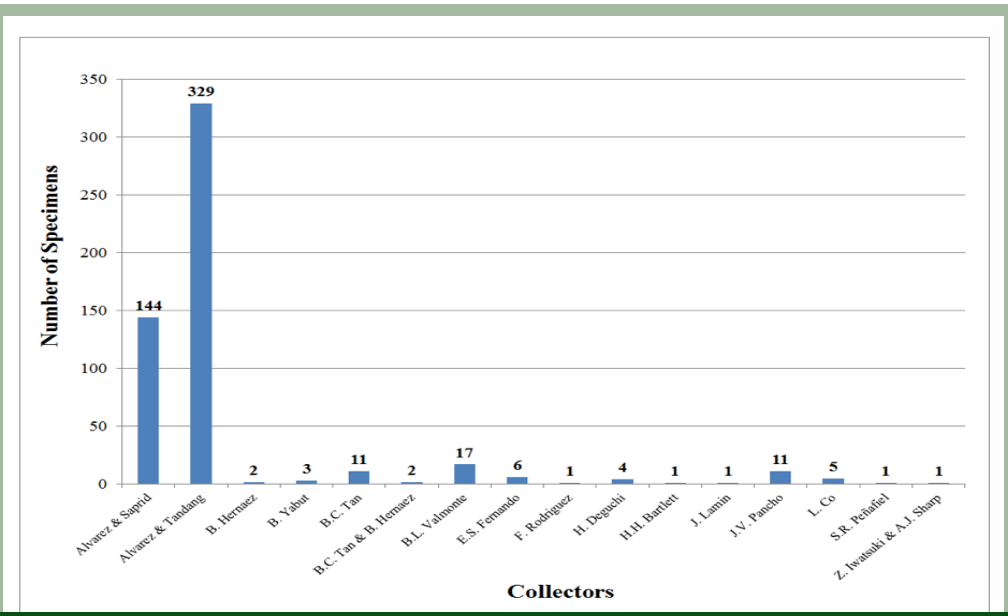

Figure 3. The collectors and number of collections from the Cordillera Administrative Region deposited and accessioned in the Botanical Herbarium of the UPLB Museum of Natural History.

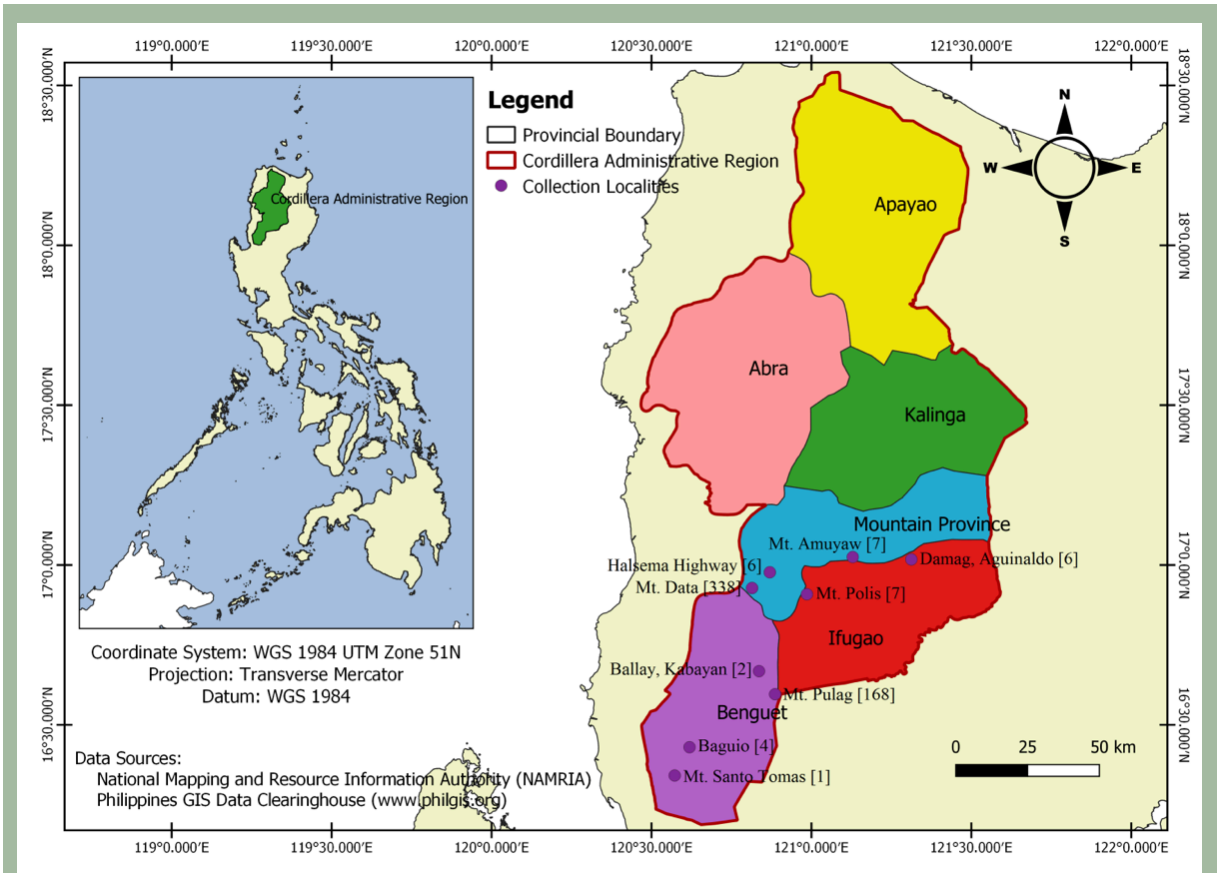

Figure 4. Geographic extent of liverwort collection in the Cordillera Administrative Region based on accessioned specimens in the Botanical Herbarium of the UPLB Museum of Natural History. Numbers in brackets indicate the number of specimens collected from each locality.

New Records for the Cordillera Administrative Region

Bazzania ceylanica (Mitt.) Steph., Bot. Jahrb. Syst. 23(1/2, 3): 306, 1896. [Lepidoziaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78592*, in mossy forest, with *Lepidozia trichodes*, 30 March 1978, *Alvarez & Saprid 0-78260*. This species was previously reported in the country from Luzon without specific locality (Miller et al., 1983; Tan & Engel, 1986).

Bazzania japonica (Sande Lac.) Lindb., Acta Soc. Sci. Fenn. 10: 224, 1872 [1873]. [Lepidoziaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78493*. MOUNTAIN PROVINCE, in mossy forest, 2,300 m, 11 June 1965, *J.V. Pancho 5263*. The Philippine distribution of this Asiatic species was earlier reported from Batan Island (Inoue, 1965; Tan & Engel, 1986; see also Bakalin, 2016 and Pócs & Ninh, 2005). The collections reported here represent the first record of this species in Luzon Island.

Bazzania merrillana (Steph.) Inoue ex Bonner, Index Hepat. 3: 359, 1963. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along trail to weather station, 17 May 1979, *Alvarez & Tandang 0-79452*, in tropical rainforest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79507*, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79724*, in tropical rainforest along trail to weather station, with *Mastigophora diclados, Plagiochila sp.*, and *Metzgeria sp.*, 17 May 1979, *Alvarez & Tandang 0-79457*. Previous known records of this species in the country include Mt. Mariveles (Bataan) and Mt. Makiling (Laguna and Batangas) in Luzon, Mt. Halcon in Mindoro, Mt. Kanlaon (Negros Occidental) in Negros, and Mt. Hilong-Hilong (Agusan del Norte, Agusan del Sur, and Surigao del Sur) and Mt. Apo (Cotabato, Davao City, and Davao del Sur) in Mindanao (Tan & Engel, 1986).

Bazzania ovistipula (Steph.) Abeyw., Ceylon J. Sci., Biol. Sci. 2(1): 45, 1959. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, along trail to mossy forest, 17 May 1979, *Alvarez & Tandang 0-79638*. The earlier Philippine record of this species is from Mt. Halcon in Mindoro (Kitagawa, 1973; Tan and Engel, 1986); the collection reported here extends the local distribution of this species to Luzon Island.

Bazzania pectinata (Lindenb. & Gottsche) Schiffn., Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 60(2): 259, 1893. [Lepidoziaceae]—MOUNTAIN PROVINCE, in mossy forest, 2,300 m, 11 June 1965, *J.V. Pancho 5278*. The local distribution of this tropical Asiatic species is previously known from Manila in Luzon and Mt. Halcon in Mindoro (Tan & Engel, 1986; see also Khotimperwati et al., 2018).

Ceratolejeunea belangeriana (Gottsche) Steph., Sp. Hepat. (Stephani) 5: 396, 1913. [Lejeuneaceae]—IFUGAO PROVINCE, Aguinaldo Municipality, Damag District, on boulder along stream in forest, ca. 800-900 m alt., 5 February 1984, *E.S. Fernando 367*. This paleotropical species was earlier reported in the country from Mt. Makiling (Laguna and Batangas), Mt. Banahao (Laguna and Quezon Province), and Mt. Bulusan (Sorsogon Province) in Luzon (Tan & Engel, 1986; see also Pócs, 2011).

Cheilolejeunea trifaria (Reinw., Blume & Nees) Mizut., J. Hattori Bot. Lab. 27:132, 1964. [Lejeuneaceae]—IFUGAO PROVINCE, Aguinaldo Municipality, Damag District, on roots of fern growing in boulder along stream in forest, ca. 800-900 m alt., 5 February 1984, *E.S. Fernando 364*, on decaying tree branches along stream in forest, ca. 800-900 m alt., 5 February 1984, *E.S. Fernando 377*. This pantropical species is previously known in the country from Mt. Banahao (Laguna and Quezon Province) in Luzon (Tan & Engel, 1986; see also Zhu et al., 2002).

Frullania hasskarliana Lindenb., Syn. Hepat. 3: 453, 1845. [Frullaniaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78523*. This tropical Asiatic species was previously reported in the Philippines by Jack and Stephani (1892) with vague locality information (see also Tan & Engel, 1986). Reported here is the first specific locality information for this species in the country.

Gottschelia schizopleura (Spruce) Grolle, J. Hattori Bot. Lab. 31: 16, 1968. [Cephaloziellaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest, 2,300 m, 11 June 1965, *J.V. Pancho 5030*, in tropical forest along roadside to Nandupit, 30 March 1978, *Alvarez & Saprid 0-78240*, in tropical forest along trail to summit, with *Jackiella javanica*, 31 March 1978, *Alvarez & Saprid 0-78546*. MOUNTAIN PROVINCE, Mt. Data, in tropical

rainforest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79264*. This paleotropical species was first reported in the Philippines by Grolle (1968b) with non-specific locality information (see also Long & Váňa, 2007). The collections reported here represent the first specific localities of this species within the country.

Jackiella javanica Schiffn., Hep. Fl. Buitenzorg: 212, 1900. [Jackiellaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along roadside to Nandupit, with Jungermannia sp., 30 March 1978, *Alvarez & Saprid 0-78241*, in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78472*. MOUNTAIN PROVINCE, Mt. Data, in tropical forest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79510*. The presence of this Asiatic species in the Philippines was reported by Inoue (1974) and Piippo (1985) with non-specific locality information (see also Tan & Engel, 1986 and Váňa, 1992). Reported here are the first specific localities of this species within the Philippines.

Lepidozia cladorhiza (Reinw., Blume & Nees) Nees, Syn. Hepat. 2: 210, 1845. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79541*, on humus in *Lithocarpus* forest, elevation about 2,000 m, 7 March 1980, H. Deguchi s.n. This tropical Asiatic species was previously reported in the Philippines from Mt. Banahao (Laguna and Quezon Province) in Luzon, Mt. Kanlaon (Negros Occidental) in Negros, and Mt. Apo (Cotabato, Davao City, and Davao del Sur) in Mindanao (Tan & Engel, 1986).

Lepidozia trichodes (Reinw., Blume & Nees) Nees, Syn. Hepat. 2: 203, 1845. [Lepidoziaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in forest 5 km from camp, 2,300 m, 11 June 1965, *J.V. Pancho 5346*. MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along trail to weather station, 17 May 1979, *Alvarez & Tandang 0-79361*, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79669*. Previous known Philippine localities for this Asiatic species are Batan Island, Mt. Mariveles (Bataan) and Mt. Makiling (Laguna and Batangas) in Luzon, and Mt. Apo (Cotabato, Davao City, and Davao del Sur) in Mindanao (Tan & Engel, 1986).

Mastigolejeunea humilis (Gottsche) Schiffn., Hepat. (Engl.-Prantl): 129, 1893. [Lejeuneaceae]—BENGUET PROVINCE, Baguio City, Pacdal Nursery, 29 March 1978, *Alvarez & Saprid 0-78206*. Earlier Philippine records for this paleotropical species include Nueva Viscaya, Montalban (Rizal), Mt. Banahao (Laguna and Quezon Province), and Mt. Malinao (Albay) in Luzon, Iloilo Province in Panay, Samar, Bukidnon Province in Mindanao, and Tawi-Tawi (Sukkharak & Gradstein, 2014; Tan & Engel, 1986).

Microlejeunea ulicina (Taylor) Steph., Hedwigia 29(2): 88, 1890. [Lejeuneaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in mossy forest near peak, 13 May 1982, *Bing L. Valmonte 23*. This species was previously reported from Mt. Banahao (Laguna and Quezon Province) and Mt. Bulusan (Sorsogon Province) in Luzon (Tan & Engel, 1986 as *Lejeunea ulicina*).

Nowellia curvifolia (Dicks.) Mitt., Nat. hist. Azores: 321, 1870. [Cephaloziaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78533*. This species was first reported in the Philippines by Grolle (1968a) and is known to occur in the oceanic parts of eastern Canada and USA, from the Azores and Britain to Eastern Europe, in the coastal areas of Siberia, in East Asia, and in the high mountains of Central and South America and Southeast Asia (Pócs et al., 2012). *Nowellia curvifolia* is previously known in the Philippines without specific locality information (see Tan & Engel, 1986); reported here is the first specific locality in the country.

Plagiochila renitens (Nees) Lindenb., Sp. Hepat. (Lindenberg) 2-4: 90, 1840. [Plagiochilaceae]—MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79266*. The local distribution of this tropical Asiatic species is until recently known only from Mt. Apo and Mt. Batangan in Mindanao (Tan & Engel, 1986); the collection reported here extends the local distribution of this species to Luzon Island.

Plagiochila teysmannii Sande Lac., Plagiochila Sandei: 6, 1856. [Plagiochilaceae]—MOUNTAIN PROVINCE, Mt. Amuyaw, Barlig side, on pine forest with patches of mossy forest (5500-6000 ft. elev.), 28-29 December 1986, *B.C. Tan s.n*. This tropical Asiatic species is hitherto known only from Mt. Malasimbo in Mindoro and General Santos City in Mindanao (So, 1999; Tan & Engel, 1986). Reported here is the first known locality of this species in Luzon Island.

Scapania javanica Gottsche, Natuurk. Tijdschr. Ned.-Indië 4: 575, 1853. [Scapaniaceae]—IFUGAO PROVINCE, Mt. Polis, in tropical forest, 2,500 m, 6 August 1965, *J.V. Pancho 4784*. This tropical Asiatic species is heretofore known from Luzon without specific locality information (Tan & Engel, 1986). The collection reported provides the first specific locality for this species in the country.

Solenostoma tetragonum (Lindenb.) R.M. Schust. ex Váňa & D.G.Long, Nova Hedwigia 89 (3/4): 509, 2009. [Solenostomataceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical rainforest along roadside to Nandupit, 30 March 1978, *Alvarez & Saprid 0-78235*. IFUGAO PROVINCE, Mt. Polis, in field, 1,700 m, 7 August 1976, *B. Hernaez 0-31*; Aguinaldo Municipality, Damag District, on boulder along river in forest, ca. 800-900 m alt., 5 February 1984, *E.S. Fernando 369*. The occurrence of this Asiatic species in the Philippines was reported by Inoue & Miller (1965 as *Plectocolea tetragona*) and by Tan & Engel (1986 as *Jungermannia tetragona*) with non-specific locality information (see also Váňa & Long, 2009). The collections cited here represent the first specific localities of the species in the country.

Wettsteinia inversa (Sande Lac.) Schiffn., Ann. Jard. Bot. Buitenzorg, suppl. 2: 45, 1898. [Adelanthaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78492*. MOUNTAIN PROVINCE, Mt. Amuyaw, Barlig side, on mossy forest (6500-7000 ft. elev.), 28-29 December 1986, *B.C. Tan s.n.*, on mossy forest near summit (8000-8600 ft. elev.), 28-29 December 1986, *B.C. Tan s.n.*; Mt. Data, 1980, *H. Deguchi s.n.* This tropical Asiatic species thrives in montane habitats across its range and is previously known in the Philippines from Mt. Kanlaon in Negros (Aryanti & Gradstein, 2007; Tan & Engel, 1986). The collections reported here extend the local distribution of this species to Luzon Island.

Species with Additional Locality Information

Bazzania javanica (Sande Lac.) Schiffn., Consp. Hepat. Arch. Ind.: 163, 1898. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79673, 0-79767*. New to Mt. Data. This species was previously reported from Mt. Pulag (Benguet) in Luzon and Mindanao (Tan & Engel, 1986).

Bazzania praerupta (Reinw., Blume & Nees) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4(13): 414, 1877. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79775*, with Bazzania japonica, *Alvarez & Tandang 0-79532*. New to Mt. Data. The species is known previously from Mt. Pulag (Benguet) and Mt. Mariveles (Bataan) in Luzon (Tan & Engel, 1986).

Bazzania tridens (Reinw., Blume & Nees) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4(13): 415, 1877. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along trail to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79254*, in tropical rainforest along trail to weather station, *Alvarez & Tandang 0-79353*, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79623*. New to Mt. Data. Earlier recorded in the Philippines from Batan Island and Mt. Pulag (Benguet), Mt. Makiling (Laguna and Batangas), and Mt. Banahao (Laguna and Quezon Province) in Luzon (Tan & Engel, 1986).

Bazzania uncigera (Reinw., Blume & Nees) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4(13): 415, 1877. [Lepidoziaceae]—MOUNTAIN PROVINCE, Mt. Data, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79739*, in tropical rainforest along trail to weather station, with *Bazzania tridens*, 17 May 1979, *Alvarez & Tandang 0-79453*. New to Mt. Data. Previous known localities are Mt. Pulag (Benguet), Mt. Malinao (Albay), and Mt. Mayon (Albay) in Luzon and Mt. Apo (Cotabato, Davao City, and Davao del Sur) and Mt. Kabatuan (Surigao del Norte) in Mindanao (Tan & Engel, 1986).

Frullania philippinensis Steph., Sp. Hepat. (Stephani) 4: 468, 1911. [Frullaniaceae]—MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79292*. New to Mt. Data. The Philippine distribution of this species is hitherto known only from Mt. Pulag in Benguet Province (Tan & Engel, 1986).

Frullania serrata Gottsche, Syn. Hepat. 3: 453, 1845. [Frullaniaceae]—IFUGAO PROVINCE, Mt. Polis, in field, 1,700 m, 7 August 1976, *B.F. Hernaez 0-17*. New to Mt. Polis. This species is previously recorded in the Philippines from Mt.

Santo Tomas (Benguet), Mt. Pulag (Benguet), and Mt. Banahao (Laguna and Quezon Province) in Luzon, Cuernos de Negros (Negros Oriental) in Negros, and Mindanao (Tan & Engel, 1986).

Lepidozia fauriana Steph., Sp. Hepat. (Stephani) 3: 631, 1909. [Lepidoziaceae]—IFUGAO PROVINCE, Aguinaldo Municipality, Damag District, on large boulder along a river in forest, ca. 800-900 m alt., 5 February 1984, *E.S. Fernando 366*. New to Ifugao. This species was reported previously from Mt. Data (Mountain Province), Mt. Pulag (Benguet), and Mt. Mariveles (Bataan) in Luzon and Mt. Kanlaon (Negros Occidental) in Negros (Tan & Engel, 1986).

Marchantia paleacea Bertol., Opusc. Sci. 1: 242, 1817. [Marchantiaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), along roadside in mossy forest, 29 March 1979, *B.C. Tan 75-181*. MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along trail to weather station, 17 May 1979, *Alvarez & Tandang 0-79397*. New to Mt. Pulag and Mt. Data. Previous locality records for this species include Baguio City (Benguet) and Lucban Municipality (Quezon Province) in Luzon (Tan & Engel, 1986).

Mastigophora diclados (Brid. ex F.Weber) Nees, Naturgesch. Eur. Leberm. 3: 18, 1838. [Mastigophoraceae]—MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79279*, in tropical rainforest along trail to weather station, 18 May 1979, *Alvarez & Tandang 0-79460*, along trail to mossy forest, with *Bazzania merrillana*, 18 May 1979, *Alvarez & Tandang 0-79628*. New to Mt. Data. This species is widespread in the Philippines and is known from Mt. Pauai (Benguet), Mt. Pulag (Benguet), Mt. Pinatubo (Zambales), and Mt. Makiling (Laguna and Batangas) in Luzon, Mt. Halcon and Mt. Ilong in Mindoro, Cuernos de Negros (Negros Oriental) and Mt. Kanlaon (Negros Occidental) in Negros, and Misamis, Mt. McKinley (Davao City, Davao del Sur), and Mt. Apo (Cotabato, Davao City, and Davao del Sur) in Mindanao (Tan & Engel, 1986).

Plagiochila frondescens (Nees) Lindenb., Sp. Hepat. (Lindenberg) 2-4: 52, 1840. [Plagiochilaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1979, *Alvarez & Saprid 78513*. New to Mt. Pulag. Earlier Philippine records are from Mt. Data (Benguet), Mt. Banahao (Laguna and Quezon Province), Lucban and Tayabas Municipalities (Quezon Province) in Luzon, and Cuernos de Negros and Lake Balinsasayao (Negros Oriental) in Negros (Tan & Engel, 1986).

Plagiochila gracilis Lindenb. & Gottsche, Syn. Hepat. 5: 632, 1847. [Plagiochilaceae]—BENGUET PROVINCE, Kabayan Municipality, Ballay, in mossy forest around Lake Talbayog (Tabeyoc), ca. 7,000 ft. elev., 25 October 1985, *B.C. Tan & B. Hernaez s.n*. New to Benguet. Previously known records in the Philippines are from Mt. Amuyaw and Mt. Data in Mountain Province (So, 2001b; Tan & Engel, 1986).

Plagiochila junghuhniana Sande Lac., Ned. Kruidk. Arch. 3: 416, 1854. [Plagiochilaceae]—MOUNTAIN PROVINCE, Mt. Data, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79627*. New to Mt. Data. Earlier known Philippine localities for this species include Mt. Santo Tomas (Benguet) and Mt. Makiling (Laguna and Batangas) in Luzon, Polillo Islands, Cuernos de Negros and Lake Balinsasayao (Negros Oriental) in Negros, Mt. Palacio (Butuan) and General Santos City in Mindanao (So, 2001b; Tan & Engel, 1986 as *Plagiochila massalongoana*).

Plicanthus hirtellus (F.Weber) R.M. Schust., Nova Hedwigia 74(3/4): 492, 2002. [Anastrophyllaceae]—MOUNTAIN PROVINCE, Mt. Data, in tropical rainforest along trail to weather station, 17 May 1979, *Alvarez & Tandang 0-79405*, in tropical rainforest along roadside to FORI Station, 17 May 1979, *Alvarez & Tandang 0-79198*, with *Mastigophora diclados* and *Plagiochila semidecurrens*, 17 May 1979, *Alvarez & Tandang 0-79512*, along trail to mossy forest, 17 May 1979, *Alvarez & Tandang 0-79558*. New to Mt. Data. The occurrence of this species in the Philippines particularly in Mt. Pulag was reported by Bonner (1963; as *Chandonanthus fragillimus* Steph.). *Plicanthus hirtellus* is known to occur in high elevations in the Paleotropics (Aryanti & Gradstein, 2007; Váňa & Piippo, 1989).

Porella javanica (Gottsche) Inoue, J. Hattori Bot. Lab. 30: 60, 1967. [Porellaceae]—IFUGAO PROVINCE, Mt. Polis, in tropical forest, 2,500 m, 6 August 1965, *J.V. Pancho 4713*. New to Mt. Polis. Heretofore known in the Philippines from Bontoc, Mountain Province (Hattori, 1975; Tan & Engel, 1986).

Schistochila aligera (Nees & Blume) J.B.Jack & Steph., Hedwigia 31(1): 12, 1892.

[Schistochilaceae]—MOUNTAIN PROVINCE, on oak forest, 2,300 m, 11 June 1965, *J. Lamin 1011*; Mt. Data, along trail to mossy forest, 18 May 1979, *Alvarez & Tandang 0-79797*. New to Mt. Data. Previously known in the Philippines from Mt. Pulag (Benguet), Mt. Mariveles (Bataan), Baler (Aurora), Mt. Makiling (Laguna and Batangas), and Mt. Banahao (Laguna and Quezon Province) in Luzon, Mt. Guiting-Guiting (Romblon) in Sibuyan, Mt. Silay (Negros Occidental) in Negros, and Mt. Lumot (Misamis Oriental) and Mt. Apo (Cotabato, Davao City, and Davao del Sur) in Mindanao (So, 2003a; Tan & Engel, 1986 as *Paraschistochila aligera*).

Syzygiella securifolia (Nees) Inoue, J. Hattori Bot. Lab. 46: 232, 1979. [Adelanthaceae]—MOUNTAIN PROVINCE, Mt. Amuyaw, Barlig side, on mossy forest near summit (7000-8000 ft. elev.), 28-29 December 1986, *B.C. Tan s.n.* New to Mt. Amuyaw. Heretofore known in the Philippines from Mt. Data in Mountain Province (Tan & Engel, 1986).

Thysananthus aculeatus Herzog, Ann. Bryol. 4: 89, 1931. [Lejeuneaceae]—MOUNTAIN PROVINCE, Mt. Data, in forest, 7,000 ft., 4 November 1977, *S.R. Peñafiel 0-771212*. New to Mt. Data. Previous Philippine records of this species include Mt. Santo Tomas (Benguet) and Mt. Banahao (Laguna and Quezon Province) in Luzon and Mt. Urdaneta (Agusan del Norte) in Mindanao (Sukkharak, 2015; Tan & Engel, 1986).

Trichocolea pluma (Reinw., Blume & Nees) Mont., Voy. Bonite, Bot. 1: 238, 1846. [Trichocoleaceae]—BENGUET PROVINCE, Mt. Pulog (Pulag), in tropical forest along trail to summit, 31 March 1978, *Alvarez & Saprid 0-78448-B, Alvarez & Saprid 0-78491-B*. New to Mt. Pulag. In the Philippines, this species has been previously reported from Mt. Iraya in Batan Island, Mt. Data (Mountain Province), Mt. Makiling (Laguna and Batangas), Majayjay Municipality (Laguna), and Lucban and Tayabas Municipalities (Quezon Province) in Luzon, Mt. Halcon in Mindoro, Mt. Salakot in Palawan, Cuernos de Negros (Negros Oriental) and Mt. Kanlaon (Negros Occidental) in Negros, and Mt. Apo (Cotabato, Davao City, and Davao del Sur) in Mindanao (Katagiri et al., 2013; Tan & Engel, 1986).

Conclusions

In recent times, the role of natural history collections as a major source of information not only for taxonomic and systematic research but also for biodiversity assessments and planning (e.g. O'Connell et al., 2004; Ponder et al., 2001; Ward, 2012) and monitoring changes in species distribution range (e.g. Allen et al., 2001; Boakes et al., 2010), phenological shifts (e.g. Miller-Rushing et al., 2006; Robbirt et al., 2010), temporal changes in the community level (e.g. Magurran et al., 2010), and species declines (e.g. Shaffer et al., 1998) including recommendations in improving its use on ecological or environmental research (e.g. Pyke & Ehrlich, 2010) has been emphasized. Hence, the information derived from records of accessioned specimens coupled with data resulting from extensive and systematic fieldwork may be incorporated and used as a robust data set in understanding bryophyte diversity and distribution in the CAR. The conversion of forests into areas for human settlement and farming is, among others, regarded as the main cause of decline in bryophyte diversity in the East and Southeast Asia (Tan, 2000). In the CAR, this is exemplified by the case of Mt. Santo Tomas where a dramatic decrease (>50%) in moss species richness from 175 species in 1939 to less than 80 species in the 1990s has been observed (Sastre-De Jesus & Tan, 1995). Many areas across the region constantly face this threat such as the Mt. Pulag National Park (Fernando & Cereno, 2010) and Mt. Data National Park (Fernando et al., 2008). Additionally, a number of conservation areas remains bryologically understudied such as Mt. Amuyaw which is regarded as one of the eight (8) hotspots of moss diversity in East and Southeast Asia (Tan, 2000; Tan & Iwatsuki, 1999), Balbalasang-Balbalan National Park (Malabrigo, 2013), and the Apayao Lowland Forest (CI-DENR-PAWB-Haribon, 2006).

Recommendations

With the current state of bryophyte collection and research in the CAR, the following are recommended: 1) conduct inventories and examination of herbarium specimens from other herbaria with sizable number of materials from the region such as the Philippine National Herbarium (PNH) and the Jose Vera Santos Memorial Herbarium of the University of the Philippines Diliman (PUH); and 2) carry out extensive and systematic collection work in the region particularly in areas of high conservation value.

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