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EDITORS: ZENNOSKE IWATSUKI, BENITO C. TAN,
YELITZA LEÓN V. AND S. ROB GRADSTEIN

SPECIES DIVERSITY AND RICHNESS OF THE MOSSES OF THE
COLOMBIAN CHOCÓ REGION

JAIME AGUIRRE-C.¹ AND J. ORLANDO RANGEL-CH.¹

ABSTRACT. The mosses of the Chocó biogeographic region of Colombia comprise a total of 132 species in 24 families and 60 genera. This subset represents 14% of the species, 22% of the genera, and 35% of the families reported for the country.

The richest families in genera and species are: Pilotrichaceae (12 genera/36 species), Calymperaceae (3/20), Sematophyllaceae (5/12), Neckeraceae (4/7) and Pterobryaceae (4/7). The most species-rich genera are *Fissidens* (9), *Syrrhopodon* (9), *Lepidopilum* (8) and *Calymperes* (6).

Analysis with reference to the major altitudinal/ecological zones reveals the following pattern: Region I, which includes the estuaries and lacustrine landscapes of the alluvial plains and low hills and terraces (0–200 m), is characterized by 91 species in 38 genera and 20 families; in the mid to higher elevations (>200–1000 m) of ecogeographic Region II there are 40 species in 31 genera and 18 families.

Epiphytes are the most diverse growth form, with 105 species, and are especially prevalent in region I. Neotropical taxa predominate in the Chocó phytogeographical region (49.2% of species), followed by those of Mesoamerican and wide continental distribution.

INTRODUCTION

The Colombian biogeographic Chocó extends from the Gulf of Urabá (in the Caribbean zone) and the Panamanian border in the north to the Ecuadorian border in the south; the foothills of the western cordillera of the Andes (from 800–1000 m) define the eastern, and the Pacific littoral zone the western limit of the biogeographic region (Rangel-Ch., 2004). Fig. 1.

Churchill & Linares (1995) estimated a total of around 200 species of mosses in the [political] Department of Chocó. In the northern sector of the biogeographical Chocó up to 1800 m, Frahm (1994) identified 125 species, and projected a species total of 150. Among the bryophytes, the liverworts are more abundant than the mosses. Though there are species restricted in distribution to the region, no moss genus is endemic to the Chocó (Frahm, op. cit.). The Colombian Chocó includes the lowlands above 500 m in elevation along the

¹ Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá-Colombia-S.A. e-mail. J. Aguirre-C.: jaguirrec@unal.edu.co; J. O. Rangel-Ch.: jorangelc@unal.edu.co

country's Pacific coast except The Serranía del Baudó and Serranía del Darién. With annual precipitation greater than 10,000 mm, it is one of the wettest Neotropical regions and is characterized by lowland tropical rainforest. Based on the assumption that the bio-geographical Chocó-region is related with its small surface, it is one of the most rich and high diversified areas of the world, we think that it is important to include a general scope about plant-communities and total amount and variability of the precipitation, perhaps the factor most related with the high values of biodiversity.

THE VEGETATION TYPES OF THE COLOMBIAN BIOGEOGRAPHIC CHOCÓ

The lowlands of the Colombian Pacific, currently considered part of the biogeographic Chocó or Chocó region, comprise the strip of land between the Pacific Ocean and the foothills of the western cordillera of the Andes. Geopolitically the region in Colombia consists of parts of the Departments of Chocó, Valle del Cauca, Cauca, Nariño, and Antioquia [the areas of the lower Atrato River and the Gulf of Urabá]. Ecogeographically (i.e., in terms of substrate and climate), the region includes estuaries, alluvial or outwash plains, and lowlands up to the hills and ranges of medium to high elevation (Fig. 2). The low hills and alluvial plains are most diverse in plant communities (21 and 20, respectively) with great richness as well in river/lake environments (19 communities); the pattern is typified by close correlation with hydrological factors (high and low-water periods).

Mangrove communities, characterized by *Rhizophora mangle* and *R. harrisonii*, and "natales", by *Mora megistosperma* and *Rhizophora* species, predominate in the estuaries. Aquatic vegetation is represented by floating groups, with *Eichhornia crassipes* and *Pistia stratiotes*. Beach and beach-vicinity communities are characterized by the palm, *Raphia taedigerae* ("panganal" or *Raphieturn taedigerae*) and the forest with *Hibiscus tiliaceus*, *Montrichardia arborescens* (= *Montrichardietum arborescentis*) stands and the palm, *Mauritiella macroclada* predominate in the alluvial plains, but forests of *Prioria copaifera* (*Prioretum copaiferae*), of *Camposperma panamensis* ("sajales") and of *Otoba* (*Dialyantera gracilipes*) are also important. Some types of vegetation are characteristic of both the plains and adjacent hills—for instance, forests of *Dacryodes occidentalis* and *Otoba gracilipes*; of *Huberodendron patinoi*, *Cordia panamensis*, *Aiphanes* sp. and *Euterpe oleracea*; the palm *Wettinia quinaria*; and the palm, *Phytelephas seemannii*. Important communities of the low hills (>100–250 m) are: mixed palm-cedar forests of *Cavallinesia platanifolia* ("guipo" or "macondo", = *Cavanillesietum platanifoliae*), *Oenocarpus bataua*, and *Cedrela angustifolia*; forests with *Brosimum utile* and forests with *Protium* cf. *dacryodes*, *Brosimum utile* and *Pterocarpus officinalis* ("bambudo"). Low and mid-elevation hills (>100–300 m) are characterized by forests with *Brosimum utile*, *Iriartea deltoidea* and *Wettinia quinaria*. Mid-elevations (>300–500 m) are distinguished by *Brosimum utile* ("sandé") and *Cariniana pyriformis* ("abarco") communities and mixed forests of *Anacardium excelsum* ("aspavé"), *Bombacopsis quinata* and *Brosimum utile*, as well as extensive palm stands of *Welfia regia* ("amargo"), *Brosimum utile* forest associations, and communities dominated by *Wettinia radiata*, *Eleagia utilis* y *Pourouma* cf. *aspera*.

There are floristic similarities among the major vegetation and habitat types, in a hydric series starting at the coast—on both the Pacific and Caribbean (Atlantic) slopes—that

starts with mangroves (*Rhizophora mangle*) and continues with river/lake and alluvial plain environments or the upland vegetation or tropical rainforest in areas with annual precipitation greater than 3000 mm. If latitude is considered along with these factors the following patterns emerge:

a. Widespread geographic distribution from Peru to Honduras-Mexico. This group includes estuarine formations; *Rhizophora mangle* mangrove swamps; wetland formations such as stands of *Montrichardia arborescens* (also present in the Colombian Amazon); swamp forests of *Symphonia globulifera* (widespread on both coasts, as well as in the Amazon region); swamp forests (referred to as “guandales” in Colombia) of *Caraipa guianensis* (also in the Amazon); and swamp forests (“cuangarial”) of *Virola sebifera*. Also included are formations of tropical rainforest characterized by an emergent stratum with elements of 35+ m height and a dense tree substratum dominated by species of *Brosimum*, *Otoba*, *Terminalia*, *Dipteryx*, *Oenocarpus* and *Ceiba*. These have an extensive range along the Pacific slope from Ecuador to Mexico and in some cases are represented in the Caribbean zone and in disjunct Amazonian areas. Among the dominant species are *Brosimum alicastrum*, *Dialium guianense*, *Cedrela odorata*, *Terminalia amazonia*, *Andira inermis* and *Ceiba pentandra* (the last two also in alluvial plain habitats). Gallery forest communities also belong in this group, especially those dominated by *Anacardium excelsum*.

b. Limited geographic range (Nicaragua to Ecuador). Includes the estuarine formations with *Mora megistosperma* forests (“natales”), floodplain communities (“sajales”) of *Camptosperma panamense*, and the swamp forests of *Pterocarpus officinalis*. Tropical rainforest formations with *Brosimum utile* and *Poulsenia armata* (as well as other species) also occur in this group.

c. Restricted geographic range (only from Central America to Colombia). Includes the river/lake formations with palm swamps of *Raphia taedigera* (“pangana”, “jolillo”), the alluvial plain formations with *Prioria copaifera* (“cativales” or “rodiales”) and the tropical rainforest communities consisting of *Welfia regia* palm stands.

d. Restricted geographic range (Colombia-Panama border to Peru). Formations of the alluvial plain: forests with *Otoba* species (“guandales”, “cuangariales”); formations of semi deciduous forest with *Cavanillesia platanifolia*; and tropical rainforest formations with *Oenocarpus bataua*.

The broad distribution patterns already apparent are evidence of floristic similarities that are correlated with relative distance among the areas in question. For example, in Panama the majority of the vegetative associations are the same as those of the northern Chocó; moreover, the condition of lower rainfall in Panama is implicitly a factor to consider in understanding the evolutionary ecology of the communities and species of the relatively drier enclaves in the Chocó (e.g., the Cerro del Cuchillo [Cárdenas, 2003]) which is characterized by species that otherwise have a greater distributional expression in Central America.) The floristic similarities of diverse geographical remnants of the “tropical rainforest”, appear to suggest very ancient geographical connections; for instance, resemblances in structure and floristic composition are maintained even among the contemporary vegetation of the Caribbean and Pacific coastal regions, notwithstanding the marked ecological differences among the two zones.

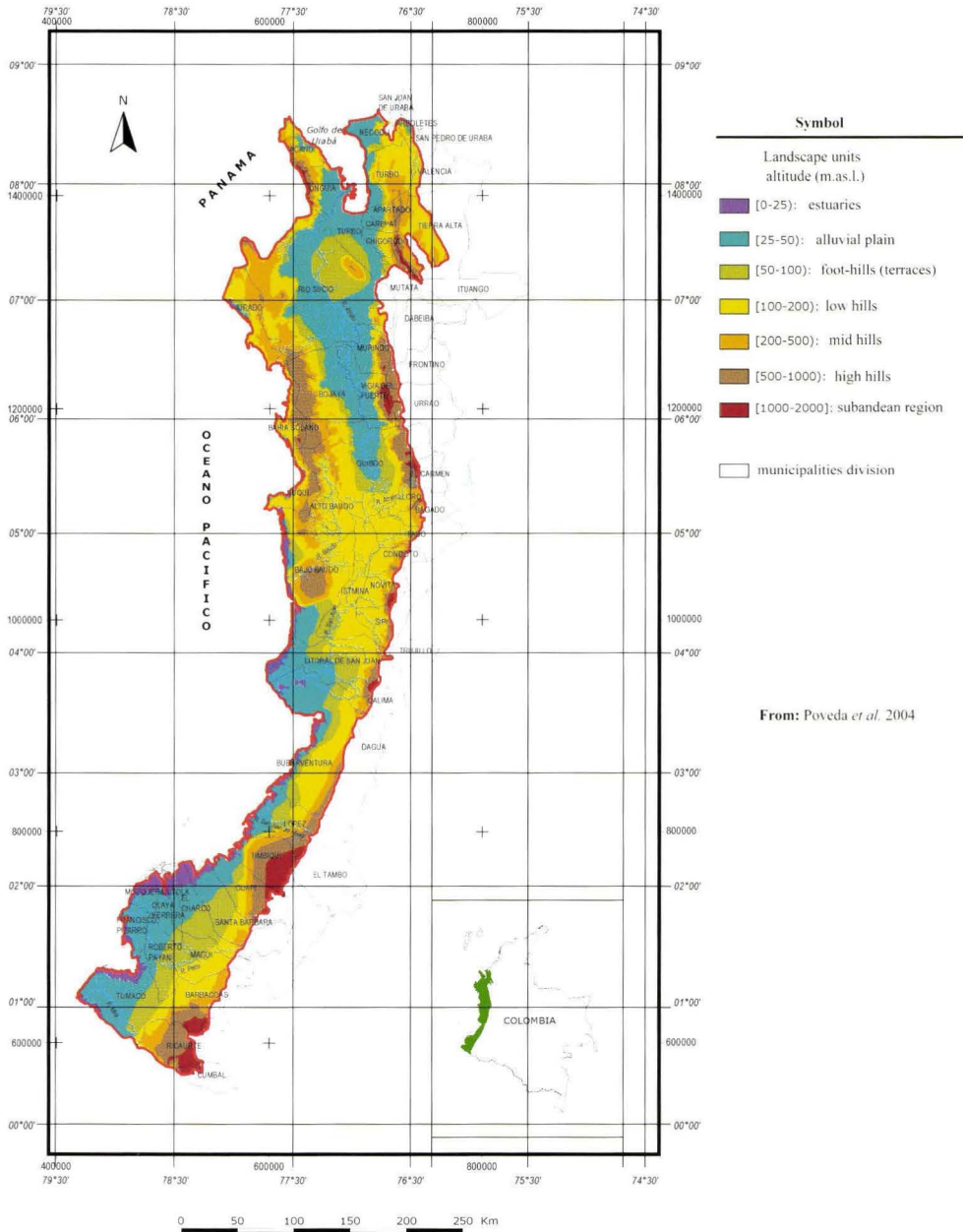


Fig. 1. Landscape units on the basis of topography in Chocó-region.

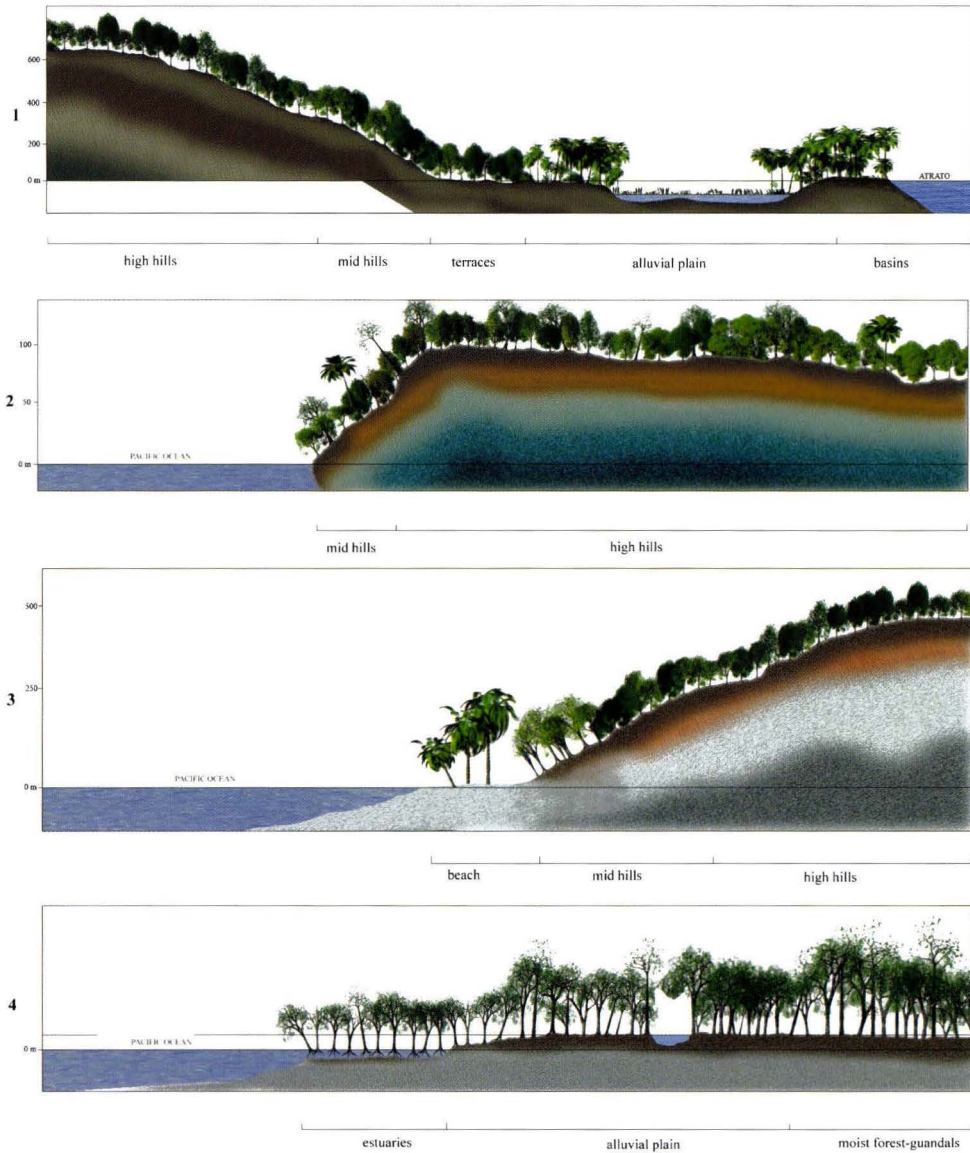


Fig. 2. Great landscapes in Chocó region
 1. North zone: P.N.N. katis (adapted from Zuluaga, 1987)
 2. Central zone: Slopes of Serranía del Baudó
 3. Transition between north None and South zone
 4. South zone

THE CLIMATE

There is a clear difference in rainfall distributional patterns within the Chocó biogeographical region: in lowland coastal zones or estuarine environments between 0–4 m, annual rainfall totals 3088 mm and is bimodal (four seasons), with heaviest rains between August and November. From 5 to 10 m in riverine/lacustrine environments the annual total is 3894 mm and is unimodal (two seasons) with the rainy period between May and November. From 10 to 50 m in the alluvial plain, the seasonal distribution is similar, but total annual precipitation is 5938 mm. From >50 to 150 m, it is unimodal (biseasonal), with an annual total of 6532 mm and the main rainy season extending from April through November. From >150–500 m a bimodal (four season) regime predominates, with an annual total of 2423 mm and rainiest periods from April–May and October–November. From >500–860 m the bimodal (4 season) regime predominates, with an annual total of 2261 mm; the rainy periods occur between April–May and September–November. In the transition between hot and temperate zones the rainfall is higher, perhaps because of the phenomenon of the seasonality of the clouds that give rise to copious orographic rains (5003 mm). From 1100–2300 m the rainfall diminishes and then becomes greater again at higher elevations. July and January are the typical dry months in these zones. All the proposals of climatic zonification of the Chocó biogeographic region take into account three subregions: North, Central, and South. According to our formulation, the gradation according to latitudinal belts and ecogeographical environments shows the following relationship: North latitudinal belt (9° to 6°30'N) environments between 0–50 m (3007.9 mm), >50–150 m (8000.37 mm), >150–500 (4361 mm), >500–1000 (3121 mm); Central latitudinal belt (6°30' to 3°30'N) environments between 0–50 m (6479.6 mm), >50–150 (8000.37 mm), >150–500 m (4361 mm), and >500–1000 (3121 mm); and Southern latitudinal belt (<3°30' to 1°N) environments from 0–50 m (4806.8 mm), >50–150 m (7263 mm), and >500–1000 (1888 mm).

The northern part of the region is characterized by some areas with low annual precipitation values (750 mm); others with higher values (around 7000 mm annually); and in the area closest to the central zone most localities register >3500 mm annually. Moreover, this zone includes the areas of the highest rainfall on earth (e.g., in the vicinity of Quibdó, with >11,000 mm per year). The South has areas of low rainfall around Tumaco, but also includes places with high annual precipitation (e.g., Barbacoas and Bocas del Napi). The Center is the belt with the highest average values for all ecogeographical environments; there are no areas of low rainfall except in the enclaves of the Dagua (Valle del Cauca Department) and a strip along the Western cordillera of the Andes. The rainiest zones include the low and middle elevation terraces between 50–150 m. Next is the South, with low values in Tumaco and the vicinity of Olaya Herrera. The belt with the unambiguously lowest values is the North where there are relatively dry places such as San Pedro de Urabá and the Darien Range [Serranía del Darien]. The central zone of the biogeographical Chocó is characterized by the highest average annual relative humidity (89.71%), followed by the Southern and Northern zones with 87.65% and 81.25% respectively. The median annual temperature is greatest in the Northern sector, [Cañafisto station (6°28'N, 75°51'W)=27.42°C]. The maximum temperature (33.7°C) was registered in Sautatá, where the daily

temperature amplitude is also greatest. In general, the values for mean annual temperature are highest in the Northern sector and diminish towards the South.

Climate types, according to Thornwaite, comprise the super-humid type A (Caraño, Condoto, Lloró) through the semiarid type C (La Noque, Cañafisto). In the Central zone all the hydric balances show an excess of water, while in the Northern and Southern zones there are seasons with a marked environmental deficiency of water. In the North, the distribution regimes are unimodal-biseasonal, in the Central zone they are bimodal-tetraseasonal, and in the South both patterns occur about equally.

METHODOLOGY

The data compiled for this analysis derive from recent publications, updated lists of Colombian mosses, the MOBOT database, as well as direct observation and verification of the determination of specimens from the Colombian National Herbarium (COL).

The methodology for categorizing distributions and ecology is that of Rangel-Ch. (1995), and the major environments of the biogeographic Chocó follow Rangel (2004). Rangel (op. cit.) and Poveda & Rojas, (2000) are the bases for the corological and ecological analyses. For the nomenclature status of the taxa we followed Churchill et al., 2000; Crosby et al., 2000 and www.mobot.org. Species' geographic ranges are categorized according to the system proposed by Wijk & al. (1959–1969) and Delgadillo et al. (1995). The topographic landscape categories are defined as follows:

Ecogeographic region I (0–200 m) comprises: estuarine zones (0–4 m), riverine/lacustrine (5–10 m), alluvial plains (>10–50 m), low terraces (>50–100 m), low hills (>100–200 m).

Ecogeographic region II (>200–1000 m): hills at middle-elevation (>200–500 m), hills at higher-elevations (>500–1000 m).

ANALYSIS OF SPECIES DIVERSITY AND RICHNESS

The list totals 132 species of mosses belonging to 60 genera, 24 families, and 3 infra-specific categories. The families richest in genera/species are: Pilotrichaceae (12 genera, 36 species), Calymperaceae (3–20), Sematophyllaceae (5–12), Fissidentaceae (1–9), Neckeraceae (4–7), Pterobryaceae (4–7), Brachytheciaceae (3–5), Hypnaceae (5–5), Bartramiaceae (2–4), Bryaceae (2–4), and Orthotrichaceae (2–4).

The most species-rich genera are *Fissidens* (9), *Syrrhopodon* (9), *Lepidopilum* (8), *Calymperes* (6), *Callicostella* (5), *Cyclodictyon* (5), *Octoblepharum* (5), *Thamniopsis* (5), *Trichosteleum* (4), *Bryum* (3) and *Crossomitrium* (3).

Ecosystem variability. In ecogeographic region I (0–200 m), there are 91 species in 41 genera and 19 families; the distribution of species richness according to taxonomic scale is the same as that for the entire region. Elements restricted to this ecoregion are *Groutiella* species (Orthotrichaceae) which typically occur in lowland tropical zones; species of *Macromitrium* (Orthotrichaceae) endemic to Gorgona Island; *Splachnobrym obtusum* (Splachnobryaceae) which is generally found in moist to semi-arid forests; and *Eulacophyllum cultelliforme* (Stereophyllaceae) which normally grows on rocks and decomposing wood (Fig. 3).

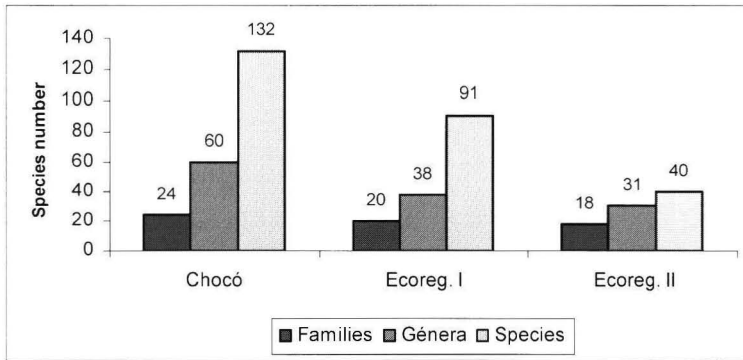


Fig. 3. Families, genera and species number in the Chocó region and the ecoregion I-II.

In ecoregion II (>200–1000 m), there are 40 species in 31 genera and 18 families. The species-richness pattern in terms of families and genera is similar to that of ecoregion I, except for the Fissidentaceae, Leskeaceae, Leucobryaceae, Orthotrichaceae, Splachnobryaceae y Stereophyllaceae that do not occur in this region and for the: Campyliaceae (with the lowest observation of *Campyllum praegracile* in the Andean zone) and Rutenbergiaceae (represented by *Pseudocryphaea domingensis*, an epiphyte of tropical moist to sub-Andean forests (Fig. 3).

ECOGEOGRAPHICAL SELECTIVITY

In the entire region (0–1000 m) there are 5 species that occur throughout the gradient: *Leucomium strumosum*, *Callicostella colombica*, *Lepidopilum muelleri*, *Trachyxiphium guadalupense* and *Trichostomum tenuirostre*.

There are 91 species restricted to Ecoregion I, among which figure: *Fissidens zollingeri* and *F. minutus* on soil or rock; *Neckeropsis disticha*, *Pireella pohlii* and *Trichosteleum papillosum*, which are epiphytic on bark or decomposing trunks in riverine/lacustrine zones and the alluvial plain; and *Philonotis bernoulli*, which is terrestrial on rocky soil and on decomposing wood in the low terraces.

The species restricted to the low terraces (60–100 m) are for the most part epiphytes: *Cyclodictyon roridum*, *Fissidens diplodus*, *Groutiella obtusa*, *Macromitrium cirrosum*, *M. perichaetiale*, *Pterogonidium pulchellum*. *Lepidopilum cubense*, *Fissidens cylindrothecus*, and *Octoblepharum stramineum* are restricted to the low hills (>100–200 m).

There are 34 species restricted to Ecoregion II. The species-richness pattern in families and genera is similar to the overall pattern for the Chocó region. *Campyllum praegracile* and *Pseudocryphaea dominguensis* are among the most important species.

GROWTH HABIT

Figure 4 illustrates moss habitat preferences for the entire region. Epiphytic elements are most abundant, with 105 species. In Ecogeographic Region I there are 23 epilithic

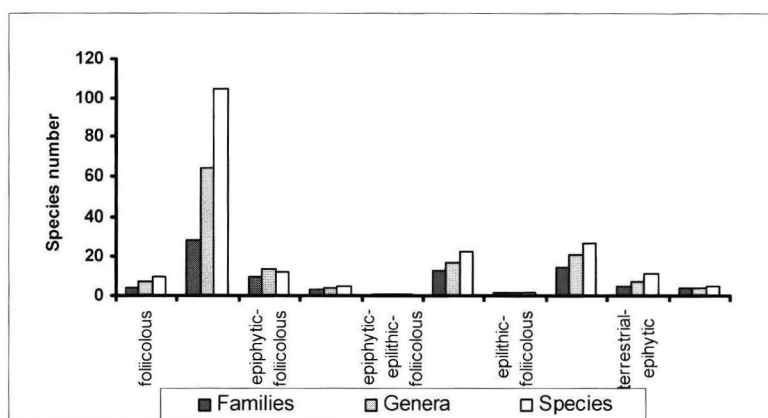


Fig. 4. Moss habitat preferences in the Chocó region.

species, 32 terrestrial species and 3 epiphyllic species: *Crossomitrium patrisiae*, *Syrrhopodon rigidus* and *Zelometeorium patulum*. There are species that occur in more than one habitat as follows –terrestrial-epiphytic: *Calymperes afzelii*, *Syrrhopodon leprieurii*, *Fissidens pellucidus*, *Fissidens prionodes*, *Leucobryum martianum* and *Sematophyllum galipense*; terrestrial-epilithic: *Fissidens intrmarginatus* and *F. minutus*; epilithic-epiphyllic: *Leskeodon longipilus*; epiphytic-epiphyllic: *Crossomitrium patrisiae*, *Syrrhopodon rigidus*, *Isodrepanium lentulum*; and epiphytic-epilithic: *Fissidens mollis* and *F. pellucidus*.

In Ecogeographic Region II epiphytic and epilithic species are abundant, e.g., *Breutelia tomentosa*, *Philonotis glaucescens*, *Bryum limbatum*, *Lepidopilum tortifolium*, *Callicostella radicans*, *C. rufescens*, *Hyophila involuta*, *Sematophyllum galipense*, *Porotrichum korthalsianum* and *Thuidium urceolatum*. Among the terrestrial species are: *Philonotis uncinata*, *Rhodobryum roseodens*, *Calymperes afzelii*, *Syrrhopodon leprieuri*, *Bryohumbertia filifolia*, *Fissidens pellucidus*, *Vesicularia vesicularis* var. *rutilans* and *Trichostomum tenuirostris*. There are two epiphyllic species: *Lepidopilum polytrichoides* and *Zelometeorium patens*.

Some species can be found in more than one habitat –terrestrial-epiphytic: *Fissidens prionodes*; terrestrial-epilithic: *Barbula indica*; epilithic-epiphyllic: *Lepidopilum scabriscutum*; epiphytic-epiphyllic: *Cyclodictyon albicans*, *Squamidium leucotrichum*, *Zelometeorium patens*, *Isodrepanium lentulum* and *Hildebrandtiella guyanense*; and epiphytic-epilithic: *Fissidens pellucidus*.

DISTRIBUTION

Figure 5 illustrates the distribution of Chocó moss species in the geographic areas proposed by Wijk et al. (1962). The following categories emerge.

1. Endemic elements (2 spp.): *Fissidens cylindrothecus* and *Syrrhopodon isthmi*
2. Neotropical elements: Species with ranges between 20°N–20°S, with the following subsets:

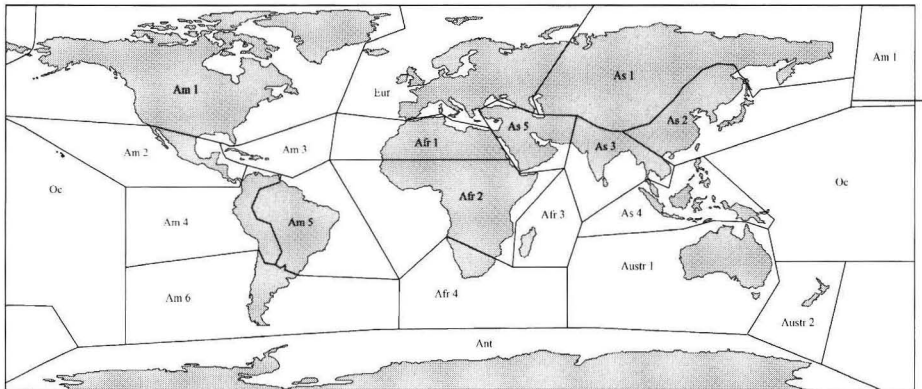


Fig. 5. Geographic areas proposed by Wijk et al. (1962).

a. Species that occur only in the Am4 area (7 spp.): *Amblytropis setosa*, *Campyllum praegracile*, *Fissidens intromarginatus*, *Holomitrium arboreum*, *Rhodobryum roseodens*, *Syringothecium sprucei*.

b. Species with a widespread distribution in areas Am2 through Am5 (42 spp., 32% of the total species reported): *Acroporium pungens*, *Bryohumbertia filifolia*, *Bryum limbatum*, *Crossomitrium patrisiae*, *Cyclodictyon albicans*, *C. rubrisetum*, *C. varians*, *Ectropothecium leptochaeton*, *Hemiragis aurea*, *Hildebrandtiella guyanensis*, *Isodrepanium lentulum*, *Isopterygium tenerum*, *Lepidopilum cubense*, *L. polytrichoides*, *L. scabrisetum*, *L. surinamense*; *L. tortifolium*, *Leucobryum martianum*, *Macromitrium cirrosum*, *Meteoridium remotifolium*, *Mittenothamnium reptans*, *Octoblepharum cocuiense*, *O. pulvinatum*, *Orthostichopsis praetermissa*, *Pilotrichum bipinnatum*, *P. fendleri*, *Pirella angustifolia*, *Pterogonidium pulchellum*, *Sematophyllum galipense*, *S. subsimplex*, *Squamidium leucotrichum*, *Syrrhopodon circinatus*, *S. leprieurii*, *S. lycopodioides*, *S. prolifer*, *Syrrhopodon rigidus*, *Thamniopsis cruegeriana*, *T. undata*, *Thuidium tomentosum*, *T. urceolatum*, *Zelometeorium patulum*, *Z. recurvifolium*.

c. Elements that occur in areas Am2 and Am4 (8 spp.): *Philonotis uncinata*, *Callicostella ciliata*, *C. tenerrima*, *Crossomitrium acuminatum*, *Fissidens diplodus*, *Lepidopilum permarginatum*, *Thamniopsis difusa*, *T. pendula*.

d. Elements that occur in areas Am2, 4, 5 (3 spp.): *Octoblepharum stramineum*, *Thamniopsis killipii*, *Zelometeorium patens*.

e. Elements that occur in Am3, 4, 5 (4 spp.): *Taxithelium pluripunctatum*, *Macromitrium perichaetiale*, *Calymperes guildingii*, *Trichosteleum sentosum*.

f. Species distributed from Am4 to Am5 (8 spp.): *Pilotrichum evanescens*, *Syrrhopodon hornsuschii*, *S. incompletus*, *Fissidens guianensis*, *F. prionodes*, *Groutiella obtusa*, *Porotrichum filiferum*, *Trichosteleum arrectum*.

3. Mesoamerican elements

Species that occur in Am2 to Am4 (15 spp.): *Callicostella colombica*, *C. depressa*, *Calymperes nicaraguense*, *Crossomitrium epiphyllum*, *Cyclodictyon roridu*, *Fissidens pel-*

lucidus, *Hypnella diversifolia*, *Porotrichodendron lindigii*, *Porotrichum korthalsianum*, *Trachypodium guadalupense*, *Eulacophyllum cultelliforme*, *Splachnobryum obtusum*, *Leskeodon andicola*, *L. longipilus*, *Cyclodictyon lindigianum*.

4. Extra-neotropical elements

a. Species distributed from Am1 to Am4 (2 spp.): *Pirella cymbifolia*, *P. pohlii*.

b. Species whose range includes Am1 to Am5 (7 spp.): *Callicostella pallida*, *Dicranella hilariana*, *Fissidens pellucidus*, *Groutiella apiculata*, *Neckeropsis undulata*, *Pseudocryphaea domingensis*, *Vesicularia vesicularis*.

5. Elements with disjunct distribution (3 spp.)

Am4 y Asia (3, 4): *Fissidens minutus*

Orthostichopsis terragona (Am2 to Am5) and Asia 2, *Philonotis glaucescens* (Am1 to Am5), Australia.

6. Neotropical-african elements (9 spp.)

Breutelia tomentosa, *Fissidens flaccidus* (Am2 to 6) Africa (2, 3), *Henicodium geniculatum* (Am 1 to 5), Africa (2, 3), *Sematophyllum subpinnatum* (Am 1 to 5), Africa (2, 3), *Taxithelium planum* (Am1 a 5 and Africa 2), *Orthostichella pentasticha* (Am2 to 5) Africa, *Porotrichum substriatum* (Am2 and 5), Africa, *Trichosteleum papillosum* (Am4, 5) Africa 2 (Amazon basin), *Neckeropsis disticha*.

7. Elements of widespread continental distribution (11 spp.)

Syrrhopodon gaudichaudii (Am, Africa and Oceania), *Barbula indica* Am (1 to 4), Africa (2 to 4) and Australia, *Fissidens zollingeri* Am (1 to 5), Asia (2 to 4), Oceania, *Hyophila involuta* Am (1 to 5), Africa (4), Asia (2 to 4), Europa y Oceania, *Trichostomum tenuirostre* Am (1 v 5), Africa (1 to 4), Asia (1, 3), Europa, Oceania, *Bryum coronatum* Am (1 v 5), Africa (2, 4), Asia (3, 4), Australia (1), Oceania, *Calymperes afzelli* Am (2 v 5), Africa (2, 3), Asia (2 a 4), Australia, Oceania, *C. erosum* Am (2 to 5), Africa (2, 3), Asia (3, 4), Australia, Oceania, *C. lonchophyllum* Am (2 to 5), Africa (3, 4), Australia, Oceania, *C. palisoti* Am (2 to 5), Africa (2, 3), Asia (2, 4), Australia, Oceania, *C. afzelii* Am (2 to 5), Africa (2, 3), Asia (2 to 4), Australia Oceania.

8. Pantropical (4 spp.)

Octoblepharum albidum (Am1 to 6), Africa (1,2), Asia (2 to 4), *Leucomium strumosum* (Am2 to 5), Africa (2, 3), Asia (3, 4), *Papillaria nigrescens* (Am1 to 5), Africa (1), Asia (2), *Hyophila involuta*.

FINAL CONSIDERATIONS

There are 132 species of moss in the biogeographic Chocó that belong to 60 genera and 24 families. In Ecogeographic Region I there are 99 species in 19 families and 41 genera and in Ecogeographic Region II there are 40 species in 31 genera and 18 families. There is a remarkable similitude among the richness patterns found in biogeographical Chocó region in mosses, spermatophyte and plant communities (Rangel, 2004); the highest values were presented in alluvial plains and low terraces, reflecting the great influence of the hydric factor (high precipitation and high water volume of the rivers).

Epiphytic species are most abundant 105 species that are most typical of Ecoregion I (0–200 m).

Phytogeographically, neotropical elements are most important, with 49.2% of the total, followed by elements of Mesoamerican and then widespread continental distribution.

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APPENDIX: LIST OF SPECIES FROM CHOCÓ REGION

		Landscape (ecogeographical units)						
		Ecoregion I (0–200)			Ecoregion II (>200–1000)			
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
DEPARTMENTS								
BARTRAMIACEAE								
<i>Breutelia tomentosa</i>	Nar							×
<i>Philonotis bernoillii</i>	Cho			×				
<i>Philonotis glaucescens</i>	Cho, VCau		×		×			
<i>Philonotis uncinata</i>	Ant, Cau, Cho, Ris, VCau		×					
BRACHYTHECIACEAE								
<i>Meteoriidium remotifolium</i>	Cho							×
<i>Squamidium leucotrichum</i>	Cho						×	
<i>Zelometeorium patens</i>	Cau, Cho, Ris				×			
<i>Zelometeorium patulum</i>	Ant, Cau, Cho, Nar, Ris, VCau						×	
<i>Zelometeorium recurvifolium</i>	Cho						×	
BRYACEAE								
<i>Bryum apiculatum</i>	Ant, Cau, Cho, Ris, VCau			×				×
<i>Bryum coronatum</i>	Ant, Cho		×	×				
<i>Bryum limbatum</i>	Ant, Cho, Ris			×				×
<i>Rhodobryum roseodens</i>	Ris							×
CALYMPERACEAE								
<i>Calymperes afzeltii</i>	Cho, Ris			×				×

Landscape (ecogeographical units)		Ecoregion I (0–200)						Ecoregion II (>200–1000)	
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations	
DEPARTMENTS									
<i>Calymperes erosum</i>	Cau, Cho, Nar, VCau		×			×			
<i>Calymperes guildingii</i>	Cau, Nar				×				
<i>Calymperes lonchophyllum</i>	Cau, Cho		×		×				
<i>Calymperes nicaraguense</i>	Cho, Ris					×			
<i>Calymperes palisotii</i>	Ant, Cau, Cho			×					
<i>Octoblepharum albidum</i>	Ant, Cau, Cho			×					
<i>Octoblepharum cocuiense</i>	Cau, Cho, VCau			×					
<i>Octoblepharum pulvinatum</i>	Cau, Cho, Nar, Ris			×					
<i>Octoblepharum stramineum</i>	Ris					×			
<i>Syrrophodon circinatus</i>	Cho						×		
<i>Syrrophodon gaudichaudii</i>	Cho						×		
<i>Syrrophodon hornschiichii</i>	Cho, Nar, VCau					×			
<i>Syrrophodon incompletus</i> var. <i>incompletus</i>	Cau, Cho		×			×			
<i>Syrrophodon incompletus</i> var. <i>berteroanus</i>	Cho, Nar		×			×			
<i>Syrrophodon isthmi</i>	Cho, Nar, Ris, VCau								×
<i>Syrrophodon lepreurii</i>	Cho, Nar, Ris, VCau								
<i>Syrrophodon lycopodioides</i>	Cau, Cho			×					×
<i>Syrrophodon prolifer</i>	Cau, Nar								×
<i>Syrrophodon rigidus</i>	Cau, Cho, Nar, VCau			×					×

Landscape (ecogeographical units)		DEPARTMENTS						
		Ecoregion I (0–200)				Ecoregion II (>200–1000)		
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
CAMPYLIACEAE								
<i>Campyllum praegracile</i>	Cho							×
DALTONIACEAE								
<i>Leskeodon andicola</i>	Cho						×	
<i>Leskeodon elongatus</i>	Cho			×				
DICRANACEAE								
<i>Bryohumbertia filifolia</i>	VCau							
<i>Dicranella hilariana</i>	VCau			×			×	
<i>Holomitrium arboreum</i>	Cho			×				×
FISSIDENTACEAE								
<i>Fissidens cylindrothecus</i>	Ris							
<i>Fissidens diploodus</i>	Cau							×
<i>Fissidens flaccidus</i>	Cho, Nar, Ris		×					
<i>Fissidens guianensis</i>	Ant, Cho			×				
<i>Fissidens intromarginatus</i>	Ant, Cho		×	×				
<i>Fissidens minutus</i>	Cau, Cho, Ris			×				
<i>Fissidens pellucidus</i>	Ant, Cho		×	×				
<i>Fissidens prionodes</i>	Cau, Cho			×				
<i>Fissidens zollingeri</i>	Ant, Cau, Cho		×	×				

		Landscape (ecogeographical units)						
		Ecoregion I (0-200)			Ecoregion II (>200-1000)			
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
DEPARTMENTS								
HYPNACEAE								
<i>Ectropothecium leptochaeton</i>	Cho	×						
<i>Isopterygium tenerum</i>	Cau, Nar, VCau		×					
<i>Mittrethamnium reptans</i>	Cho							×
<i>Syringothecium sprucei</i>	Nar		×					
<i>Vesicularia vesicularis</i>	Ant, Cho, Nar, VCau		×	×		×		
<i>Vesicularia vesicularis</i> var. <i>rutilans</i>	Ant, Cho, VCau		×	×		×		
LEMBOPHYLLACEAE								
<i>Orthostichella pentasticha</i>	Ris							×
LESKEACEAE								
<i>Haplocladium microphyllum</i>	Cho			×				
LEUCOBRYACEAE								
<i>Leucobryum maritimum</i>	Cau, Cho, VCau		×	×				
LEUCOMIACEAE								
<i>Leucomium strumosum</i>	Cau, Cho, Nar, VCau					×	×	
METEORACEAE								
<i>Papillaria nigrescens</i>	Ris, VCau							×
NECKERACEAE								
<i>Isodrepanium lentulum</i>	Cho							
<i>Neckeropsis disticha</i>	Ant, Cho, Nar				×			×

Landscape (ecogeographical units)		DEPARTMENTS						
		Ecoregion I (0–200)			Ecoregion II (>200–1000)			
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
<i>Neckeropsis undulata</i>	Ant, Cho, Ris		×			×		
<i>Porotrichodendron lindigii</i>	Cho					×		
<i>Porotrichum filiferum</i>	Ris						×	
<i>Porotrichum korthalsianum</i>	Ris						×	
<i>Porotrichum substriatum</i>	Cho						×	
ORTHOTRICHACEAE								
<i>Groenitella apiculata</i>	Cau, Cho, Nar	×						
<i>Groenitella obtusa</i>	Cau				×			
<i>Macromitrium cirrosium</i>	Cau				×			
<i>Macromitrium perichaetiale</i>	Cau				×			
PILOTRICHACEAE								
<i>Amblytropis setosa</i>	Cho, VCau			×				
<i>Callicostella ciliata</i>	Cho			×				
<i>Callicostella colombica</i>	Ant, Cau, Nar			×			×	
<i>Callicostella depressa</i>	Cho			×				
<i>Callicostella pallida</i>	Ant, Cau, Cho, Nar, Ris	×						
<i>Callicostella tenerrima</i>	Cho	×					×	
<i>Crossomitrium acuminatum</i>	Cho							×
<i>Crossomitrium epiphyllum</i>	Cho, Ris							
<i>Crossomitrium patrisiae</i>	Ant, Cho, Ris, VCau				×			×

		Landscape (ecogeographical units)						
		Ecoregion I (0-200)				Ecoregion II (>200-1000)		
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
DEPARTMENTS								
<i>Cyclodictyon albicans</i>	Cho, Nar			×				
<i>Cyclodictyon lindigianum</i>	Cho			×	×			
<i>Cyclodictyon roridum</i>	Cho			×	×			
<i>Cyclodictyon rubrisetum</i>	Cho			×	×			
<i>Cyclodictyon varians</i>	Cho						×	
<i>Hemiragis aurea</i>	Cho, Ris						×	
<i>Hookertopsis luteorufescens</i>	Cho						×	
<i>Hypnella diversifolia</i>	Cho, Nar						×	
<i>Lepidopilum cubense</i>	Ant, Nar					×		
<i>Lepidopilum muelleri</i>	Cau, Cho				×			×
<i>Lepidopilum pernarginatum</i>	Cho, VCau		×					
<i>Lepidopilum polytrichoides</i>	Ant, Cho, VCau					×		
<i>Lepidopilum scabrisetum</i>	Ant, Cho, Nar			×				
<i>Lepidopilum surinamense</i>	Ant, Cau, Cho, Nar					×		
<i>Lepidopilum tortifolium</i>	Cho, Nar, VCau		×	×				
<i>Pilotrichum bipinnatum</i>	Cau, Cho, Ris, VCau			×				
<i>Pilotrichum evanescens</i>	Cho, Ris			×				
<i>Pilotrichum fendleri</i>	Cho							
<i>Schizomitrium radicans</i>	Cho						×	
<i>Callicostella rufescens</i>	Cho							×

	Landscape (ecogeographical units)						
	Ecoregion I (0–200)			Ecoregion II (>200–1000)			
	estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
	DEPARTMENTS						
<i>Thamniopsis cruegeriana</i>			×				
<i>Thamniopsis diffusa</i>	V Cau		×				
<i>Thamniopsis killipii</i>	Cau, Cho, Nar, VCau		×	×			
<i>Thamniopsis pendula</i>	Cho, VCau			×			
<i>Thamniopsis undata</i>	Nar	×					
<i>Trachypodium guadalupense</i>	Cho				×		
POTTIACEAE	Cau, Nar, VCau				×	×	×
<i>Barbula indica</i>	Nar						
<i>Hyophila involuta</i>	Ant, Cau, Cho, Nar, Ris		×		×		
<i>Trichostomum tenuirostre</i>	Cho				×		
PTEROBRYACEAE							
<i>Henicodium geniculatum</i>	Ant, Ris						
<i>Hildebrandtella guyanensis</i>	Ris			×			×
<i>Orthostichopsis praetermissa</i>	Cho						
<i>Orthostichopsis tetragona</i>	Ant, Cau, Cho, Ris			×			
<i>Pirella angustifolia</i>	Cau, Cho				×		
<i>Pirella cymbifolia</i>	Cho					×	
<i>Pirella pohlii</i>	Cho					×	
RUTENBERGIACEAE							
<i>Pseudocryphaea domingensis</i>	Ris						×

		Landscape (ecogeographical units)						
		Ecoregion I (0-200)				Ecoregion II (>200-1000)		
		estuarine	riverine/ lacustrine	alluvial plains	low terraces	low hills	hills at middle- elevation	hills at higher- elevations
DEPARTMENTS								
SEMATOPHYLLACEAE								
	<i>Acroporium punctuliferum</i>	Cau	×				×	
	<i>Acroporium pungens</i>	Cau, Cho, Ris		×				
	<i>Pterogonidium pulchellum</i>	Cau		×	×			
	<i>Sematophyllum galipense</i>	Cho		×		×		
	<i>Sematophyllum subpinnatum</i>	Cho, Nar			×			
	<i>Sematophyllum subsimplex</i>	Cau, Cho, Nar, VCau		×				
	<i>Taxithelium planum</i>	Ant, Cau, Cho, Nar, VCau		×				
	<i>Taxithelium pluripunctatum</i>	Cau, Nar			×			
	<i>Trichosteleum arrectum</i>	Cau		×				
	<i>Trichosteleum papillosum</i>	Cau, Cho, Nar, VCau		×	×			
	<i>Trichosteleum sentosum</i>	Cau			×			
	<i>Trichosteleum fluviale</i>	Cho		×		×		
SPLACHNOBRYACEAE								
	<i>Splachnobryum obtusum</i>	Cho, Ris		×		×		
STEREOPHYLLACEAE								
	<i>Eulacophyllum cultelliforme</i>	Cho		×		×		
THUIDIACEAE								
	<i>Thuidium tomentosum</i>	Cho						×
	<i>Thuidium urceolatum</i>	Ris						×