

Altitudinal additamenta to the uppermost ranges of mosses in Ecuador

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Abstract. Of the 26 mosses listed in this report *Amblystegium varium*, *Calliergonella cuspidata*, *Chrysoblastella chilensis*, *Drepanocladus aduncus*, *D. revolvens*, *Racomitrium geronticum*, and *Scorpidium turgescens* are new to the Ecuador moss-flora. The others listed provide updated reports on what was previously stated as their highest altitudinal ranges in both this country and the Neotropics. The taxonomic status of *Drepanoclaus leitensis*, *D. polycarpus*, *Hypnum lacunosum* and *Racomitrium geronticum* are discussed. Collections were made at: Chimborazo Volcano 4700-5200m, Cotopaxi Volcano 3900-4500m, Laguna Toreadore - peak of Patul Mt. 3800-4500m and on N. Tungurahua Mt., close to the tree limit at ca. 3800m.

The mosses listed below are notable species because they are either new to the Ecuadorian moss-flora or their localities were not previously reported from such high elevations. They were selected from a collection that I made during geobotanical observations in the high alpine zones in 1988. The following localities were visited:

Chimborazo Volcano, in the vicinities of the tourist refuge (ca. 5000m, 1°27' S., 78°54' W.) at the S. Chimborazo glacier with the peak 6310m. The collection area was part of the nival and subnival zones. The nival zone extends between the refuge and the border of the glacier. In late November it

was covered by a blanket of snow whose continuity (ca. 1.7 km northwards from the building) was interrupted by sparsely vegetated, dry, rocky tops of hills, ephemeral pools with muddy borders and huge sharp angled stones in ice. The subnival zone, extended down slope ca. 200-250m from the outermost limit of the snow cover. Its land configuration forms dry gibbous hills (similar to hillocks outcropping from snow in the nival zone), separated one from another by gentle boggy depressions covered by moss bogs producing peat and peat-like deposits up to 30 cm thick in most favorable habitats. The continuity of moss-blankets is disturbed by

narrow rivulets, minute water pools, circular mud boils, hummocks raised up by ground ice, rocky streams advancing from slopes and frost cracks. Between xeric and hydric plant gradients occur the mesic zone of which width and thickness control slope inclinations and the water supply. Below the subnival zone commences the arid belt of loose vegetation growing on thick volcanic ashes, composed mainly of tussocks of tall grasses and extensive, loose, low shrub growth. Moss collections were made in nival and subnival zones, between 4750-5200m. In the arid zone observations were performed along the river valley from the large, partly dry peat-bog known as Tortillias (ca. 3000m) to the refuge, and on the way back, along the tourist trail from the glacier to the agriculture zone.

Cotopaxi Volcano, W. side of this mountain with the ice cap, 5789m (0°35' S, 78° 22' W). The main collection was made in the vicinity of Laguna de Limpiopungu, 3900 - 4000m, up to the lowest limit of the nival zone, ca. 4500m. For more details see the description below of a transect referring to *Hypnum lacunosum*. Additional collections and observations were made between Lasso and the gate to the Cotopaxi National Park.

Laguna Toreadore - Patul Mt. Moss collections were made between Laguna Toreadore, ca. 3800m, and the nearby peak of Patul Mt., 4633m (2°38' S, 79°09' W). It is a small part of a huge high alpine lake land called El Cajas National Recreation Area, located 25-40 km to the NW of Cuenca. Laguna Toreadore lies at the uppermost limit of a *Polylepis* forest. Its SW vicinities are boggy, valleys adjacent to its western borders are forested, its eastern side is hilly and covered mainly by grassland, and north towards the peak of Patul extends dry rock-land, extensively overgrown by *Racomitrium* communities. In the northern parts of the lake occur reed swamps and aquatic growth. Tangurahua Mt. In loose, low alpine jungle close to the tree limit at ca. 3800m and down slope to the thermal springs at El Salado.

Altitudinal data of previously reported uppermost localities of species in Ecuador follow mainly Steere (1948), for the Neotropics Delgadillio et al. (1995) and are explained when needed. Herbarium

vouchers, coded on labels E/M.K. and numbered 1 to 51 are housed in NY with duplicates of each species marked D/E/M.K. reserved on a request for the national Ecuadorian herbarium specializing in cryptogames. Some duplicates are deposited in KRAM and MO, as indicated in the full text. I have kept a few stem duplicates or microscope preparations with leaves and stem cross-sections of several species as comparative materials for future studies.

Amblystegium varium (Hedw.) Lindb. [syn. *Hygramblystegium varium* (Hedw.) Moenk.]. N. Tangurahua Mt., ca. 3800m, along borders of stream ending in El Salado, on rocks splashed by water and on muddy soil, E/M.K. 1. Frequent. Fertile. Probably reaching the nival zone of the Tangurahua glacier. Diagnostic features of collected specimens vary considerably depending on micro-habitats and water supply. The normally flexuose costa when shortened becomes bent or straight, marginal serration is often discontinuous or absent, leaves are sometimes wider than on typical specimens.

New to the Ecuadorian moss-flora. In the Neotropics previously reported up to 1900m.

According to my observations it seems to be frequent in Ecuador as indicated by the following localities: the Cotopaxi region, NE. vicinities of Lasso, ca. 2800-3000m, on sandy terrace, E/M.K. 2; the Rio Pastaza valley, between Rio Negro (ca. 1000m) and Agoyan Waterfall (ca. 2000m), on alluvial mesic to hydric deposits, E/M.K. 3, 4; the vertical wall at the El Salado hot spring is covered by an extensive and luxuriant growth of this species.

Calliergonella cuspidata (Lindb.) Loeske. Around Laguna Toreadore, 3800-3900m. Mesic borders of blanket moss bogs and permanently wet meadows, E/M.K. 5, 6. Generally frequent. Sterile. The Cotopaxi area, around Laguna de Limpiopungu, 3900-4000m. In moss bogs, E/M.K. 7, 8. Rather rare. Sterile. Duplicate in MO.

New to the moss-flora of Ecuador. In the Neotropics (Peru, Brazil) up to 4500m.

Campylopus aerodictyon (C. Muell.) Mitt. Chimborazo Volcano, 4900-5100m. In the nival zone in *C. nivalis* patches, E/M.K. 9. Rare. Sterile.

Duplicate in MO. The determination was confirmed by B. Allen.

In Ecuador reported up to 3200m (9500 ft) and in the Neotropics up to 4500m.

C. nivalis (Brid.) Brid. Chimborazo Volcano, 4800-5100m, between stones or on silty dry soil on hillocks outcropping from the snow cover, E/M.K.10. In the nival zone specimens are short and strongly damaged by nival factors. Leaves of these plants are smaller, fragile, mostly with broken leaf ends, with shorter and wider blades but anatomically they are typical. In rock chasms and between stones in dry and sheltered places of the subnival zone occur its luxuriant forms with long, narrow leaves and dentate apex. Between these two environmental modifications exist all intermediate gradients. Duplicate in MO. The determination was confirmed by B. Allen.

It is not well known in Ecuador. In the Neotropics it has previously been reported up to 4550m.

C. subjugorum Broth. The subnival zone of Chimborazo Volcano, 4800-5000m, on dry tops of higher moss-hummocks among bogs and on dead stands of *Distichia*, E/M.K. 11, 12. Rare. Sterile. The duplicate is in MO. Determined by B. Allen. In the opinion of H. Robinson it is *Campylopus* cf. *capitulatus* Bartr.

In Ecuador up to 4650m (Thériot 1936, cf. Steere 1948). In the Neotropics (Peru) up to 5200m (Frahm 1975).

Ceratodon purpureus (Hedw.) Brid. Chimborazo Volcano, up to 5150m, in the nival zone on snow free habitats (mud around ephemeral pools, fine gravelly soil) from the tourist refuge to 1-1.5 km towards the glacier. Below the snow zone on dead parts of dense growth, on anthropogenic habitats and some others, E/M.K. 13. A search for specimens with sporophytes was unsuccessful. Frequent. Sterile.

Specimens stressed by nival conditions are low, dense, often fragile, dark, their leaves mainly triangular. Other features are as in *C. purpureus* ssp. *purpureus*. A few hundred meters below the refuge fertile specimens of both *C. purpureus* ssp. *purpureus* and *C. purpureus* ssp. *stenocarpus* were observed on many places.

C. purpureus is common in Ecuador but only published from a few localities (see Steere 1948). At the Antisana glacier it occurs up to 4650m (Bartram 1964). In the Neotropics up to 3900m (Delgadillo et al. 1995).

Chrysoblastella chilensis (Mont.) Reim. Chimborazo Volcano, 4750-5000m, in the arid zone on volcanic ashes and between stones in the subnival zone among other mosses, E/M.K. 14. Rare. Sterile.

The range of this taxon is poorly known because its taxonomic status was not clear until recently clarified by Buck (1981).

New to the Ecuadorian moss-flora. In the Neotropics previously reported up to 3100m.

Cratoneurum filicinum (Hedw.) Spruce. Frequent in the vicinities of Laguna Toreadore, 3800-4000m, moss-bogs at its SW part. Specimens in this locality are 7-12 cm high, red, upwards directed, pinnate branching, branches short and curved, leaves straight and triangular, E/M.K. 15. Per borders of wet meadows at the E. side of the lake specimens are lower, irregularly branching, their leaves curved, cells of upper leaf parts often longer than 5:7, E/M.K. 16. Single, loosely leaved, irregularly branched plants, up to 20 cm long, were seen in reed swamps. Sterile.

From Ecuador reported once only from 3100m. I observed it several times in mountain bogs, e.g., in abundance at the SE Coyambe glacier just at the upper tree limit. In the Neotropics up to 4700m.

Daltonia tenuifolia Mitt. Chimborazo Volcano, from 4750m up to lower parts of the subnival zone, on fine mineral soils considerably enriched with humus and also on dead and dry tops of moss-hummocks among bogs, E/M.K. 17. Rare. Fertile.

Previously known in Ecuador from Prov. Chimborazo (Pallatanga), ca. 2000m (Mitten 1869), at tree line, revised by Bartram (1931); cf. also Steere (1948). In the Neotropics previously reported up to 3100m.

Drepanocladus aduncus (Hedw.) Warnst. Chimborazo Volcano, 4750-4900m, subnival moss bogs, per borders of ephemeral rivulets and shallow pools, E/M.K. 18, 19. Rare. Sterile.

Cotopoxi Volcano, ca. 3900m, around Laguna de Limpiopungu, in moss-bogs, rarely in water, E/M.K. 20. Rare. Sterile. Duplicates in KRAM.

Plants at the first locality, depending of water conditions, develop environmental modifications which can be arranged in a catena presented in Fig. 1. Adnate plants permanently submerged are single, up to 6 cm long, rarely forked, flexuose, brown, loosely leafed; leaves straight, 2-3 mm long and 0.6-0.8 mm wide, costa weak and reaching $\frac{3}{4}$ of leaf length; mid-leaf cells 5-8x longer than wider, alar cells distinct, auriculate, composed of inflated, oval, hyaline cells, indistinctly decurrent, not reaching costa, sharply separated from lamina cells. These plants can be referred to *D. aduncus* f. *aquaticus* (San.) Moenk., *D. aduncus* f. *pseudofluitans* (San.) Moenk. or *D. aduncus* f. *filicuspis* Moenk. Stems whose upper parts extend above the water level are branching, have secund leaves with stronger costae, shorter mid-cells and smaller alar cells. They are intermediate between aquatic forms and those from bogs called "*D. polycarpus*" (see below). Typical expressions of this modification grow in moss-bogs. Depending on the degree of substrate desiccation, their lateral branches develop into smaller than normal dendroidal morphoses which assume the function of the decaying main stems. Under most mesic conditions, especially with a short water deficit period, specimens are dwarf, only up to 2 cm long, densely leafed, leaves smaller, with stronger curvature and costa, smaller alar cells, mid-leaf cells only 1:1.5(2) or as long as wide and their areolation similar to cell net of psuedoparaphyllia. They represent the last stages of depauperation.

D. aduncus as here presented is new for the moss-flora of Ecuador (cf. below, *D. leitensis*). In the Neotropics reported up to 4350m.

D. leitensis (Mitt.) Broth. [Steere 1948 under the name *D. leitensis* (Mitt.) Steere]. I strongly support Robinson's opinion about this taxon (Robinson et al. 1977, p. 115): "... specimens seem to be nothing but a short leaved and short-leaf-celled form called *D. aduncus*... etc". Crum (1957) however, listed it as a species. I had a chance to discuss its species status with the late W.C. Steere on the basis of NY specimen #27625 from N. Cayambe Volcano (3450m) and my specimens

(s.n.) from SE Cayambe (swamps at the tree limit). We agreed that this taxon is non-separable from *D. aduncus*. Moreover, W. C. Steere informed me that all South American collections named *D. leitensis* examined by him also belonged to *D. aduncus*.

D. polycarpus (Voit) Warnst. (syn. *D. polycarpus* (Voit) Warnst.). Hedenäs (1996) exhaustively and convincingly presented the taxonomic problems of this moss, calling it a "*Drepanocladus aduncus-polycarpus* complex". Numerous opinions published during the last century about the taxa embraced by this complex treat their taxonomic positions as seasonal forms or "good species". In the light of my field observations presented above "*Drepanocladus polycarpus*" is only an environmental modification controlled by the water supply available to substrates. This is not a new idea (cf. Hedenäs, l.c.). Previous similar opinions were based on materials from the temperate zone of the Northern Hemisphere, except for observations published by Robinson et al. (1977) regarding "*D. leitensis*" (see above). Moreover, the interesting experiment performed by Hedenäs (l.c.) confirms to some extent my field observations. Much more could be added to the "*Drepanocladus aduncus-polycarpus* complex", however that is out of the scope of this note. Generally, in my opinion, this problem is greatly exaggerated in proportion to its scientific significance.

D. revolvens (Sw.) Warnst. Laguna Treadore, ca. 3800-3900m, large patches in moss-bogs, E/M.K. 21-23. Frequent. Sterile.

New to the moss-flora of Ecuador. In the Neotropics reported from Peru, 3400-4550m (Hegewald & Hegewald 1985) and in N Columbia from the Prov. Magdalena (Florschütz-de Waard & Florschütz 1979, cf. Churchill 1989) without altitudinal data. While surveying for mosses in this province I did not see habitats suitable for *D. revolvens* on the lowlands or in the mountains up to 1300m.

Encalypta asperifolia Mitt. From Tortillias up to Chimborazo Mt. ca. 4450m. In rock fissures with organic soil, E/M.K. 24. Rather rare. Fertile.

In Ecuador known from two high alpine

localities (Horton 1983, Fig. 233, see also Steere 1948) ca. 3000m (9000 ft). In Neotropica up to 4520m.

Eustichia jamesonii (Brid.) Brid. Chimborazo Volcano, 4990-5100m, in the nival zone. Rare on hills outcropping from snow, where it occurs together with poor forms of *Bartramia* sp. and *Philonotis* sp., E/M.K. 25. Specimens strongly stressed by nival factors, 0.5-1 cm tall, with short leaves 0.5-0.75 mm long, wider and blunder than typical ones, weakly distichous but arranged in a spiral phylotaxy. Marginal projections low as papillae and teeth disappear towards apex. It is more frequent and typical in the subnival zone where it grows between stones and on organic substrates. These plants seem to be similar to "small and poorly developed" specimens described by Crum (1994) from Mexico and Guatemala. Cotopaxi Volcano, 3900-4100m, in the zone of dwarf bosco (observed also 3600-3850m). On humic soil and in rock fissures, E/M.K. 26. Rather rare. Sterile.

Bartram (1949) after examinations of many specimens of this species from various parts of South America concluded: "...I suspect they are merely forms of one broadly distributed species possibly referable to *E. longirostris* Brid." (see also Robinson 1975, p. 37). This is quite possible.

It is difficult to be precise concerning the altitudinal range of this taxon because of its taxonomic uncertainty. Previously reported in Ecuador from ca. 4000m. In the Neotropics up to 3048m.

Hypnum lacunosum (Brid.) Hoffm. Around Laguna Toreadore, 3700-3900m, on dry grassy slopes and outcropping rocks, E/M.K. 27. Frequent. Sterile. Cotopaxi Volcano, from Laguna de Limpiopungu to the nival zone at the W. Cotopaxi glacier, E/M.K. 28-33. Frequent. Sterile.

Ecology of this moss at the last locality was surveyed along a transect from boggy borders of Laguna de Limpiopungu nearly up to the nival zone, where it occurs in several distinct eco-forms connected one to the other by gradual transition ecotones. (1) On wet places, among dense moss bogs, stems of this form are 3- 4 cm high, green, thin, loosely leafed, nearly unbranched, upwards directed, clearly

complanate, leaves large with indistinctly curved apices. Their habits are similar to *Hypnum pratense*, E/M.K. 31. (2) Per borders of the peat zone, especially in grassy places, stressed by a seasonal water deficit, occur rusty forms, in dense flat patches, producing a specific grassy peat-like deposit. Their decumbent stems are forked or poorly branched, densely leaved, with secund, smaller and narrower leaves, E/M.K. 29, 33. (3) In under story of loose, very dry, shrubby vegetation, especially on inclined slopes, forms are most typical, robust, brown, 8-10 cm tall, forming loose patches. Their stems are turgid, simple or forking, weakly complanate, densely leaved, usually upwards directed, leaves large, slightly secund with distinctly recurved tops. When moist their habits resemble *Rhytidium rugosum*, E/M.K. 28. (4) In widely open chasms, between stones and on borders of larger stones above the tree limit grow small, irregularly branching, complanate, plagiotropous forms, with small, secund, usually red leaves. They seem to be depauperate plants, E/M.K. 30.

Most bryologists consider *H. lacunosum* as *H. cupressiforme* var. *lacunosum* Brid. Crum (1957) when he discussed its variability and taxonomic distinctness, stipulated that European specimens were not seen. I have studied them over many years, both in the field and in laboratories. On dry loess substrates, among steppe vegetation or on rocky and sunny shelves, e.g., in Poland (Kuc 1964), *H. cupressiforme* var. *lacunosum* has stems nearly julaceous, cuspidate, up to several cm long, single or forked. In Bulgaria (Kuc et al. 1965), on islands of the Adriatic Sea, S. Spain in Sierra de Lujar (unpublished materials), among Mediterranean xeric shrub growth, on rocky, sunny soils occur its forms similar to *H. lacunosum* in South American but they are smaller, never found in boggy places and distributed from sea level up to mid-elevations in mountains. Common and permanent features of these forms are the following: extra large alar cells, areolation and anatomic structure of stem in its cross-section. Literature about *H. lacunosum* is extensive but its taxonomic position still is disputable and needs an opinion of a competent monographer. Therefore its species rank applied here is a suggestion only.

Previously reported from Ecuador up to 4300m at the Antisana glacier by Bartram (1964), who stated: "This well marked variety seems to be one of the commoner species at high altitude". In the Neotropics reported up to 4035m.

Plagiomnium rhynchophorum (Hook.) T. Kop. W. Laguna Toreadore, 3750-4000m. In valleys covered by *Polylepis* forest, E/M.K. 35. Frequent but restricted to this biome, where it grows as single specimens or loose colonies in thick bryophyte mats, on rotten logs, lower parts of trees and bases of rock walls; all in mesic and shadowy conditions. Largest patches reach several square meters. Luxuriant specimens reach 6 cm and produce long arched stoloniform stems. Few sporophytes were observed.

Its highest previously reported locality in Ecuador was 3109m (Bartram 1955, Robinson et al. 1977). Williams (1927, p. 494) reported this species from 8700 ft., not meters as erroneously figured Steere (1948, p. 105). In the Neotropics previously known up to 3200m.

Pleurozium schreberi (Brid.) Mitt. From Laguna Toreadore up to 4200m, in *Polylepis* forests. On humic soil, rotten wood and lower parts of snags, E/M.K. 36. Rare. Sterile.

In Ecuador its highest altitudinal data of 4300m was reported by Bartram (1964). In the Neotropics up to 4500m.

Polytrichum juniperinum Hedw. Chimborazo Volcano, 4750-5180m. In the nival zone specimens growing between stones and on mud around ephemeral pools are greatly stressed by nival conditions though can be up to 5 years old. Their annual growth rates are ca. 0.5 cm long, rusty brown, head-like and arranged one on another, E/M.K. 37. Frequent. Sterile. Specimens in the subnival zone are green, with annual growth rates up to 1.5 cm, growing on soil between stones, among other mosses or on peat.

The previous highest altitudinal record in Ecuador is 4650m from vicinities of the Antisana glacier (Bartram 1964). In the Neotropics previously reported up to 4700m.

Robinson et al. (1971) published a useful list of its numerous synonyms.

Racomitrium crispipilum (Tayl.) Jaeg. Chimborazo Volcano, in nival and subnival zones, 4750-5150m, on dry rocky soil, E/M.K. 38. Rare. Sterile. The Laguna Toreadore area, 3800-4000m, on rock-land, E/M.K. 39, 40. Frequent and in large patches. Sterile. W. Cotopoxi Mt. from ca. 2920-3850m, on rocky dry open habitats, E/M.K. 41-43. Rare. Sterile.

Previously reported from Ecuador up to 4650m. In the Neotropics up to 4800m.

Racomitrium geronticum C. Muell. [syn. *R. lanuginosum* subsp. *geronticum* (C. Muell.) Vitt & Marsh]. Collected only once below Patul peak ca. 4100m, on rocks along streams and in mats of *R. lanuginosum*, E/M.K. 44. Probably frequent but not observed in field. Sterile.

New to the Ecuadorian moss-flora and the Neotropics.

Vitt & March (1988) excellently presented the morpho-anatomical distinctness of this taxon based mainly on differences in awn dentition and considered it as *R. lanuginosum* subsp. *geronticum*. I did not find intermediate characteristics between awn teeth of these taxa and for this reason C. Mueller's concept is here accepted. Generally awn teeth of *R. geronticum* are more similar to awn teeth of *R. pruinosum* than of *R. lanuginosum*.

The Ecuadorian locality is quite disjunct from the distribution center in southern South America and some maritime Antarctic islands, see P.VII, Fig.1 in Vitt & Marsh (l.c.), who considered it as a "seemingly endemic South American species".

R. lanuginosum (Hedw.) Brid. From the northern border of Laguna Toreadore to 4400m below the peak Patul, in large silver mats on bedrock, E/M.K. 45. In the most favorable habitats mats are 15 cm thick and often underlain by a specific, peat-like *Racomitrium* bio-product. Common and abundant above the tree limit on the whole area of the El Cajas National Recreation Area and most probably reaches the highest peaks. Its lowest altitudinal limit is defined by the appearance of forest formations in the alpine zone. Sterile.

Previously reported from highest localities in Ecuador by Mitten (1869), cf. also Steere (1948) - ca. 3180m (9500 feet). The data of up to 2896m

given for the Neotropics by Delgadillo et al. (1995) is not precise. I never have seen it in Ecuador below 1000m.

An interesting opinion about its occurrence in Peru is expressed by Deguchi (1987): "The rarity of this moss in Peru is ... phytogeographically noteworthy, since it can be found here and there in middle to southern Chile...". In the light of these observations, occurrence of this species in Ecuador now gives the range of this species the character of disjunctive, well bordered distribution groups (Chimborazo, Cajas, Cotopaxi and probably elsewhere).

Rhacocarpus purpurascens (Brid.) Par. Laguna Toreadore area, 3600-3900m, on dry, sunny rocks, E/M.K. 46. Abundantly in some places but not enough observed in field. Probably reaching higher elevations and seems to be a frequent plant. Sterile.

It was reported from Ecuador up to 4300m (Bartram 1964). In the Neotropics up to 4400m.

Sanionia uncinata (Hedw.) Loeske. Cotopaxi Mt., 3700-4500m, in dwarf shrubs clusters on silty soil and between stones per a border of the nival zone, E/M.K. 47. Frequent. Sterile.

In Ecuador previously reported by Mitten (1869) from the mountain Carguairazo at ca. 4000m (11,000-12,000 ft.; cf. Steere 1948). In the Neotropics figured by Delgadillo et al. (1995) only up to 3658m.

Scorpidium turgescens (T. Jens.) Loeske. Around Laguna Toreadore, ca. 3850m, blanket moss-bogs at SW. parts of this lake, in reed swamps (long specimens) and along lowest boggy parts of some streams. In small patches, loose tufts or in single specimens mingled in stands of hydrophilous growth, E/M.K. 48-50. Not rare. Sterile.

Laguna Toreadore specimens have a highly unusual pathological feature (also observed by R. Ochyra - pers. comm.). It first appears on leaf margins at both sides of the apex of premature leaves compacted in stem apical buds as distinct teeth, straight or curved but never recurved, always smaller than the apiculus. On mature leaves, starting from the space between the apiculus and these "teeth" develop ruptures

reaching below the middle of leaf.

For examination of diagnostic features of *S. turgescens* such as leaf shape, leaf concavity, alar cells, decurrency, cucullate or recurved apex and others, material should not be covered by a cover glass because it greatly reduces their three-dimensionality.

New to the Ecuadorian moss-flora. In the Neotropics up to 4100m.

In the Laguna Toreadore population of *S. turgescens* one can recognize the following ecomorphoses. (1) *S. turgescens* f. *tenue* (Berggr.) Podp. (syn. *S. turgescens* var. *tenue* (Berggr.) Kar.): thin, green, mostly single stems, loosely leaved by small leaves (cf. Kuc 1963, Fig. 29). They are lateral stems, which can survive harsh conditions better than typical ones. (2) The dendroidal green form, growing upwards, in tufts (#50) known as *S. turgescens* f. *uliginosum* (Lindb.) Podp. (3) The form called *S. turgescens* f. *cuspidatum* Kuc (Kuc 1963), characterized by short, turgid, strongly apiculate, decumbent red stems with strongly damaged older leaves. It develops in mobile water, e.g. per borders of streams.

Hedenäs (1993) incorporated *S. turgescens* into *Pseudocalliergon* (Limpr.) Loeske together with very different mosses (*Calliergon trifarium*, *Drepanocladus brevifolius*, *D. lycopodioides* and *P. angustifolius*, a *Drepanocladus*-like moss) creating a taxonomic syndrome not accepted by me. On the other hand *S. turgescens* is a very distinct taxon, worthy of a new generic name separating it from *Scorpidium*.

Toloxis imponderosa (Tayl.) Buck [syn. *Papillaria imponderosa* (Tayl.) Broth.]. N. Tungurahua, 3600-3800m, in forest, on humic soil at the river, E/M.K. 34. Very rare. Sterile.

Known from this mountain up to ca. 2330m (Steere 1948) and from a few more localities in Ecuador. In the Neotropics previously reported up to 2800m.

Warnstorfia exannulata (B.S.G.) Loeske. Around Laguna Toreadore, 3750-3800m. and along streams, in moss bogs at SW. border of the lake and in shallow water among aquatic vegetation at its N. border, E/M.K. 51. Frequent. Sterile.

This is an environmental adaptation characterized by purple colouration, floating

stems, straight leaves, strongly reduced dentition of leaf margin, costa ending in apex and large alar cells. It seems to be closest to *W. exannulata* var. *purpurascens* (Schimp.) Loeske.

From Ecuador previously reported only from Laguna Papallacta, 3800m, by Robinson et al. (1977). In the Neotropics up to 3900m.

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