



## Article

# Liverwort Diversity in Cambodia: New Records Show There Is Still Much to Learn

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**Abstract:** In Southeast Asia, Cambodia is one of the least studied countries in terms of liverwort diversity. A partial study of about 500 specimens gathered from 2009 to 2013 yielded 66 species new to the country, which raised the number of known species in Cambodia to 210, a number still far below expectations. Twenty genera are new to the country, including *Dumortiera*, *Jackiella*, and *Lepidozia* that are very common and characteristic elements of the mesophytic tropical flora in Asia. The distribution within the country of already known species is supplemented with new data. Two new combinations are proposed: *Plectocolea polyrhizoides* (Grolle) Bakalin et S.S. Choi comb. nov. and *Plectocolea longifolia* (Schiffn.) Bakalin et S.S. Choi comb. nov.

**Keywords:** liverworts; Hepaticae; Southeast Asia; taxonomic diversity; Indochina; cryptogamic plants

## 1. Introduction

Cambodia is a small country in Southeast Asia and is bordered by Laos in the north, Vietnam in the east, and Thailand in the west. The southern part of the country opens to the Gulf of Thailand (Gulf of Siam). The area of Cambodia is 181,040 square kilometers, which is slightly less than that of Syria (185,180) and slightly larger than that of Uruguay (176,220), or twice lesser than Germany (357,592). A list of the liverworts of Cambodia was published in 2020 by Ingerpuu et al. [1] under the title “The Angkor Wat Kingdom-liverworts from Cambodia”. However, the surroundings of Angkor Wat are too dry for many liverwort species to be found in the country, and other provinces contribute more to the taxonomic diversity of the country. Cambodia is divided into 25 administrative provinces, which have been studied very unevenly. According to the published list [1], out of 138 species, 112 species are known in the province of Kampot, Koh Kong—55, Siem Reap—27, Preah Sihanouk—4, Kampong Thow—1, Modulkiri—1, and Pursat—1. Several species are provided in the checklist without specifying the province.

In general, the country has terrain ranging from plains to hilly landscapes. The western part of the country is bordered by the Cardamom Mts., with the highest point of Cambodia being Mt. Oral (1813 m a.s.l.). Southward of the Cardamom Mts. is the Elephant Range, stretching with a few peaks surpassing 1000 m a.s.l. (including the widely known Mount Bokor). The eastern part of the country possesses the spurs of the Southern Annam Mountains, with the highest peaks at 1100–1500 m above sea level. In terms of relief, Cambodia is much smoother than its neighbors in Indochina: Laos, Thailand, and Vietnam, where the mountains in the northern (and more humid) parts either almost reach, or slightly exceed, 3000 m above sea level. Therefore, while generally agreeing with the authors of the Cambodian liverwort checklist [1] that the 138 species known from Cambodian territory do not reflect the actual diversity, we nevertheless considered it hardly appropriate to compare the potential diversity of Cambodian liverworts with Thailand or, especially, Vietnam.

The diversity of Cambodian liverworts has been studied very unevenly, not only in the territorial sense but also in the systematic sense. Noteworthy are the low numbers of species



**Citation:** Bakalin, V.A.; Choi, S.S.; Park, S.J. Liverwort Diversity in Cambodia: New Records Show There Is Still Much to Learn. *Diversity* **2023**, *15*, 241. <https://doi.org/10.3390/d15020241>

Academic Editors: Grzegorz J. Wolski and Michael Wink

Received: 20 January 2023

Revised: 6 February 2023

Accepted: 7 February 2023

Published: 8 February 2023



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known for the genera *Bazzania* (2), *Frullania* (5), *Plagiochila* (6), and *Solenostoma* s.l. (2) with the absence of recorded species from *Calypogeia*, *Riccardia*, etc. Apparently, this is because the researcher who made the greatest contribution to the knowledge of the liverworts of Cambodia, Dr. Pierre Tixier (1918–1997), was mainly interested in Lejeuneaceae.

Our studies on the liverworts of Cambodia, carried out from 2009 to 2013, resulted in collecting a significant amount of material, and revealing taxa that were not previously reported for Cambodia. The presentation of these new records is the main purpose of this account.

## 2. Materials and Methods

The materials were collected mostly by Seung Se Choi, while Vadim Bakalin took part in field research in December 2011. The distribution by province and dates of collection are shown in Table 1 and Figure 1. Some habitats are shown in Figures 2 and 3. In total, 2606 liverwort specimens were collected. Of this number, approximately 500 have been studied microscopically. Most of the specimens containing representatives of Lejeuneaceae, Plagiochilaceae, and Frullaniaceae have been studied only partially or are currently being studied together with our colleagues. There are significant difficulties in studying these families since, in many cases, there is an unclear status of the taxon and suggestions that many specimens belong to potentially new-for-science species. Since it is not known when the work with these families, as well as with other groups (where specimens are identified only to the genus [potentially new species]), will be completed, we decided to present the entire list of species that are known to date in our collection. A very small part of the species from our collection was published in the *Heteroscyphus* treatment and *Fossombronia* for Cambodia [2,3]. We list them in the below list of species but do not indicate them as new to the country.

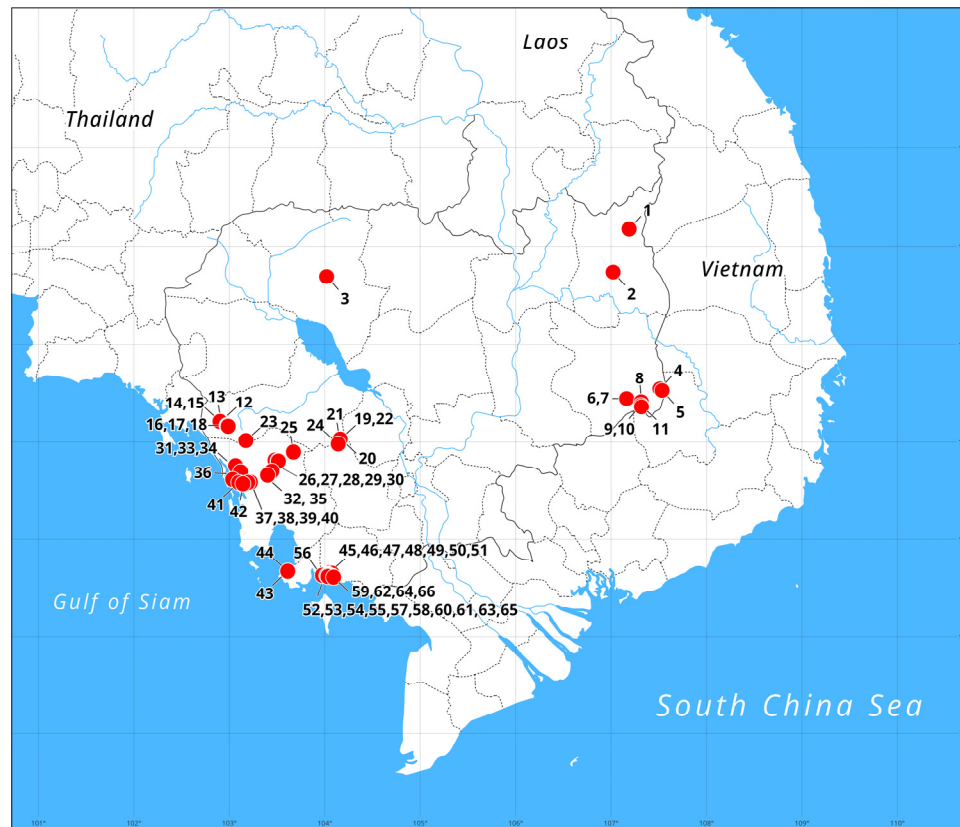


Figure 1. Collecting sites in Cambodia (in accordance to the Table 2 and the checklist).

**Table 1.** The data on collections.

Collection Dates	Province Name	Total Number of Specimens
5–8 December 2009	Koh Kong	160
10–11 December 2009	Kampot	182
13 December 2009	Pursat	9
4–7 May 2010	Kampot	246
8–9 May 2010	Koh Kong	56
15 December 2010	Stung Treng	17
16–18 December 2010	Ratankiri	60
20 December 2010	Siem Reap	2
17–20 December 2011	Modulkiri	441
22–26 December 2011	Koh Kong	551
27 December 2011	Preah Sihanouk	7
28–30 December 2011	Kampot	489
1–3 January 2012	Pursat	19
10–12 January 2013	Kampong Speu	142
15–18 January 2013	Pursat	148
22 January 2013	Kampot	77

**Table 2.** The collecting localities coordinates and their belonging to the province.

Number in the Map	Northern Latitude	Eastern Longitude	Province Name
1	14.17100000	107.1861944	Ratankiri
2	13.73147222	107.0182222	Ratankiri
3	13.68538889	104.0163611	Siem Reap
4	12.54444444	107.5086111	Modulkiri
5	12.52686111	107.5312222	Modulkiri
6	12.44194444	107.1602778	Modulkiri
7	12.44191667	107.1598333	Modulkiri
8	12.40972222	107.3127778	Modulkiri
9	12.37194444	107.3091667	Modulkiri
10	12.37091667	107.3093611	Modulkiri
11	12.35611111	107.3150000	Modulkiri
12	12.21166667	102.9100000	Pursat
13	12.21161111	102.9103889	Pursat
14	12.21044444	102.8998333	Pursat
15	12.20697222	102.8995833	Pursat
16	12.16647222	102.9731389	Pursat
17	12.16313889	102.9796111	Pursat
18	12.15813889	102.9850278	Pursat
19	12.03241667	104.1710278	Kampong Speu
20	12.02988889	104.1629722	Kampong Speu
21	12.02852778	104.1535000	Kampong Speu
22	12.02833333	104.1588333	Kampong Speu
23	12.01375000	103.1704167	Pursat
24	11.97930556	104.1378611	Kampong Speu
25	11.89722222	103.6686944	Koh Kong
26	11.81555556	103.4761111	Koh Kong
27	11.81141667	103.5187222	Koh Kong
28	11.80880556	103.5067222	Koh Kong
29	11.80527778	103.5108333	Koh Kong
30	11.80500000	103.5110000	Koh Kong
31	11.75836111	103.0619444	Koh Kong
32	11.70336111	103.4423889	Koh Kong
33	11.69644444	103.1160278	Koh Kong
34	11.69638889	103.1158333	Koh Kong
35	11.66200000	103.3984722	Koh Kong
36	11.61783000	103.0323100	Koh Kong
37	11.59694444	103.2255556	Koh Kong

Table 2. Cont.

Number in the Map	Northern Latitude	Eastern Longitude	Province Name
38	11.59158333	103.2244167	Koh Kong
39	11.59058333	103.2177778	Koh Kong
40	11.58800000	103.1910000	Koh Kong
41	11.58700000	103.0960000	Koh Kong
42	11.57447222	103.1398333	Koh Kong
43	10.67447222	103.6089722	Preah Sihanouk
44	10.67400000	103.6090000	Preah Sihanouk
45	10.66236111	104.0484444	Kampot
46	10.65900000	104.0510000	Kampot
47	10.65892000	104.0512800	Kampot
48	10.65891667	104.0512778	Kampot
49	10.65888900	104.0513890	Kampot
50	10.65230556	104.0741667	Kampot
51	10.65208333	104.0731389	Kampot
52	10.64164000	104.0304700	Kampot
53	10.64163889	104.0304722	Kampot
54	10.63341667	104.0335278	Kampot
55	10.63297222	104.0348889	Kampot
56	10.63216667	103.9730833	Kampot
57	10.62953000	104.0178600	Kampot
58	10.62952778	104.0178611	Kampot
59	10.62633000	104.0498600	Kampot
60	10.62378000	104.0273900	Kampot
61	10.62377778	104.0273889	Kampot
62	10.62333333	104.0727778	Kampot
63	10.62119444	104.0315833	Kampot
64	10.62116667	104.0783611	Kampot
65	10.62038889	104.0303889	Kampot
66	10.61269444	104.0898056	Kampot

The collection sites for the material summarized in this paper are shown on the map (Figure 1), with the numbering used in the annotation of each species after the species name; the collecting sites are marked in bold font. The geographic coordinates of each locality and the names of the provinces are given in Table 2. In addition to data on collection sites, the annotated list contains data on the elevations in m above sea level at which the species was collected and a list of field numbers for the specimens. The listed annotation categories are separated from each other by a semicolon (;). The names and nomenclature, as a rule, correspond to the World Checklist of Liverworts [4], except for the narrow generic treatment in the family Solenostomataceae, and the acceptance of the genus *Asperifolia*. The specimens cited in this paper are kept in herbarium JNU, and duplicates of the majority of specimens are in herbarium VBG. Species reported for the first time from Cambodia are marked with an asterisk. Some species are supplied with nomenclature comments. The taxa in the list are placed in alphabetical order. Some species' habits are shown in Figure 4.





**Figure 2.** Landscapes of field trips in Cambodia. (A) Mt. Samkoh in Pursat Province; (B) Virachey National Park in Rattanakiri Province; (C) Rainforest at Bokor National Park in Kampot Province; (D) Rainforest at Bokor National Park in Kampot Province; (E) Dry forest at Srae Ambel District in Koh Kong Province; (F) Small waterfall and cliffs in Bokor National Park in Kampot Province; (G) Riverbank of Tatai river in Koh Kong Province; (H) Mangrove forest in Koh Kong Province (Photo by S.S. Choi, 2009–2013).





**Figure 3.** Some habitats of liverworts in Cambodia. (A) Hanging on orchids and branches at Bokor National Park in Kampot Province; (B) On leaves at Mt. Samkos in Pursat Province; (C) On tree bark at Bokor National Park in Kampot Province; (D) On fern leaves at Bokor National Park in Kampot Province; (E) On tree roots at Bokor National Park in Kampot Province; (F) On tree bark at Phnum Krachau Pramaoy District Pursat Province; (G) Kachanh waterfall at Banlung District in Rattanakiri Province; (H) On rocks near the valley at Bokor National Park in Kampot Province (Photo by S.S. Choi, 2009–2013).





**Figure 4.** Some liverworts in Cambodia. (A) *Lobatiriccardia coronopus*; (B) *Anastrophyllum piligerum*; (C) *Mastigophora diclados*; (D) *Schistochila aligera*; (E) *Pleurozia gigantea*; (F) *Plectocolea comata*; (G) *Plagiochilium oppositum*; (H) *Plectocolea ariadne*; (I) *Zoopsis liukiensis*. (Photo by S.S. Choi, 2009–2013).

The nature environments were previously described in [1]; therefore, only a brief summary seems necessary. Cambodia is a tropical country lying approximately between 14 and 10° N and 102 and 107° E. The altitudes are not high there and rarely exceed 1300–1400 m a.s.l. Phnom Aural is the tallest peak in Cambodia (1813 m a.s.l.). Climate has

a very distinct Southeast Asian monsoon character with very minor temperature variations across the year. In Phnom Penh city (weather station on 19 m alt.), the mean monthly temperature varies from 26 to 29 °C, with 1371 mm precipitation per year with a distinct maximum from April to November [5]. In higher elevation, in Sen-Monorom (Mondulhiri Province), at a weather station situated on 695 m a.s.l., the mean monthly temperature varies from 20 to 25 °C, with 2203 mm precipitation per year and with similarly distinct summer maximum [6]. These parameters of annual precipitation in a tropical country, especially in combination with monsoon climate characteristics, suggest the dominance of xeromesophytic vegetation. Indeed, the dominant forest type is dry evergreen to semi-evergreen forests [1], changing to rain tropical forests only in the southwestern part of the country, where most liverworts are known ([1], also the present paper). Potentially taxonomically rich rain forests in the Southern Annamite mountains located in the northeastern corner of the country are still very weakly explored. The most extent of the area now covered by forests is secondary due to strong human impact (cutting, forest fires), and true primary forests are rare in Cambodia. This especially concern dry evergreen forests [1], while rain forests in the Cardamom Mountains partially belong to rare in Indochina intact rain forests [1]. Mangrove forests scattered along the sea coast were strongly disturbed and still very poorly explored, respecting bryophytes.

The highest liverwort diversity is occurred in epiphyllous habitats and on tree trunks and branches. To a lesser extent, the same should be said about moist and wet stones and cliffs near streams. Other habitats, like mesic and dry cliffs in the forests, roadsides, and decaying wood have taxonomic diversity quite low. However, such relatively liverwort-poor habitats contribute a lot to the taxonomic diversity of the country when being taken together.

### 3. Results

#### 3.1. Species List

\**Acromastigum divaricatum* (Nees) A. Evans ex Reimers—33; 289; C9299b

\**Anastrophyllum piligerum* (Reinw., Blume & Nees) Steph.—20, 25; 1213, 1719; C2057, C5360

\**Aneura pinguis* (L.) Dumort.—1; 149; C8020

\**Asperifolia indosinica* Bakalin & A.V. Troitsky—1, 13, 14, 42, 48, 50; 149, 154, 819, 893, 902, 905; C5949, C2144, C3023, C5757, C8013, C8304a

\**Bazzania appendiculata* (Mitt.) S. Hatt.—45; 872; C2317

\**Bazzania asperrima* Steph.—21; 1383; C2011, C2012

\**Bazzania callida* (Sande Lac. ex Steph.) Abeyw.—15, 45, 48; 872, 905, 1003; C2293, C5786, C8309

\**Bazzania fauriana* (Steph.) S. Hatt.—18; 1285; C2223

\**Bazzania loricata* (Reinw., Blume & Nees) Trevis.—15, 45; 872, 1003; C2564, C5935, C5938, C5940

\**Bazzania oshimensis* (Steph.) Horik.—15; 1003; C5903, C5922, C5934—The status of the taxon is questionable. It is commonly treated as a modification within the morphologically malleable *B. tridens*. However, short, sometimes indistinct, lobation and distinctly convex lobes turned toward the ventral side of the shoot (versus distinctly lobed and more or less plane leaves in *B. tridens*) may help distinguish this species. A detailed study of the status of this species, preferably using molecular methods, is needed.

\**Bazzania semiopaca* N. Kitag.—7, 20; 605, 1719; C2069, C5130—Studies of the relationships with *B. asperrima* are necessary to determine whether the depth of the leaf lobation is a feature that correlates with genetic distinctions.

*Bazzania tridens* (Reinw., Blume & Nees) Trevis.—15, 18, 19, 21, 22, 24; 526, 865, 1003, 1285, 1383, 1813; C2009, C2010, C2023, C2029, C2120, C2122, C2216, C5922

\**Bazzania uncigera* (Reinw., Blume & Nees) Trevis.—18, 19, 20; 1285, 1719, 1813; C2061, C2104, C2260

\**Calypogeia latissima* Steph.—54, 64; 938, 981; C8234, C8238, C9188



- \**Calypogeia* cf. *tosana* (Steph.) Steph.—33, 64; 289, 981; C9190, C9280—The plants are characterized by very shortly incised leaves (only observable with a microscope). The identification of the material is doubtful because plants without oil bodies were studied.
- \**Cephalozia hamatiliba* Steph.—66; 510; C9217
- \**Cephaloziella crispata* N. Kitag.—12; 816; C8346
- \**Cephaloziella microphylla* (Steph.) Douin—9; 880; Cam-76-1a-11
- \**Cephaloziella stephanii* Schiffn. ex Douin—48; 905; C8271
- \**Cephaloziella willisana* (Steph.) N. Kitag.—48; 905; C8317—The conspecificity of this taxon with *Cylindrocolea kiaerii* (based on *Jungermannia kiaeri* Austin with the type from Africa) is questionable due to commonly observed genetic differences between regional populations. Indochinese plants commonly have more transversely inserted leaves, and there is a noticeable difference in distribution.
- \**Cheilolejeunea boninensis* Mizut.—54; 938; C8248a
- \**Cheilolejeunea kitagawae* W. Ye et R.L. Zhu—48; 905; C8290a
- Cheilolejeunea trapezia* (Nees) Kachroo et R.M.Schust.—39; 363; C8032a
- \**Chiastocaulon oppositum* (Reinw., Blume & Nees) S.D.F.Patzak, M.A.M.Renner, Schäf.-Verw. & Heinrichs—15, 20; 1003, 1719; C2055, C5943, C5943
- \**Cladoradula campanigera* (Mont.) M.A.M.Renner, Gradst., Ilk.-Borg. & F.R.Oliveira-da-Silva—19, 20, 22; 526, 1719, 1813; C2098, C2100, C2101/1, C2124, C2130, C2142
- \**Cladoradula perrottetii* (Gottsche ex Steph.) M.A.M.Renner, Gradst., Ilk.-Borg. & F.R.Oliveira-da-Silva—16, 45; 872, 941; C2201, C2336
- Cololejeunea schmidtii* Steph.—8; 431; C8074b
- Conoscyphus trapezioides* (Sande Lac.) Schiffn.—53, 65; 998, 1007; C5458, C8337
- \**Cuspidatula contracta* (Reinw., Blume et Nees) Steph.—19, 20; 1719, 1813; C2057, C2059/1, C2139
- \**Denotarisia linguifolia* (De Not.) Grolle—20, 25, 49; 905, 1213, 1719; C2059, C5360, C8293
- Drepanolejeunea pentadactyla* (Mont.) Steph.—8; 431; C8074a
- \**Drepanolejeunea ternatensis* (Gottsche) Schiffn.—54; 938; C8247c
- Drepanolejeunea vesiculosa* (Mitt.) Steph.—52; 988; C8264
- \**Dumortiera hirsuta* (Sw.) Nees—6; 530; Cam-80-30-11, Cam-80-47-11
- Fossombronia japonica* Schiffn.—17; 643; C18065
- Frullania apiculata* (Reinw., Blume & Nees) Dumort.—36, 38, 47, 52, 57, 60, 63; 96, 361, 905, 998, 1034, 1065, 1073; C8175, C8176, C8176a, C8194, C8286, C8330, C8333, C8334, C9046, C9047, C9139, C9145, C9165, C9258/2, C9260, C9270, C9272
- \**Frullania gaudichaudii* (Nees & Mont.) Nees & Mont.—34; 289; C9283, C9283/2, C9283/3
- Frullania gracilis* (Reinw., Blume & Nees) Dumort.—60; 1073; C8176a
- \**Frullania serrata* Gottsche—52, 59, 63; 988, 1034; C8261, C8326, C9061
- \**Frullania trichodes* Mitt.—48; 905; C8294c
- \**Fuscocephaloziopsis catenulata* subsp. *nipponica* (S. Hatt.) Váňa & L. Söderstr.—45, 48; 872, 905; C2291, C2312, C8273, C8316, C8317—*Cephalozia nipponica* S. Hatt. may not be conspecific to *Fuscocephaloziopsis catenulata*, and should be treated as an independent species. However, we prefer not to create a new combination under *Fuscocephaloziopsis* until a specific study on this issue is performed.
- \**Fuscocephaloziopsis gollanii* (Steph.) Váňa & L. Söderstr.—48, 61, 64; 905, 981, 1073; C8199, C8277, C9186
- \**Herbertus dicranus* (Gottsche, Lindenb. et Nees) Trevis.—48; 905; C8317a
- Heteroscyphus argutus* (Nees) Schiffn.—3, 4, 6, 7, 9, 11, 14, 17, 20, 25, 26, 28, 29, 38, 51, 56, 63; 171, 232, 361, 429, 530, 605, 700, 855, 880, 869, 900, 902, 954, 1034, 1213, 1121, 1719; C2073, C2146, C2148, C2287, C3227, C5014, C5025, C5039, C5123, C5275, C5330, C5337, C5355, C5739, C5742, C8123, C8130, C9083, C9268, Cam-76-44-11, Cam-77-26-11, Cam-79-22-11, Cam-80-27-11, Cam-80-38-11, Cam-81-78-11, Cam-81-79-11, Cam-88-24-11, Cam-88-28-11
- Heteroscyphus aselliformis* (Reinw., Blume & Nees) Schiffn.—14, 54; 902, 938; C2143, C8247b
- Heteroscyphus coalitus* (Hook.) Schiffn.—2, 4, 5, 6, 7, 8, 10, 15, 18, 25, 26, 29, 32, 45, 51, 54, 55, 56, 63; 232, 304, 405, 530, 605, 688, 700, 855, 800, 872, 900, 938, 954, 962, 1003, 1213, 1285;

C2196, C2264, C2319, C2334, C3047, C5060, C5066, C5092, C5094, C5118, C5122, C5126, C5274, C5275, C5294, C5344, C5519, C5714, C5717, C5719, C5738, C5742, C5787, C5801, C5916, C5946, C8045, C8237, C9113, C9132, Cam-78-9-11, Cam-79-10-11, Cam-79-12-11, Cam-79-14-11, Cam-79-16-11, Cam-79-24-11, Cam-79-25-11, Cam-79-56-11, Cam-79-9-11, Cam-80-12-11, Cam-80-27-11, Cam-80-47-11, Cam-81-79-11, Cam-88-20-11

*Heteroscyphus pandei* S.C. Srivast. & A. Srivast.—8, 26 27; 431, 700, 800; C8089, Cam-78-9-11, Cam-88-23-11

*Heteroscyphus splendens* (Lehm. & Lindenb.) Grolle—17, 37, 45, 51, 54, 55, 62, 63, 65; 380, 872, 938, 954, 962,992,1007, 1034,1121; C2281, C2292, C5447, C5448, C5471, C5478, C5515, C5517, C5526, C5561, C5678, C8244b, C9014, C9071, Cam-87-26-11, Cam-87-33-11

*Heteroscyphus tener* (Steph.) Schiffn.—37, 65; 380, 1007; C5454, C5457, C5471, C5482, C5503, C5507, Cam-87-42-11

*Heteroscyphus zollingeri* (Gottsche) Schiffn.—8 9, 10 29, 56; 232, 700, 800, 855, 880; C5060, C5275, Cam-76-9-11, Cam-78-10-11, Cam-81-76-11, Cam-81-92-11

\**Jackiella javanica* Schiffn.—12, 14; 816, 902; C2144, C2146, C8345a

\**Kurzia gonyotricha* (Sande Lac.) Grolle—48; 905; C8314a

\**Kurzia lineariloba* Mizut.—48; 905; C8304c

*Lejeunea flava* (Sw.) Nees—7; 429; C8150c

*Lejeunea sordida* (Nees) Nees—54; 938; C8248b

\**Lepicolea yakusimensis* (S.Hatt.) S.Hatt.—25; 1213; C5372

\**Lepidozia fauriana* Steph.—18; 1285; C2250

*Leptolejeunea epiphylla* (Mitt.) Steph.—7; 429; C8144a

*Leptolejeunea balansae* Steph.—6; 361; C9247

\**Lobatiriccardia coronopus* (De Not. ex Steph.) Furuki—18; 1285; C2253

*Lopholejeunea eulopha* (Taylor) Schiffn.—54; 938; C8249a, C8250

*Lopholejeunea subfusca* (Nees) Schiffn.—54; 938; C8246a

\**Mastigolejeunea humilis* (Gottsche) Schiffn.—24; C2001

*Mastigophora diclados* (Brid. ex F. Weber) Nees—19, 20, 25, 45, 61; 872, 1073, 1213, 1719, 1813; C2064, C2139, C2356, C5361, C8207

\**Microlejeunea punctiformis* (Taylor) Steph.—54; 938; C8247b

\**Neolepidozia wallichiana* (Gottsche) Fulford & J. Taylor—16, 19, 39; 363, 941, 1813; C2104, C2134, C2203, C8028, C8029

*Notoscyphus lutescens* (Lehm. & Lindenb.) Mitt.—12, 29, 35, 45; 356, 700, 816, 872; C2327, C5201, C8353, Cam-81-122-11

\**Nowellia curvifolia* (Dicks.) Mitt.—61; 1073; C8289

\**Odontoschisma grosseverrucosum* Steph.—18; 1285; C2226, C2227

*Pallavicinia levieri* Schiffn.—3, 18, 30, 33, 35, 40, 41, 44, 63, 64; 171, 289, 981, 1034, 1285; C2196, C3091, C9083, C9190, C9280, C9298; Cam-86-9-11, Cam-78-27-11, Cam-79-11-11, Cam-79-13-11, Cam-81-102-11, Cam-83-37-11, Cam-83-42-11, Cam-83-44-11, Cam-89-5-11, Cam-89-6-11, Cam-89-7-11, Cam-90-2-11

\**Plagiochila fruticosa* Mitt.—18, 45; 872, 1285; C2250, C2311

*Plagiochila sandei* Dozy ex Sande Lac.—55; 992; C9001, C9030

\**Plagiochila subtropica* Steph.—14; 902; C2167

*Plectocolea ariadne* (Taylor ex Lehm.) Mitt.—13; 819; C5950

\**Plectocolea comata* S. Hatt.—7; 605; C5124

\**Plectocolea hasskarliana* (Nees) Mitt.—23; 509; C5950

\**Plectocolea longifolia* (Schiffn.) Bakalin et S.S. Choi comb.nov. (Basionym: *Nardia longifolia* Schiffn. Denkschriften der Kaiserlichen Akademie der Wissenschaften, Wien. Mathematisch-naturwissenschaftliche Klasse 67: 189. 1898. Sumatra. In monte Singalang, in silvis primaebis ad decliv. orient. ad terram in ripis torrentis, regio nubium, 2000 m, 24 July 1894, V. Schiffner 437 (FH; isoelectotypes G00281102!, S-B38079, not seen)—7; 605; C5120/1—The species is morphologically similar to *P. comata*, as is also mentioned in the original description by V. Schiffner. However, the name is treated as the synonym of *P. truncata* by Vána & Inoue [7].



\**Plectocolea polyrhizoides* (Grolle ex Amakawa) Bakalin et S.S. Choi comb. nov. (Basionym: *Jungermannia polyrhizoides* Grolle ex Amakawa Journal of the Hattori Botanical Laboratory 29: 262, f. 7. 1966. Holotype: Nepal, Poelt H145 JE! Isotype HIRO!)—7, 43; 55, 605; C5120, C5125, C5253, C5254—The species is treated as *Solenostoma polyrhizoides* (Grolle ex Amakawa) Váňa & D.G. Long. Recent literature showed [8], however, that if the narrow genus concept is adopted in Solenostomataceae, then this taxon should be transferred to *Plectocolea*.

\**Plectocolea rosulans* (Steph.) S. Hatt.—15; 1003; C5910, C5912, C5916

\**Plectocolea setulosa* Herzog—14; 902; C2147

\**Plectocolea sikkimensis* (Schiffn. ex Steph.) Bakalin—48; 905; C8317

\**Plectocolea tetragona* (Lindenb.) Amakawa—2, 15, 35, 43; 55, 304, 356, 1003; C3051/2, C5227, C5250, C5254, C5799, C5913

*Plectocolea truncata* (Nees) Herzog—31, 50; 65, 893; C5244, C5749

\**Pleurozia gigantea* (F. Weber) Lindb.—25; 1213; C5362, C5369

\**Plicanthus birmensis* (Steph.) R.M. Schust.—48, 54, 58; 905, 938, 1065; C8244b, C8317, C9171

\**Ptychanthus striatus* (Lehm. et Lindenb.) Nees—15; 1003; C5920

\**Radula anceps* Sande Lac.—13; 819; C5914

*Radula acuminata* Steph.—7; 429; C8144b

\**Radula apiculata* Sande Lac. ex Steph.—15; 1003; C5801

\**Radula cavifolia* Hampe—19; 1813; C2139

*Radula javanica* Gottsche—18; 1285; C2279

\**Schistochila aligera* (Nees et Blume) J.B. Jack et Steph.—18; 1285; C2268, C2272

\**Schizophyllopsis bidens* (Reinw., Blume & Nees) Váňa & L. Söderstr.—46; 905; C8290

*Spruceanthus polymorphus* (Sande Lac.) Verd.—39; 363; C8027b

\**Telaranea major* (Herzog) J.J. Engel et G.L. Merr.—33; 289; C9297

*Thysananthus aculeatus* Herzog—39; 363; C8330b

*Thysananthus spathulistipus* (Reinw., Blume et Nees) Lindenb.—55; 992; C9035

\**Tricholepidozia neesii* (Lindenb.) E.D. Cooper—16, 26; 700, 941; C2203, Cam-88-20-11

*Trichocolea pluma* Dumort.—18; 1285; C2248

\**Zoopsis liukuensis* Horik.—39, 45; 363, 872; C2320, C8035

### 3.2. Statistics

Data on the occurrence of 100 species in Cambodia are given. Of these, 66 species are listed for the country for the first time. The following genera are listed for the first time for the country: *Anastrophyllum*, *Asperifolia*, *Calypogeia*, *Cephalozia*, *Cephaloziella*, *Cuspidatula*, *Denotarsia*, *Dumortiera*, *Fuscocephaloziopsis*, *Jackiella*, *Lepidozia*, *Lobatirricardia*, *Mastigolejeunea*, *Neolepidozia*, *Nowellia*, *Odontoschisma*, *Pleurozia*, *Schistochila*, *Tricholepidozia*, and *Zoopsis*.

## 4. Discussion

In the list, we presented species that are both new to the country and already known. This was done to clarify the distribution of species within the country since the knowledge of the latter is very poor. In total, 20 new genera are newly recorded for the country, among which are *Dumortiera*, *Jackiella*, and *Lepidozia*. These must be here, as it is impossible to imagine a mesophytic tropical flora in Asia where these genera would not be distributed. All newly recorded taxa should be expected in the country, taking into account their known occurrence in Vietnam and Thailand.

The number of species listed has a questionable status. For instance, *Plectocolea longifolia* and *Cephaloziella willisana* are currently not recognized as ‘good’ species by most researchers. In contrast, we consider these taxa to be good species, especially taking into account that several recent taxonomic revisions based on an integrative approach (combining morphological, molecular, ecological, and geographical methods) led to restoring of forgotten names and revealing new-for-science species, showing that (a) liverworts sometimes have smaller ranges than hitherto assumed and, (b) “semicryptic” taxa are not

at all uncommon in Asian liverworts. Recent examples of the latter in Pacific Asia include *Blepharostoma* [9], *Ptilidium* [10], *Tetralophozia* [11], and several other genera.

It is difficult to predict how many more known liverwort species will be in Cambodia if purposeful research is carried out. However, it is clear that knowledge of liverwort diversity is only at the initial stage in the country. In addition to understanding the general diversity, it is necessary to focus on studying the patterns of species distribution throughout the country, which will help form a coherent and adequate concept of the history of the formation (=florogenesis) of the Indochinese liverwort flora.

## 5. Conclusions

The previously known data on liverwort occurrence in the country were available from 7 provinces, with only two of them counting more than 50 known taxa (Kampot, Koh Kong). The present list provides data on liverworts collected in 8 provinces, including two with the first data published (Stung Treng and Kampong Speu). Therefore, the liverworts are now known from 9 provinces, and this is still quite far from the 25 provinces in the administrative subdivision of Cambodia. We suggest that future research should go the following two ways: (1) exploration of previously unstudied provinces and (2) conducting of research in potentially liverwort promising areas in Southern Annamite Range spurs, Cardamom Range and Elephant Mountains, although these areas were already explored before.

**Author Contributions:** Conceptualization, V.A.B. and S.S.C.; methodology, V.A.B., S.S.C.; validation, S.S.C. and S.J.P.; formal analysis, V.A.B. and S.S.C.; investigation, V.A.B., S.S.C. and S.J.P.; resources, V.A.B., S.S.C.; data curation, S.S.C. and S.J.P.; writing—original draft preparation, all coauthors; writing—review and editing, V.A.B. and S.S.C.; visualization, V.A.B. and S.S.C.; supervision, V.A.B. and S.S.C.; project administration, S.S.C.; funding acquisition, S.S.C. All authors have read and agreed to the published version of the manuscript.

**Funding:** The work of V.A.B. was partially supported by the Russian Science Foundation («The revision of Lepidoziaceae [Marchantiophyta] in Pacific Asia», grant no. 23-24-00029), and is within the framework of the institutional research project “Cryptogamic Biota of Pacific Asia” (no. 1021043000529-9). The work of S.S.C. was partially supported by a grant from the National Ecosystem Survey of the National Institute of Ecology (NIE-A-2023-01).

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Acknowledgments:** We are sincerely grateful to B.Y. Sun, who cared about our work, and significantly helped with permissions and organization of all field trips with the international project dealing with the study of ferns in Cambodia. We are very grateful to Y.S. Mamontov for the identification of *Frullania gaudichaudii* specimens. We also thank D. Bakalin for typesetting the map of the collecting sites. The work of V.A.B. was partially supported by the Russian Science Foundation («The revision of Lepidoziaceae [Marchantiophyta] in Pacific Asia», grant no. 23-24-00029), and is within the framework of the institutional research project “Cryptogamic Biota of Pacific Asia” (no. 1021043000529-9). The work of S.S.C. was partially supported by a grant from the National Ecosystem Survey of the National Institute of Ecology (NIE-A-2023-01) and the National Institute of Biological Resources (NIBR2009-2013), funded by the Ministry of Environment of the Republic of Korea.

**Conflicts of Interest:** The authors declare no conflict of interest.

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