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The Bryologist, Vol. 104, No. 4. (Winter, 2001), pp. 602-606.

Stable URL:

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New Moss Records for Mexico from the Lacandona Tropical Rain Forest, Chiapas

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Abstract. *This paper reports nine new moss records for Mexico from the Lacandona Forest: Calymperes rubiginosum, Fissidens guianensis var. guianensis, Mniomalja viridis, Orthostichella hexasticha, Orthostichopsis praetermissa, Phyllocladon falcifolium, Syrrhopodon flexifolius, Syrrhopodon africanus subsp. graminicola, and Syrrhopodon hornschurchii. Findings reported here demonstrate that there is still incomplete knowledge of the moss diversity in the Lacandona tropical rain forest region. Future research in tropical forests of southeastern Mexico and Central America will help to corroborate the continuity of distributional patterns from South America to North America through the Central American bridge.*

Resumen. *Se comunican nueve registros nuevos para México de la Selva Lacandona: Calymperes rubiginosum, Fissidens guianensis var. guianensis, Mniomalja viridis, Orthostichella hexasticha, Orthostichopsis praetermissa, Phyllocladon falcifolium, Syrrhopodon flexifolius, Syrrhopodon africanus subsp. graminicola, y Syrrhopodon hornschurchii. Los resultados obtenidos demuestran que, en la selva tropical perennifolia de la región Lacandona, el conocimiento sobre la diversidad de los musgos todavía es incompleto. Investigaciones futuras en las selvas tropicales del sureste de México y Centroamérica, ayudarán a corroborar la continuidad de los patrones de distribución desde Sudamérica a Norteamérica a través del puente centroamericano.*

The Lacandona region, Chiapas, is located in southeastern Mexico and holds the northernmost and largest remnant of tropical rain forest on the North American continent (Medellín et al. 1992). Estimated biodiversity in the Lacandona tropical forests is significantly rich, and therefore it has been listed as one of the megadiverse sites of the world (Mittermeier et al. 1997). A large part of the forest is included in the Montes Azules Biosphere Reserve (Gobierno del Estado de Chiapas et al. 1992). It is an area of high sociopolitical interest, threatened by human activities such as deforestation, hunting, agriculture, livestock, and oil exploitation (O'Brien 1995, 1998).

In the past decade, the Lacandona forest has been the subject of diverse studies that are contributing to the accurate estimation of its biodiversity (e.g., Equihua 1998; de la Maza & de la Maza 1985; Martínez et al. 1994; Medellín 1991; Salgado Ortíz 1993) and to the understanding of this complex

ecosystem (e.g., Dirzo & Miranda 1990; Medellín 1994; Medellín & Equihua 1998; Medellín & Gaona 1999; Mendoza & Dirzo 1999). As a result of these studies, a new family of angiosperms, the Lacandoniaceae, was described (Martínez & Ramos 1989). Also new records of diverse organisms are continuously added to biological inventories (e.g., Equihua & Pocs 1999; López et al. 1998). Martínez et al. (1994) have registered 3,400 species of vascular plants for the entire Lacandona forest (ca 2,000,000 ha). In the Chajul area alone (Fig. 1) 637 species of vascular plants (Martínez et al. 1994), 113 species of mammals (López et al. 1998; Medellín 1991), 800 of diurnal butterflies (de la Maza & de la Maza 1985), and 345 species of birds (Salgado Ortíz 1993) have been registered.

As part of the efforts towards a better understanding of the biodiversity in the Montes Azules Biosphere Reserve (Lacandona Forest), a bryofloristic inventory of the southern part of the Reserve

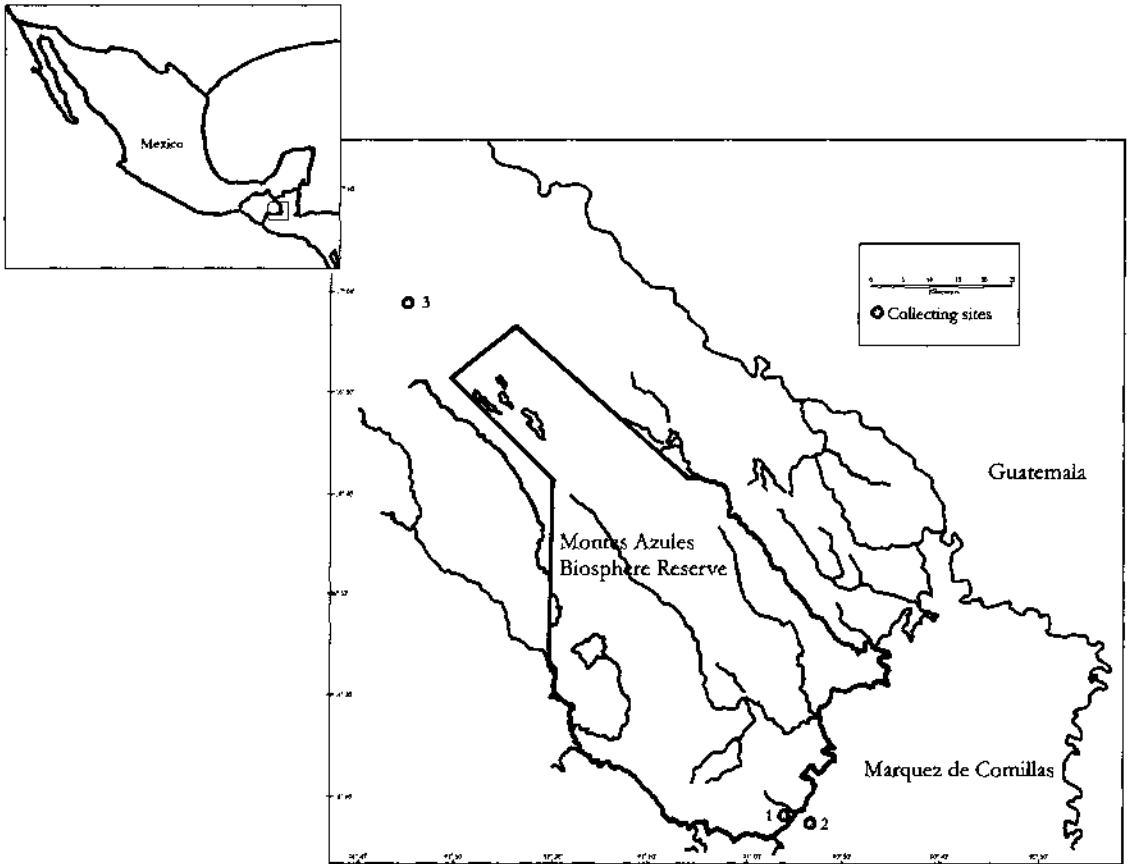


FIGURE 1. Collecting localities in the Lacandona Forest, Chiapas, Mexico. 1) Chajul Biological Station, 2) Ejido Boca de Chajul, 3) Nahá village.

was started in 1996 by the first author. Epiphyllous liverwort records were published recently (Equihua & Pocs 1999). In this study we report nine new additions to the Mexican moss flora from collections made in the Reserve area from 1996 to 1998. Even though other bryologists have collected in Chiapas (e.g., Bourell 1992; Delgadillo & Cárdenas 1989; Sharp 1945), there is no systematic survey of the mosses of the Lacandona rain forest. Floristic records on the mosses of Chiapas are based on collections from the central and northern part of the state. Sharp (1945) discussed the biogeographical importance of the flora of the central part of the state and its similarities with that of eastern United States. Delgadillo and Cárdenas (1989) reported 155 species of mosses of high elevations. Both studies were based mainly on collections from the coniferous and oak forests in the highlands of the state. Recently, as part of the Flora of Chiapas project, Bourell (1992) reported 364 species of mosses based on the extensive collections of D. Breedlove and herself from the municipalities of Chiapa de Corzo and Huistán. Our study is one of the few papers (see also Delgadillo 1976, 1987; Delgadillo

& Reese 1976) dealing with the mosses of tropical rain forests of México.

METHODS

Most of the field work was done during the summer and fall of 1996 and 1997 and the summer of 1998. Collections from previous trips were also included in this study. A total of 1,506 moss samples were collected during visits to the areas of Chajul (including the Ejido Boca de Chajul), Ixcán, Tzendales, Nahá, Lacanhá-Chanzayab, and Nuevo Chapultepec (Equihua & Pocs 1999). Collections were made by standard floristic methods (Delgadillo & Cárdenas 1990). Specimens gathered by C. Equihua are referred to with numbers. Other specimens are marked with last name and number. Coordinates were calculated *in situ* with a Trimble GPS, datum WGS84.

Identification of the specimens was based on Sharp et al. (1994), Reese (1993), Florschütz (1964), and Churchill and Linares (1995). All the specimens were identified by the authors with the exception of *Fissidens guianensis* var. *guianensis*, that was determined by R. Pursell, and *Orthostichella hexasticha*, which was determined by D. Griffin III. Specimens are deposited at the National University of Mexico, Mexico City (MEXU), Institute of Ecology, Xalapa (XAL), with some duplicates at London (BM), the University of Louisiana (LAF), and Missouri Botanical Garden (MO). Our citations of the new records are organized by genus and species, collecting number, herbarium where

the specimen is deposited, general distribution of the species, habitat, microhabitat, and other taxonomic comments as appropriate.

Collecting Localities.—LACANDONA FOREST (outside the Biosphere Reserve):

No. 740, 2044, 4596. Marquez de Comillas region. Butterflies Reserve within the Ejido Boca de Chajul. 16°06'N, 90°56' W. 180 m elevation.

Newton 4596, De Luna 2388-b, Marquez de Comillas region, Butterflies Reserve within the Ejido Boca de Chajul. 16°06'13"N, 90°56'49"W. 180 m elevation.

No. 1517b. Trail south of Nahá village, towards Nabolón camp and Nahá lake. 16°59'N, 91°35'W. 787 m elevation.

No. 1567. Northern side of Nahá lake. 16°59'N, 91°35'W. 745 m elevation.

Montes Azules Biosphere Reserve:

No. 788, 790, 796, 808, 1401a, 1428a, 1429, 1433, 1445, 1449. Trail from Chajul Biological Station to Savannas 1 & 2. Between 16°07'N, 90°56'W and 16°07'N, 90°57'W. 120 m elevation.

Gradstein 7942, 7949, 7955, 7975, 7989, 7990, 7994, 7998, 8010, 8019, 8031, 8043, 8047, 8062, 8068a, 8081, 8090a. Area 5 km upstream from Chajul Biological Station. 16°07'N, 90°57'W. 120 m elevation.

Medellín. s.n. On side of Arroyo José 200 m NE of the Chajul Biological Station. 16°06'28"N, 90°56'36"W. 120 m elevation.

MOSES NEW TO MEXICO

Calymperes rubiginosum (Mitten) Reese, 796, 808, 1428a, 1429 LAF, MEXU. Distributed from Honduras to northern South America at low elevations (Reese 1993). The specimens were collected in tropical rain forest (16°07'N, 90°56'W), and in low tropical forest. All of the specimens came from tree trunks (*Miconia* sp. and other unidentified tree species) under humid conditions, but sites with rather open canopy (with the exception of specimen 808 that came from a shaded site). Specimens 796 and 808 had abundant gemmae growing from the costa at the apex of the leaves. Specimens 1428a and 1429 had sporophytes.

Fissidens guianensis var. *guianensis* Montagne, *Gradstein 7942, 7955, 7975, 7989* (MEXU, MO). The species is reported as widely distributed in the Neotropics (Churchill & Linares 1995), but never before found in Mexico. The specimens reported here were collected during ecological research (Equihua & Gradstein, in prep.). The specimens were found in an undisturbed forest and in an 8 yr old abandoned agricultural field with regenerating 2-story rain forest, rich in *Cecropia* sp. Growing between 0–2 m height.

Mniomalia viridis (Mitten) Müll. Hal., 790, 1445 (MEXU). This species is widely distributed in the Neotropics (Churchill & Linares 1995). The specimens came from the area surrounding the Chajul Biological Station in tropical rain forest. Both spec-

imens were collected from tree trunks under exposed, humid to dry conditions.

Orthostichella hexasticha (Schwägr.) Buck, *Medellín s.n.* (MEXU). Found originally in Cuba and Hispaniola growing on trees and shrubs (Buck 1998), our specimen was collected was growing in the area surrounding the Chajul Biological Station as an epiphyte on a liana trunk in tropical rain forest, under humid and exposed conditions.

Orthostichopsis praetermissa Buck, 2053 (MEXU). Widely distributed in humid forests in the Americas, growing on tree trunks and frequently in the canopy (Buck 1998; Churchill & Linares 1995). The only specimen we collected of this species was found in the area surrounding the Chajul Biological Station, growing on a tree branch under exposed and wet conditions.

Phyllocladon falcifolium (Schwaegr.) Crosby, *Newton 4596, DeLuna 2388-b* (BM XAL). Widely distributed in the Neotropics (Churchill & Linares 1995). Collected from low tropical rain forest on a tree trunk from a Butterfly Reserve established by the people from the Ejido Boca de Chajul. The reserve was severely damaged by fire during the dry season of 1998. The status of this *Phyllocladon* population after our visit is unknown.

Syrrophodon flexifolius Mitten, 788b (MEXU). Distributed in Costa Rica, Panama, and the Amazon region of Venezuela and Brazil, up to 1,200 m elevation. Our specimen came from a tree trunk in tropical rain forest, under exposed and humid conditions mixed with *Syrrophodon africanus* subsp. *graminicola*.

Syrrophodon africanus Mitt. subsp. *graminicola* (Williams) Reese, 788a (MEXU). Distributed in tropical America, from Belize to Brazil, to ca 500 m elevation. Our specimen was collected in tropical rain forest on a tree trunk under exposed, humid conditions.

Syrrophodon hornschurchii Martius, 740, 1433, 1449, 2044 (MEXU). Originally described by Reese (1993) as an endemic to South America, from Colombia to Brazil, it is now known from Panama in Central America (Salazar Allen & Chung 1997). The Mexican specimens are an extension of its range from Central America. Our specimens were found in tropical rain forest on tree trunks of *Calophyllum mexicanum* and *Miconia* sp. All our specimens were found under exposed and humid conditions and had abundant gemmae ventrally at the tips of leaves, specimen 740 had sporophytes.

DISCUSSION

The Lacandona region has been demonstrated to harbor a vast richness in biodiversity (Mittermeier et al. 1997). This is shown by continuing discovery

of new records of diverse organisms for the region (López et al. 1998). We have collected extensively in the Lacandona area; these new records represent 6% from a sample of 250 specimens. All these new records come from rain forest.

Our findings show three patterns: 1) species widely distributed in the Neotropics (*Fissidens guianensis* var. *guianensis*, *Mniomalia viridis*, *Orthostichopsis praetermissa*, *Phyllocladum falcifolium*, and *Syrhropodon africanus* subsp. *graminicola*); 2) an Amazonian element (*Calymperes rubiginosum*, *Syrhropodon hornschiichii*); and 3) a Caribbean element (*Orthostichella hexasticha*). This pattern is consistent with previous findings in liverworts (Equihua & Pócs 1999), mammals (Medellín et al. 1992), and diurnal butterflies (de la Maza & de la Maza 1985). Future research in this and other central american regions will help understand distributional patterns from South America to North America through the Central American Bridge (Delgadillo 1995).

The fires of 1998 once again demonstrated to us how fragile the rain forest is. The Butterfly Reserve in the vicinity of the Boca de Chajul village was severely damaged during these fires and the *Syrhropodon hornschiichii* populations were probably lost. This spot within the Lacandona region is also the site of new records of diurnal butterflies (J. de la Maza, pers. comm.). The areas visited in the Nahá region are also being rapidly developed with the construction of roads and the expansion of the human population. Besides natural perturbation, the Lacandona region is severely threatened for political and socio-economical reasons (O'Brien 1998). Continued work on the biodiversity and ecology of the species of the region will help us save one of the richest forests in the country and one of the last and best remnants of tropical rain forest in the northern hemisphere. As bryologists, we must demonstrate that bryophytes, the second largest group of green plants (Buck & Thiers 1989) should be part of these conservation efforts.

ACKNOWLEDGMENTS

This study was supported by a grant from the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México (CONABIO, grant H285) and financial aid by Conservation International, México to the first author. We greatly thank C. Delgadillo for his help and advice while working with the identification of the specimens, as well as for giving us access to the MEXU collection. B. Allen and W. Reese kindly provided specimens from species not available at MEXU. W. Reese also kindly helped us with the identification of some Calymperaceae reported here. N. Salazar Allen and W. Reese critically reviewed an earlier version of this manuscript.

LITERATURE CITED

- BOURELL, M. 1992. A checklist of the bryophytes of Chiapas, Mexico. *Tropical Bryology* 6: 39–56.
- BUCK, W. D. 1998. Pleurocarpus mosses of the West Indies. *Memoirs of the New York Botanical Garden* 82: 1–400.
- & B. M. THIERS. 1989. Bryological studies in the tropics, pp. 484–493. In D. G. Campbell & H. D. Hammond (eds.), *Floristic Inventory of Tropical Countries*. New York Botanical Garden.
- CHURCHILL, S. P. & E. L. LINARES C. 1995. *Prodromus bryologiae Novo-Granatensis*. Introducción a la flora de musgos de Colombia. 2 Vols. Instituto de Ciencias Naturales, Museo de historia natural, Facultad de Ciencias, Universidad Nacional de Colombia, Santa Fé de Bogotá, Colombia.
- DE LA MAZA, J. & R. G. DE LA MAZA. 1985. La fauna de mariposas de boca del Chajul, Chiapas, México, (Rhopalocera). *Revista de la Sociedad Mexicana de Lepidopterología* 10: 1–24.
- DELGADILLO M., C. 1976. Estudio botánico y ecológico de la región del río Uxpanapa, Veracruz. *Publicaciones del Instituto Nacional sobre Recursos Bióticos* 1: 19–28.
- . 1987. The Meso-American element in the moss flora of Mexico. *Lindbergia* 12: 121–124.
- . 1995. Neotropical moss floras: species common to North and South America. *Tropical Bryology* 10: 1–6.
- & A. CÁRDENAS. 1989. Phylogeography of high-elevation mosses from Chiapas, Mexico. *THE BRYOLOGIST* 92: 461–466.
- & ———. 1990. Manual de Briofitas. Cuadernos del Instituto de Biología No. 8, UNAM, México, D.F.
- & W. D. REESE. 1976. Notes on tropical mosses of Mexico. *THE BRYOLOGIST* 79: 511–513.
- DIRZO, R. & A. MIRANDA. 1990. Contemporary Neotropical defaunation and forest structure, function, and diversity—a sequel to John Terborgh. *Conservation Biology* 4: 444–447.
- EQUIHUA, C. 1998. Brioflora de la Reserva de Montes Azules, Chis.: Diversidad, Biogeografía y Depauperación por Actividad Humana. Final report to CONABIO. México, D.F., México.
- & T. PÓCS. 1999. Epiphyllous bryophytes from the Lacandon Forest, Chiapas, México. *THE BRYOLOGIST* 102: 747–752.
- FLORSCHÜTZ, P. A. 1964. Flora of Suriname. Vol. VI, Part I. Musci. E.J. Brill, Leiden.
- GOBIERNO DEL ESTADO DE CHIAPAS, COORDINACIÓN DE PROGRAMAS ESPECIALES, AND EQUIPO TÉCNICO PLANIFICADOR. 1992. Propuesta del plan de manejo para la Reserva Integral de la Biosfera Montes Azules. Edición del Gobierno del Estado de Chiapas. Tuxtla Gutiérrez, Chiapas, México.
- LÓPEZ T., M. C., R. A. MEDELLÍN & G. YANES G. 1998. *Vampyrum spectrum* en Chiapas, México. *Revista Mexicana de Mastozoología* 3: 135–136.
- MARTÍNEZ, E. & C. H. RAMOS. 1989. Lacandoniaceae (Triuridales): una nueva familia de México. *Annals of the Missouri Botanical Garden* 76: 128–135.
- & F. CHIANG. 1994. Lista florística de la Lacandona, Chiapas. *Boletín de la Sociedad Botánica de México* 54: 99–177.
- MEDELLÍN, R. A. 1991. La selva Lacandona: an overview. *Tropical Conservation and Development Newsletter* 24: 1–5. Center for Latinamerican Studies, University of Florida.

- . 1994. Seed dispersal of *Cecropia obtusifolia* by two species of opossums in the Selva Lacandona, Chiapas, México. *Biotropica* 26: 400–407.
- & M. EQUIHUA. 1998. Mammal species richness and habitat use in rainforest and abandoned agricultural fields in Chiapas, México. *Journal of Applied Ecology* 35: 13–23.
- & O. GAONA. 1999. Seed dispersal by bats and birds in forest and disturbed habitats of Chiapas, Mexico. *Biotropica* 31: 478–485.
- O. SÁNCHEZ HERRERA & G. URBANO-VIDALES. 1992. Ubicación zoogeográfica de la Selva Lacandona, Chiapas, México, a través de la fauna de quirópteros, pp. 233–251. *In* M. A. Vásquez Sánchez & M. A. Ramos Olmos (eds.), *Reserva de la Biosfera Montes Azules, Selva Lacandona: Investigación para su conservación*. Centro de Estudios para la Conservación de los Recursos Naturales, A. C. San Cristóbal de las Casas. Publicaciones Especiales Ecosfera 1.
- MENDOZA, E. & R. DIRZO. 1999. Deforestation in Lacandonia (southeast Mexico): evidence for the declaration of the northernmost tropical hot spot. *Biodiversity and Conservation* 8: 1621–1641.
- MITTERMEIER, R. A., C. GOETSCH MITTERMEIER & P. ROBLES GIL. 1997. Megadiversity. Earth's Biologically Wealthiest Nations. CEMEX, Mexico, D.F.
- O'BRIEN, K. L. 1995. Deforestation and climate change in the Selva Lacandona of Chiapas, México. Ph.D., Pennsylvania State University.
- . 1998. *Sacrificing the Forest: Environmental and Social Struggles in Chiapas*. Westview Press, Boulder, CO.
- REESE, W. D. 1993. Calymperaceae. *Flora Neotropica* 58: 1–102.
- SALAZAR ALLEN, N. & C. CHUNG. 1997. Primera aproximación al catálogo de briófitos del Parque Nacional de Coibá (Panamá), pp. 221–243. *In* S. Castroviejo & M. Velayos (eds.), *Flora y Fauna del Parque Nacional de Coibá (Panamá)*. Madrid.
- SALGADO ORTÍZ, J. 1993. Utilización de manchones de vegetación secundaria en áreas de agostadero por una comunidad de aves de la Reserva de la Biosfera de Montes Azules, Selva Lacandona, Chiapas, México. Implicaciones para la conservación. Bachelor's Thesis. Universidad Michoacana de San Nicolás de Hidalgo. Morelia, Michoacán, México.
- SHARP, A. J. 1945. Notas sobre la flora del centro de Chiapas. *Boletín de la Sociedad Botánica de México* 3: 7.
- , H. A. CRUM & P. M. ECKEL. 1994. The Moss Flora of Mexico. *Memoirs of the New York Botanical Garden*, 69. 1113 pp.

ms. received Feb. 15, 2001; accepted July 11, 2001.