

## Bryophytes from the Cordillera del Cóndor, Ecuador

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**Abstract:** A bryophyte inventory was conducted in the tepui-like region of the Cordillera del Cóndor in southern Ecuador. A total of 166 bryophytes are recorded for the Cóndor. Hepatics are represented by 50 species, 2 subspecies, 33 genera, 16 families, for hornworts 1 species, genus, family, and for mosses 111 species, 2 varieties, 67 genera, and 32 families. *Ochrobryum gardneri* is a new record for Ecuador.

**Key words:** Bryophytes, inventory, Cordillera del Cóndor, Ecuador

### Introduction

There are significant regions in Ecuador that have been little explored for plants. The Cordillera del Cóndor is one such region in southern Ecuador (Neill 2005, 2008). The Cóndor is situated between the eastern Andean cordillera to the west and the Amazon basin to the east, astride both Ecuador and Peru. This area is punctuated by mesas and low mountains dissected by river valleys. In recent years the Cóndor region has been the focus of botanical inventories by several Ecuadorian and Peruvian institutions and the Missouri Botanical Garden.

Bryological exploration of southern Ecuador commenced at the beginning of the 19<sup>th</sup> century. Alexander von Humboldt and Aimé Bonpland in 1802 were probably the first to collect bryophytes in the environs of Loja. Later Hermann Krause (exact date unknown, possibly mid 1860's) collected in several localities in southern Ecuador (cf. Hampe 1869, Lorentz 1868). Some few bryophytes were likely collected by Reinaldo Espinosa in the 1920's and 1930's. Many years elapsed before any significant collections were made in southern Ecuador. Among the first collectors in the last quarter of the 20<sup>th</sup> century included Alberto Ortega in ca. 1975, and Danish botanists including Lauritz Holm–Nielsen from the mid to late 1970's and later by Simon Laegaard. All previous efforts related to the collection of bryophytes in southern Ecuador were part of general plant surveys that emphasized vascular plants.

The first intensive bryological study for southern Ecuador was at the San Francisco Biological Reserve (Reserva Biológica San Francisco). The reserve covers an area of ca. 1000 hectares, ranging in elevation from 1800 to 3140 m, and composed of low to high montane forest and subpáramo. Bryological investigations at the reserve included both basic inventory (Nöske et al. 2003, Parolly et al. 2004) and ecological studies (Parolly & Kürschner 2004a, b). A total of 499 bryophytes (313 hepatics, 2 hornworts, and 183 mosses) were recorded from the reserve (Nöske et al. 2003, Parolly et al. 2004). The authors observe that this is “the highest species number ever recorded from a relatively small area (1,000 ha) in the tropics.” What is equally impressive is the number of bryologists that have been involved for several years, especially hepaticologists, who have conducted field work at the reserve, and have assisted with the determination of collections. One could readily predict similar diversity numbers throughout the montane forest of the tropical Andes employing such expertise. This study provides a basis for comparing other localities of similar vegetation and elevational range.

### Area and Inventory

The Cordillera del Cóndor is positioned between 03–04.30°S, 078–079°W. The area of the Cóndor is estimated at 11,000 km<sup>2</sup>, extending ca. 150 km north-south, with much of the area at 1000-2000 meters, but reaching a maximum elevation of 2900 meters (Neill

2005, 2008). The submontane and lower montane forests that occupy the Córdor region are fundamentally different than the Andean cordillera forest due to the underlying bedrock, the former older than the latter. The Córdor is made up of Mesozoic and early Tertiary sediments of sandstone and limestone, whereas the Andean cordillera to the west is of metamorphic and volcanic rocks. The Cordillera del Córdor is physiographically and floristically allied to the tepui region or Guayana Highlands of Venezuela, although of a more recent age. The first major botanical exploration of the Cordillera del Córdor began in the 1990's as part of a RAP study (Schulenberg & Awbrey 1997, Neill 2005). Over the last decade David Neill and collaborators from Ecuador and Peru have conducted inventories in various areas of the Cordillera del Córdor region. Additional information is presented by Neill (2008) on geology, geography, and plants.

The objective of this inventory was to sample bryophytes from the different vegetation types found in the Cordillera del Córdor region of Zamora-Chinchi Province. An attempt was made to collect all bryophytes at each site. This method, while not precise, did provide limited information on frequency and substrate preference of the individual species. Field work was conducted in Zamora-Chinchi Province from 25 November to 09 December, 2005. More than 400 collections were made from 22 sites ranging in elevation from 960 to 1880 meters. Additional data for nearly 90 collections were obtained for the Córdor region from the Missouri Botanical Garden data base system Tropicos. These collections further supplement the checklist.

A total of 166 bryophytes are recorded for the Cordillera del Córdor. Hepatics are represented by 50 species, 2 subspecies, 33 genera, and 16 families; hornworts by 1 species, genus, family; and mosses by 111 species, 2 varieties, 67 genera, and 32 families. Hepatic diversity for the Córdor region represents ca. 7% of the 695 species recorded for Ecuador (León-Yáñez et al. 2006), and for mosses ca. 14% of the 807 species recorded (Churchill in prep.).

Two hepatic families are notably diverse, the Lepidoziaceae with 13 species and 5 genera and the Lejeuneaceae with 9 species and 8 genera. Two other families, Frullaniaceae and Plagiochilaceae will likely each contain more species (perhaps 10 or more species each of the genera *Frullania* and *Plagiochila*). Predictably the Lejeuneaceae will be the most diverse family with many additional species to be recorded for the Córdor region.

Three moss families are of note, the Pilotrichaceae with 18 species and 8 genera, the Dicranaceae with 11 species and 6 genera, and the Sematophyllaceae with 10 species and 5 genera. The two most diverse genera,

each with five species, include *Syrrhopodon* (Calymperaceae) and *Lepidopilum* (Pilotrichaceae). The following four genera each contain four species: *Campylopus* (Dicranaceae), *Leucobryum* (Leucobryaceae), *Sematophyllum* (Sematophyllaceae), *Thamniopsis* (Pilotrichaceae). Mosses of interest that are here considered rare throughout the Andes include *Lepidopilum erectiusculum*, *Syringothecium sprucei*, and *Ochrobryum gardneri*; the latter is also a new record for Ecuador. *Sphagnum algentryi*, described by Howard Crum in 1993, is the only known endemic moss from the Córdor region. A few species are probably not rare, but rather rarely collected, e.g., *Acroporium estrellae*, *Bryum renauldii*, *Leskeodon elongates*, and *Stereobryum subulirostrum*.

Substrate data for the Cordillera del Córdor bryophytes is broadly classified under five categories: soil, leaf litter, rocks, logs, and epiphytes. A number of species were found on more than one substrate. For hepatics 37 species were found on soil, followed by epiphytes 31, logs 12, leaf litter 9 and rocks 4. For mosses 56 species were found as epiphytes, followed by those found on soil 33, logs 31, rocks 25, and leaf litter 5.

Additional inventory of the Cordillera del Córdor will result in a doubling or tripling the number of hepatics and at least half again as many mosses as presently recorded. For example the number of the bryophytes shared between the Cordillera del Córdor and San Francisco Biological Reserve, located ca. 50 km west of the southern Córdor range, is 92 species – 37 hepatics and 55 mosses. Greater inventory effort in the Córdor region will likely increase the number of shared species, but it may also serve to demonstrate the differences with regard to bryophyte diversity and composition between the two areas given their very different geological origin and development.

The format of the checklist recognizes the three major bryophyte groups: hepatics, hornworts and mosses. Within each of these three groups the families, genera and species are listed alphabetically. Species data includes: substrate, elevation, collection number of Churchill et al. or previous collections listed in abbreviated notation. The individual Churchill collection number can be referenced to the localities given in the appendix that are in numerical sequence. All collections are from Zamora-Chinchi Province unless otherwise noted. Accepted hepatic and hornwort names follow, in general, León-Yáñez et al. (2006) and Gradstein & Costa (2003); moss names follow the current version of the tropical Andean moss web site: <<http://mobot.mobot.org/W3T/Search/andes/andesintro.htm>>; reference can also be made to an earlier published checklist (Churchill et al. 2000). All collections have been databased in Tropicos: <http://www.tropicos.org>. A total of 7220 databased Ecuadorian bryophyte collections can be accessed for

specimen lists and distribution maps. The first set of collections is deposited with the Herbario Nacional del Ecuador, Museo Ecuatoriano de Ciencias Naturales (QCNE). The first duplicate set is deposited with the Missouri Botanical Garden (MO). Additional representative duplicates are deposited at Herbario Loja, Universidad Nacional de Loja (LOJA), Herbario Nacional de Bolivia in La Paz (LPB), Universidad Nacional Mayor de San Marcos in Lima (USM), and Herbarium, Albrecht-von-Haller Institute of Plant Sciences, Georg August University Göttingen (GOET).

### Checklist of the Cordillera del Cóndor Bryophytes

#### MARCHANTIOPHYTA (Hepatics)

##### Balantiopsaceae

*Isotachis multiceps* (Lindenb. & Gottsche) Gottsche – On soil covered rocks, emergent to submersed along trail ditch. 1340–1520 m. 24351, 24411, 24438, 24515.

*Isotachis serrulata* (Sw.) Gottsche – On soil, soil bank along trail and rocks. 1380–1640 m. 24337, 24340, 24424.

##### Calypogeaceae

*Calypogeia peruviana* Nees – Shaded, on exposed tree roots. 1815 m. 24353.

*Mnioloma caespitosa* (Spruce) R.M. Schust. – Shaded sites, on exposed tree roots and over leaf litter. 1500–1600 m. 24299, 24475.

*Mnioloma crenulatum* (Biscl.) R.M. Schust. – Shaded, on logs. 1815 m. 24355–A.

##### Cephaloziaceae

*Odontoschisma denudatum* (Nees) Dumort. – On humus and logs. 1000–1680 m. 24258, 24401, 24480.

*Odontoschisma longiflorum* (Taylor) Steph. – On logs. 1520 m. 24307.

##### Frullaniaceae

*Frullania atrata* (Sw.) Dumort. – On tree trunk. 900–1000 m. Only known from Morona–Santiago Province, Km 140 on road between Loja–Gualaquiza: Holm–Nielsen et al. 4523 (MO).

*Frullania cf. mirabilis* J.B. Jack & Steph. – In full sun, on exposed soil bank. 1880 m. 24341.

##### Herbertaceae

Names follow Feldberg & Heinrichs (2006).

*Herbertus juniperoideus* ssp. *acanthelius* (Spruce) Feldberg & Heinrichs [*H. acanthelius* Spruce] – On humus covered branch, on fallen tree branch. 1340–2000 m. 24405. Also from Morona–Santiago Province, Río Quimi valley, Montenegro et al. 121 (MO).

*Herbertus juniperoideus* subsp. *bivittatus* (Spruce) Feldberg & J. Heinrichs [*H. bivittatus* Spruce] – On fallen branch. 1000–1100 m. 24162 (det. K. Feldberg).

*Herbertus juniperoideus* ssp. *pensilis* (Taylor) Feldberg & Heinrichs [*H. pensilis* (Taylor) Spruce] – Pendent from tree branches. 1340–1680 m. 24514.

##### Jungermanniaceae

*Anastrophyllum tubulosum* (Nees) Grolle – On soil bank, associated with *Campylopus* and *Polytrichadelphus*. 1880 m. 24342 (det. J. Váña).

*Jamesoniella rubricaulis* (Nees) Grolle – On branch of tree. 2740 m. Only known from Nangaritza: Delinks 1313 (MO, QCNE).

*Syzygiella anomala* (Lindenb. & Gottsche) Steph. – On soil bank. 1880 m. 24345.

*Syzygiella concreta* (Gottsche) Spruce – On branches. 1580 m. 24288.

##### Lejeuneaceae

*Bryopteris filicina* (Sw.) Nees – On stilts of palm and trunk of trees. Frequent. 1000–1520 m. 24212, 24387, 24526.

*Ceratolejeunea filaria* (Taylor ex Lehm.) Steph. – On trunk of trees. 1150–1200 m. 24374.

*Cyclolejeunea peruviana* (Lehm. & Lindenb.) A. Evans – On fern fronds, palm leaves. 980–1000 m. 24147, 24188, 24213.

*Lejeunea phyllobola* Nees & Mont. – On trunk of tree, shrub. 1000–1380 m. 24203–A, 24419–A.

*Odontolejeunea lunulata* (F. Web.) Schiffn. – On fronds of fern. 1000 m. 24149.

*Omphalanthus filiformis* (Sw.) Nees – On fallen branches, base of shrub, trunk of tree, over leaf litter, bank of trail and grassy fields. Common. 980–1680 m. 24157, 24234, 24268, 24322, 24371, 24383, 24505, 24516.

*Symbiezidium barbiflorum* (Lindenb. & Gottsche) A. Evans – On logs. 1000 m. 24254.

*Taxilejeunea pterigonia* (Lehm. & Lindenb.) Schiffn. – On rocks along stream. 1200 m. 24231.

*Taxilejeunea sulphurea* (Lehm. & Lindenb.) Steph. – On shrubs. 1380 m. 24419.

#### Lepidoziaceae

*Bazzania acanthostipa* Spruce – On branches. 1500–1600 m. 24455.

*Bazzania gracilis* (Hampe & Gottsche) Steph. – On logs and trunk of treelet. 1380–1680 m. 24280, 24487.

*Bazzania hookeri* (Lindenb.) Trevis. – On trunk of treelets, base and branches of trees. Frequent. 1000–1600 m. 24143, 24169, 24215, 24410, 24460.

*Bazzania phyllobola* Spruce – On branches and vertical rock face. 1340–1500 m. 24400, 24450.

*Bazzania stolonifera* (Sw.) Trevis. – On fallen branch. 1000 m. 24138.

*Lepidozia cupressina* (Sw.) Lindenb. – On leaf litter and exposed tree roots. 1580 m. 24278.

*Lepidozia incurvata* Lindenb. – On humus and branches. 1340 m. 24397.

*Lepidozia wallisiana* Steph. – On inclined tree trunk. 1500–1600 m. 24462.

*Micropterygium leiophyllum* Spruce – On soil, leaf litter and logs. 980–1000 m. 24145–A, 24236.

*Micropterygium cf. parvistipulum* Spruce – On horizontal tree trunk. 1340 m. 24406.

*Micropterygium trachyphyllum* Reimers – Over leaf litter, on exposed roots, logs and humus. 1500–1600 m. 24281, 24316, 24469.

*Mytilopsis albifrons* Spruce – On vertical rock; associated with *Bazzania* and *Octoblepharum*. 1500–1600 m. 24450–A.

*Telaranea nematodes* (Gottsche ex Aust.) M. Howe – On logs, base of tree, with *Bazzania*. 980–1580 m. 24191, 24266.

#### Lophocoleaceae

*Chiloscyphus breutelii* (Gottsche) J.J. Engel & R.M. Schust. [*Lophocolea trapezoides* Mont.] – On logs. 1580 m. 24298.

*Chiloscyphus martianus* (Nees) J.J. Engel & R.M. Schust. [*Lophocolea*] – On logs. 1580 m. 24293.

*Chiloscyphus polychaetus* (Spruce) J.J. Engel & R.M. Schust. [*Lophocolea*] – On logs. 1615 m. 24326.

*Clasmatocolea vermicularis* (Lehm.) Grolle – On wet rocky soil. 1380 m. 24443.

*Leptoscyphus gibbosus* (Taylor) Mitt. – On branches. 1340 m. 24403.

#### Marchantiaceae

*Marchantia chenopoda* L. – On shaded soil bank, rocks. 1150–1380 m. 24369, 24437.

#### Metzgeriaceae

*Metzgeria leptoneura* Spruce – Over leaf litter. 1520 m. 24321 (det. D.P. Costa).

#### Pallaviciniaceae

*Pallavicinia lyellii* (Hook.) Gray – On soil, exposed roots and logs. Occasional. 980–1680 m. 24141, 24181, 24486.

*Symphyogyna aspera* Steph. – On humic soil and leaf litter. 1500–1615 m. 24274, 24317, 24334, 24458.

*Symphyogyna brasiliensis* Nees – On soil and humus. 1500–1600 m. 24449.

#### Plagiochilaceae

*Plagiochila* spp. [4–5 species]

#### Pleuroziaceae

*Pleurozia paradoxa* J.B. Jack – On branches of shrub. 2731–2740 m. Know from Zamora–Chinchipe Province, southeast of Nambija, in dwarf scrub forest: *Cole* 143, 155 (MO, QCNE).

#### Scapaniaceae

*Scapania portoricensis* Hampe & Gottsche – On trunk and branches of trees, rocks, and soil. 1580–2731 m. 24297. Additional collections from Zamora–Chinchipe Province, Cordillera de Nanguipa: *Cole* 150, 190 (MO, QCNE), and Morona–Santiago Province, 15 km from Warints: *Toapanta* 1656 (MO, QCNE).

#### Trichocoleaceae

*Trichocolea paraphyllina* (Spruce) Steph. – On base of tree, humus, and over leaf litter with *Metzgeria*. 1380–1680 m. 24327, 24433, 24489.

*Trichocolea tomentosa* (Sw.) Gottsche – Over exposed roots and leaf litter. 1815 m. 24350.

#### ANTHOCEROPHYTA (Hornworts)

##### Anthocerotaceae

*Phaeoceros laevis* (L.) Prosk. – On soil, along road. 1180 m. 24218.

## BRYOPHYTA (Mosses)

## Bartramiaceae

*Breutelia chrysea* (Müll. Hal.) A. Jaeger – On wet rocks. 1380 m. 24426.

*Leiomela bartramioides* (Hook.) Paris – On trunk of trees. 1880 m. 24365.

*Philonotis hastata* (Duby) Wijk & Margad. – On wet rocks, including sandstone. 1200–1380 m. 24228, 24421.

*Philonotis longiseta* (Michx.) E. Britton – On humus at base of tree and rocks along stream. 1380–1680 m. 24436, 24493.

*Philonotis uncinata* (Schwägr.) Brid. – On soil and rocks. 1150–1200 m. 24220, 24392.

## Brachytheciaceae

*Meteoridium remotifolium* (Müll. Hal.) Manuel – On trunk and branches of treelets, logs and leaves of palm. 1150–1811 m. 24385, 24394, 24476, 24488, 24529. Additional collections from Morona–Santiago Province, along the Río Warints and vicinity of Cerro Chanquiñza: *Toapanta* 1579, 1612 (MO, QCNE).

*Squamidium leucotrichum* (Taylor) Broth. – On branches of treelets and trees, trunk of fallen tree and branches, and on living leaves (rather rare substrate). Frequent. 1000–1811 m. 24140, 24144, 24157–A, 24442, 24463, 24510. A further collection from Morona–Santiago Province, vicinity of Cerro Chanquiñaz: *Toapanta* 1622 (MO, QCNE).

*Squamidium livens* (Schwägr.) Broth. – On trunk of treelet and fallen branches. 1380–1680 m. 24412, 24499.

*Zelometeorium patulum* (Hedw.) Manuel – On trunk and branches of treelet. 1000 m. 24214.

*Zelometeorium recurvifolium* (Hornsch.) Manuel – On trunk of tree. 1000 m. 24203.

## Bruchiaceae

*Trematodon longicollis* Michx. – On soil, along road. 1188 m. 24217.

## Bryaceae

*Brachymenium columbicum* (De Not.) Broth. – On logs. 877 m. Known from a single locality near Las Orchídeas, on road from Paquisha: *Croat* 91281 (MO).

*Bryum* cf. *alpinum* Huds. ex With. – On wet rocks along stream. 1380 m. 24434.

*Bryum renauldii* Roll ex Renauld & Cardot – On sandstone rock in stream. 1380–1815 m. 24346, 24418.

*Rhodobryum grandifolium* (Taylor) Schimp. – On humus. 2722 m. Recorded for the Cordillera de Nanguipa, southeast of Nambija: *Cole* 189 (MO, QCNE).

## Calymperaceae

*Syrrhodon lepreurii* Mont. – On trunk of treelet, humus over exposed roots, tree roots and branches. Frequent. 1165–1680 m. 24291, 24451, 24473, 24497. A further collection from Morona–Santiago Province, along the Río Warints: *Toapanta* 1560 (MO, QCNE).

*Syrrhodon lycopodioides* (Sw. ex Brid.) Müll. Hal. – On trunk of trees. 1380–1680 m. 24491, 24495.

*Syrrhodon parasiticus* (Sw. ex Brid.) Paris – On trunk of tree. 1150–1200 m. 24368.

*Syrrhodon prolifer* Schwägr. var. *prolifer* – On base of tree. 1150–1200 m. 24372.

*Syrrhodon prolifer* var. *cincinnatus* (Hampe) W.D. Reese – On logs. 1000–1100 m. 24167.

*Syrrhodon rigidus* Hook. & Grev. – On tree branches. 1380–1680 m. 24497–A.

## Daltoniaceae

*Leskeodon elongatus* (Mitt.) S.P. Churchill & E. Linares – On sandstone rock in shade. 980 m. 24184.

## Dicranaceae

*Bryohumbertia filifolia* (Hornsch.) J.–P. Frahm – On soil. 1811 m. A single collection from Morona–Santiago Province, vicinity of Cerro Chanquiñaz: *Toapanta* 1620 (MO, QCNE).

*Campylopus flexuosus* (Hedw.) Brid. – On inclined tree trunk. 1380–1680 m. 24501.

*Campylopus lamellinervis* (Müll. Hal.) Mitt. – On soil covered rock. 1815 m. 24348.

*Campylopus richardii* Brid. – On soil of roadside bank, and sandstone rock. 1380–1520 m. Occasional. 24324, 24417. A further collection from the area between Zamora and Romerillos Alto: *Croat* 91585 (MO).

*Campylopus weberbaueri* Broth. – On lianas and humus. 1340–1580 m. 24287, 24408.

*Dicranella hilariana* (Mont.) Mitt. – On soil and rocky soil. 1000–1580 m. 24155, 24303, 24391.

*Holomitrium antennatum* Mitt. – On branches of tree. 1380–1680 m. 24507.

*Holomitrium arboreum* Mitt. – On logs, trunk of trees. 1480–2300 m. 24519. Also from Morona–Santiago Province, vicinity of Warints: *Toapanta 1654* (MO, QCNE).

*Holomitrium flexuosum* Mitt. – On soil? (typically epiphytic). 2300 m. Known from Morona–Santiago Province, vicinity of Warints: *Toapanta 1636* (MO, QCNE).

*Leucoloma serrulatum* Brid. – On trunk and branches of trees. 980–1811 m. Occasional. 24174, 24479. Also known from Morona–Santiago Province, along the Río Warints: *Toapanta 1559, 1629* (MO, QCNE).

*Pilopogon laevis* (Taylor) Thér. – On soil bank. 1880 m. 24343.

#### Fissidentaceae

*Fissidens asplenioides* Hedw. – On rocks along stream and vertical sandstone rock. 1000–1380 m. 24247, 24422.

*Fissidens scariosus* Mitt. – On soil. 1380–1680 m. 24492.

*Fissidens serratus* Müll. Hal. – On soil and sandstone rock. 980 m. 24184–A, 24189.

#### Funariaceae

*Funaria calvescens* Schwägr. – On soil along roadside. 1580 m. 24292. An additional collection from Nangaritz: *Delinks 1413* (MO, QCNE).

#### Hypnaceae

*Ectropothecium leptochaeton* (Schwägr.) W.R. Buck – On wet sandy soil. 1380 m. 24441.

*Mittenothamnium reptans* (Hedw.) Cardot – On rocks. 1380–1680 m. 24504. A further collection from Morona–Santiago Province, along Río Warints: *Toapanta & Quizhpe 1554* (MO, QCNE).

*Mittenothamnium substriatum* (Mitt.) Cardot – On dead branch. 1380–1680 m. 24503.

*Rhacopilopsis trinitensis* (Müll. Hal.) E. Britton & Dixon – On log, associated with *Leucobryum*. 980 m. 24196–A.

*Syringothecium sprucei* Mitt. – On base of tree. 1000–1100 m. 24168. This species is rare throughout its range in the tropical Andes, restricted to premontane and low montane forest at elevations from 1000–2100 m.

*Vesicularia vesicularis* (Schwägr.) Broth. – On logs and rocks along stream. 900–1200 m. 24199–A, 24211, 24386. A further collection from Morona–Santiago Province, Pachicutza: *Holm–Nielsen et al. 4556* (MO).

#### Hypopterygiaceae

*Hypopterygium tamarisci* (Sw.) Brid. ex Müll. Hal. – On base of tree and logs, in deep shade of closed forest. 1480–1811 m. 24533. A further collection from Morona–Santiago Province, in the vicinity of Cerro Chanquiñaz: *Toapanta 1571* (MO, QCNE).

#### Lembophyllaceae

*Pilotrichella flexilis* (Hedw.) Ångstr. – On tree trunk. 2300 m. Recorded from Morona–Santiago Province, near Warints: *Toapanta 1639* (MO, QCNE).

#### Leucobryaceae

*Leucobryum antillarum* Schimp. ex Besch. – On logs. 1815 m. 24349.

*Leucobryum crispum* Müll. Hal. – On rocks. 1380 m. 24428.

*Leucobryum giganteum* Müll. Hal. – On logs, humus and base of treelet. Occasional. 1000–1600 m. 24210, 24304, 24448. A further collection from Shaimi: *Cerón 17300* (MO, QCNE).

*Leucobryum martianum* (Hornsch.) Hampe ex Müll. Hal. – On logs, humus and base of trees. Common. 980–1600 m. 24151, 24182, 24248, 24300, 24472.

*Ochrobryum gardneri* (Müll. Hal.) Mitt. – Leaf litter covered branches. 1340 m. 24399. New to Ecuador. This species is rather rare (or rarely collected) in lowland to low montane forest. Known from Colombia and Bolivia in the tropical Andes (also Central America, Brazil and Suriname).

#### Leucomiaceae

*Leucomium strumosum* (Hornsch.) Mitt. – On logs. 1000–1200 m. 24185, 24379.

#### Macromitriaceae

*Macromitrium fusco-aureum* E.B. Bartram – On trunk. 2300 m. A single collection made from Morona–Santiago Province, 15 km from Warints: *Toapanta 1649* (MO, QCNE).

*Schlotheimia rugifolia* (Hook.) Schwägr. – On trunk of tree; associated with *Octoblepharum albidum*. 1150–1200 m. 24378–A (QCNE).

#### Meteoriaceae

*Meteorium deppei* (Hornsch. ex Müll. Hal.) Mitt. [*M. illecebrum* Sull.] – On tree trunk and fallen branch. 980–1580 m. 24239, 24260.

*Toloxis imponderosa* (Taylor) W.R. Buck [*Papillaria*] – On tree trunk. 1480–1520 m. 24523.

*Trachypus bicolor* var. *viridulus* (Mitt.) Zanten – On tree trunk; associated with *Toloxis*. 1480–1520 m. 24523–A.

#### Neckeraceae

*Isodrepanium lentulum* (Wilson) E. Britton – On branches of shrub. 1380–1680 m. 24496.

*Neckeropsis undulata* (Hedw.) Reichardt – On trunk and branches of treelets and trees. 980–1811 m. 24195, 24244, 24377, 24521. Also known from Morona-Santiago Province, Cerro Chanquiñaz: *Toapanta 1611* (MO, QCNE).

*Porotrichodendron lindigii* (Hampe) W.R. Buck – On trunk of palm. 1000 m. 24204.

*Porotrichum filiferum* Mitt. – On trunk of trees. 1480–1815 m. 24357, 24528.

#### Octoblepharaceae

*Octoblepharum albidum* Hedw. – On trunk of tree, associated with *Syrrophodon parasiticus*. 1150–1200 m. 24368–A, 24378.

*Octoblepharum cocuiense* Mitt. – On exposed tree roots, leaf litter and vertical sandstone rock. Occasional. 1000–1600 m. 24145, 24207, 24447.

*Octoblepharum pulvinatum* (Dozy & Molk.) Mitt. – On fibrous roots of tree, lianas and logs. 980–1100 m. 24158, 24175, 24237.

#### Phyllogoniaceae

*Phyllogonium fulgens* (Hedw.) Brid. – On trunk and branches of trees and treelets. Frequent. 980–1600 m. 24201, 24206, 24439, 24464, 24517. Additional collections from Morona-Santiago Province, along Río Warints: *Toapanta 1576, 1607* (MO, QCNE).

*Phyllogonium viscosum* (P. Beauv.) Mitt. – On trunk of treelets and trees. 1165–1815 m. 24309, 24360, 24452. Further collections from Morona-Santiago Province, along the Río Warints (*Toapanta 1607–A, 1624*, MO, QCNE).

#### Pilotrichaceae

*Callicostella pallida* (Hornsch.) Ångstr. – On logs. 1520 m. 24314.

*Crossomitrium patrisiae* (Brid.) Müll. Hal. – Epiphyllous, including leaves of palm. 900–1000 m. Based on two collections along Río Zamora: *Holm-Nielsen et al. 4481* (AAU), 4592 (MO).

*Crossomitrium sintenisii* Müll. Hal. – On logs. 1165 m. Only known from Morona-Santiago Province, along Río Warints: *Toapanta 1578B* (MO, QCNE).

*Cyclodictyon albicans* (Hedw.) Kuntze – On logs. 980–1800 m. 24235, 24522. A further collection from Morona-Santiago Province, near Santiago: *Ortega U. 439* (MO).

*Hypnella diversifolia* (Mitt.) A. Jaeger – On soil associated with *Breutelia*, logs, base of shrubs, and pendent from treelet branches. Common. 1380–2300 m. 24338, 24363, 24466, 24470, 24483. A further collection from Morona-Santiago Province, near Warints: *Toapanta 1650* (MO, QCNE).

*Hypnella pilifera* (Hooker f. & Wilson) A. Jaeger – On tree trunk. 2300 m. Known from a single collection from Morona-Santiago Province, near Indanza Warints: *Toapanta 1644* (MO, QCNE).

*Lepidopilum affine* Müll. Hal. – On trunk and branches of trees. 1200 m. 24224, 24225–A.

*Lepidopilum brevipes* Mitt. – On tree branches, associated with *L. affine*. 1200 m. 24225.

*Lepidopilum diaphanum* (Sw. ex Hedw.) Mitt. – On leaf litter over fibrous roots, and shrub branches. 1380–2300 m. 24498. A further collection is from Morona-Santiago Province, 15 km from Warints: *Toapanta 1657* (MO, QCNE).

*Lepidopilum erectiusculum* (Taylor) Mitt. – On branches of treelet. 1380–1680 m. 24512. Only known from about seven localities in the tropical Andes (Colombia, Ecuador and northern Peru). This species occurs in premontane and lower montane forest at elevations from 1380–2045 m.

*Lepidopilum scabrisetum* (Schwägr.) Steere – On branches of treelet and base of shrubs. 1165–1680 m. 24285, 24289, 24502. A further record from Morona-Santiago Province, at Estación Biológica Bilsa: *Toapanta 1335* (MO, QCNE).

*Pilotrichum fendleri* Müll. Hal. – On fallen branches and trunk of trees. 1150–1200 m. 24389. Additional collections from Morona-Santiago Province, along Río Warints: *Toapanta 1572, 1582* (MO, QCNE).

*Thamniopsis incurva* (Hornsch.) W.R. Buck – On logs. 980 m. 24187.

*Thamniopsis killipii* (R.S. Williams) E.B. Bartram – On logs. 1165–1380 m. 24414. Also recorded from Morona-Santiago Province, along Río Warints: *Toapanta 1571, 1578A* (MO, QCNE).

*Thamniopsis pendula* (Hook.) M. Fleisch. – On soil, along stream. 1815 m. 24354.

*Thamniopsis undata* (Hedw.) W.R. Buck – On humus, leaf litter, and soil bank. 1390–1815 m. 24356. Also from Nangaritza: *Cole* 227 (MO, QCNE).

*Trachyxiphium guadalupense* (Spreng.) W.R. Buck – On rocks, along stream. 1380–1680 m. 24500.

*Trachyxiphium subfalcatum* (Hampe) W.R. Buck – On logs and fallen tree branches. 1480–1600 m. 24465, 24530.

#### Polytrichaceae

*Pogonatum tortile* (Sw.) Brid. – On soil, associated with *Campylopus*. 1520 m. 24323.

*Polytrichadelphus longisetus* (Brid.) Mitt. – On soil banks. 1380–1880 m. 24318, 24339, 24344, 24430. Also recorded from Morona–Santiago Province: *Croat et al.* 90994 (MO, QCNE).

*Polytrichadelphus* sp. – On soil bank and sandstone rock. 1150–1380 m. 24381. Leaf limb margins entire or nearly so, orange/red spot absent.

*Polytrichum juniperinum* Hedw. – On soil and rocks. 1188–1380 m. 24216, 24430–A.

*Steelebryon subulirostrum* (Schimp. ex Besch.) G.L. Sm. – On rocky soil. 1150–1200 m. 24393. This species is infrequent throughout the tropical Andes at elevations from 1150–3140 m.

#### Pottiaceae

*Barbula arcuata* Griff. – On soil next to water. 1800 m. Only known from Morona–Santiago Province, near San Juan Bosco: *Ortega* 434 (MO).

*Barbula indica* (Hook.) Spreng. var. *indica* – On rocks, concrete of road culvert. 1200–1800 m. 24229, 24320. Also known from Morona–Santiago Province near Santiago: *Ortega* U. 447 (MO). This species and the following variety are common in open, moist or wet sites, often disturbed localities throughout the tropical Andes.

*Barbula indica* var. *gregaria* (Mitt.) R.H. Zander – On vertical rock. 1200 m. 24230.

*Hyophila involuta* (Hooker) A. Jaeger – On soil. 1800 m. Based on a single collection from Morona–Santiago Province near San Juan Bosco: *Ortega* 444 (MO).

#### Prionodontaceae

*Prionodon densus* (Sw. ex Hedw.) Müll. Hal. – On trunk of treelet. 1480–1520 m. 24535.

*Prionodon luteovirens* (Taylor) Mitt. – On trunk of tree. 1815 m. 24366.

#### Pterobryaceae

*Pterobryon densum* Hornsch. – On logs, in dense forest. 1480–1520 m. 24525.

#### Racopilaceae

*Racopilum intermedium* Hampe – Over rocks and leaf litter. 1615 m. 24329.

*Racopilum tomentosum* (Hedw.) Brid. – On leaf litter of bank, also on wet rocks. 1500–1600 m. 24276, 24453.

#### Rhacocarpaceae

*Rhacocarpus purpurascens* (Brid.) Paris – On soil, along disturbed roadside forest. 1670 m. Known only from a single collection in Zamora–Chinchipe Province, region of Nangaritza: *Delinks* 1413 (MO, QCNE).

#### Rhizogoniaceae

*Pyrrhobryum spiniforme* (Hedw.) Mitt. – On base and trunk of trees, fallen branches, logs and rocks, rarely on soil. Common. 980–1900 m. 24076, 24192, 24208, 24264, 24312, 24384, 24457, 24511. Known elsewhere in the Cordillera del Cónдор from several collections: in Morona–Santiago Province from Río Waarints: *Toapanta* 1550, 1581 (MO, QCNE); Zamora–Chinchipe Province, between Los Encuentros and El Sarsa: *Croat* 91105 (MO), Río Jambué: *Croat* 91767 (MO), Río Quimi valley: *Toapanta* 1416, 1420 (MO, QCNE).

#### Sematophyllaceae

*Acroporium estrellae* (Müll. Hal.) W.R. Buck & Schäf.-Verw. – On branches of shrubs, made in a disturbed roadside forest. 1670 m. Known from a single collection in Zamora–Chinchipe Province, region of Nangaritza: *Delinks* 1415 (MO, QCNE).

*Acroporium pungens* (Hedw.) Broth. – On trunk and branches (also pendent) of treelets and trees, lianas, logs, fallen branches, soil, wet rocky soil with *Philonotis*, and sandstone rock. Common. 1000–2300 m. 24159, 24169, 24262, 24286, 24330–A, 24332, 24370, 24427, 24456, 24494. Additional collections from Morona–Santiago Province, along and near Río Waarints: *Toapanta* 1415, 1598, 1609 (MO, QCNE).

*Aptychella proligera* (Broth.) Herzog – On wooden gate, in dense dwarf scrub forest. 2740 m. Based on a single collection, SE of Nambija: *Cole* 138 (MO, QCNE).

*Sematophyllum cucullatifolium* (Hampe) Mitt. – On rocks in stream. 1380–1680 m. 24506.



*Sematophyllum cf. cuspidiferum* Mitt. – On rocks along and in streams, logs, and humus mixed with leaf litter. 1000–1200 m. 24249, 24256, 24382.

*Sematophyllum cf. erythropodium* Mitt. – On logs. 1580 m. 24265.

*Sematophyllum subsimplex* (Hedw.) Mitt. – On logs. Common. 980–1500 m. 24137, 24166, 24240, 24471.

*Taxithelium planum* (Brid.) Mitt. – On dead tree branches. 980–1800 m. 24243. An additional collection from Morona–Santiago Province, near Santiago: *Ortega 446* (MO).

*Trichosteleum papillosum* (Hornsch.) A. Jaeger – On logs. 1500–1600 m. 24267, 24459.

*Trichosteleum cf. vincentinum* (Mitt.) A. Jaeger – On logs. 1165 m. Based on a single collection from Morona Santiago Province, along Río Warints: *Toapanta 1606* (MO, QCNE).

#### Sphagnaceae

*Sphagnum algentryi* H.A. Crum – Terrestrial in swampy area 15 km ENE of Gualaquiza in Morona–Santiago Province. 2500 m. Collected by A. Gentry (80461, MO) in 1993, and described by H. Crum in 1995. This species was assigned by Crum to section *Sphagnum*. At present, this species is the only known endemic for the Cordillera del Cóndor.

*Sphagnum magellanicum* Brid. – Moist humus banks, also base of shrubs. 1340–1600 m. 24395, 24446.

#### Splachnaceae

*Brachymitrium moritzianum* (Müll. Hal.) A. Kop. – Probably epiphytic. 1390 m. Only known from Zamora–Chinchipe Province, along summit ridge above Nangaritzza: *Cole 226* (MO, QCNE).

#### Stereophyllaceae

*Pilosium chlorophyllum* (Hornsch.) Müll. Hal. – On logs. 980–1520 m. 24176, 24305.

#### Thuidiaceae

*Thuidium tomentosum* Schimp. – On logs, rocks, base of palms and trees. 900–1520 m. 24255. A further collection, near Pachicutza: *Holm–Nielsen et al. 4569* (MO).

*Thuidium cf. urceolatum* Lorentz – On rocks and exposed tree roots. 1000–1815 m. 24205, 24362.

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#### Appendix

Cordillera del Cóndor collection localities for S. Churchill et al.

Zamora-Chinchipe Province, Ecuador

**24136–24157.** Canton Nangaritza. Parroquia: Zumi. 14.5 km S of Guayzimi. 04°08'26"S, 0078°38'44"W. 1000 m. 25 Nov 2005. **24158–24170.** Canton Nangaritza. Parroquia: Zumi. 14.5 km S of Guayzimi. 04°08'26"S, 0078°38'44"W. 1000–1100 m. 26 Nov 2005. **24171–24172.** Canton Nangaritza. Parroquia: Zumi. 25 km S of Guayzimi. 04°13'59"S, 0078°38'47"W. 960 m. 27 Nov 2005. **24173–24202.** Canton Nangaritza. Parroquia: Zumi. 26 km S of Guayzimi. 04°14'02"S, 0078°39'48"W. 980 m. 27 Nov 2005. **24203–24215.** Canton Nangaritza. Parroquia: Zumi. Cabañas Yankua, 28 km S of Guayzimi. 4°15'00"S, 0078°39'37"W. 1000 m. 27 Nov 2005. **24216–24220.** Canton Nangaritza. Parroquia: Zumi. 4.1 km S of Guayzimi on road to San José. 04°03'54"S, 0078°42'16"W. 1188 m. 28 Nov 2005. **24221–24231.** Canton Nangaritza. Parroquia: Zumi. 4.5 km S of Guayzimi on road to San José. 04°03'54"S, 0078°42'16"W. 1200 m. 28 Nov 2005. **24232–24246.** Canton Nangaritza. Parroquia: Zumi. Ca. 4 km S of Guayzimi on road to Yankua. 04°06'57"S, 0078°39'09"W. 980 m. 28 Nov 2005. **24247–24258.** Canton Nangaritza. Parroquia: Zumi. Ca. 28 km S of Guayzimi on road to Yankua. 04°14'37"S, 0078°39'42"W. 1000 m. 28 Nov 2005. **24259–24275.** Canton El Pangui. Ca. 14 km E of Los Encuentros. 03°48'39"S, 0078°36'25"W. 1580 m. 29 Nov 2005. **24276–24277.** Canton El Pangui. Ca. 15 km E of Los Encuentros. 03°49'02"S, 0078°36'47"W. 1540 m. 29 Nov 2005. **24278–24304.** Canton El Pangui. El Zarza. Ca. 26 km E of Los Encuentros. 03°50'55"S, 0078°33'57"W. 1580 m. 01 Dec 2005. **24305–24317.** Canton El Pangui. Ca. 23 km E of Los Encuentros. 03°49'41"S, 078°36'25"W. 1520 m. 02 Dec 2005. **24318–24324.** Canton El Pangui. Ca. 21 km E of Los Encuentros. 03°48'45"S, 078°36'32"W. 1520 m. 02 Dec 2005. **24325–24338.** Canton El Pangui. Ca. 33 km E of Los Encuentros. 03°51'14"S, 078°32'21"W. 1615 m. 02 Dec 2005. **24339–24340.** Canton El Pangui. Ca. 38 km E of Los Encuentros. 03°51'54"S, 078°32'03"W. 1640 m. 03 Dec 2005. **24341–24345.** Canton El Pangui. Ca. 50.5 km E of Los Encuentros. 03°54'48"S, 078°29'38"W. 1880 m. 03 Dec 2005. **24346–24366.** Canton El Pangui. Ca. 42–45 km E of Los Encuentros. 03°54'48"S, 078°29'57"W. 1815 m. 03 Dec 2005. **24367–24394.** Canton El Pangui. Cuenca del Río Tundayme, road to

Cóndor Mirador, 7.2 km SE of Tundayme. 03°36'48"S, 078°27'47"W. 1150–1200 m. 04 Dec 2005. **24395–24411.** Canton El Pangui. Cuenca del Río Wawaime, proposed area for EcuCorriente copper mine, 9.4 km SE of Tundayme. 03°34'43"S, 078°26'06"W. 1340 m. 05 Dec 2005. **24412–24444.** Canton El Pangui. Cuenca del Río Wawaime, 7.7 km SE of Campamento de Mirador (EcuCorriente). 03°34'45"S, 078°25'44"W. 1380 m. 06 Dec 2005. **24445–24459.** Canton El Pangui. Cuenca del Río Wawaime, 7.7 km SE of Campamento de Mirador (EcuCorriente). 03°35'06"S, 078°26'18"W. 1500–1600 m. 06 Dec 2005. **24460–24475.** Canton El Pangui. Cuenca del Río Wawaime, 7.7 km SE de Campamento de Mirador (EcuCorriente). 03°35'06"S, 078°26'15"W. 1500–1600 m. 07 Dec 2005. **24476–24514.** Canton El Pangui. Cuenca del Río Wawaime, 7.5 km SE de Campamento de Mirador (EcuCorriente). 03°35'06"S, 078°26'15"W. 1380–1680 m. 08 Dec 2005. **24515–24535.** Canton El Pangui. Cuenca del Río Tundayme, 14 km SW de Campamento de Mirador (EcuCorriente). 03°37'19"S, 078°28'54"W. 1480–1520 m. 09 Dec 2005.