
Biodiversity assessment of myxomycetes from two tropical forest reserves in Mexico

C. Lado^{1*}, A. Estrada-Torres², S.L. Stephenson³, D. Wrigley de Basanta⁴ and M. Schnittler⁵

¹Real Jardín Botánico de Madrid, CSIC. Plaza de Murillo, 2-28014 Madrid, Spain

²Centro de Investigación en Ciencias Biológicas, Univ. Autónoma de Tlaxcala, Apdo. Postal 183. Tlaxcala 90000, México

³Department of Biology, Fairmont State College, Fairmont, West Virginia 26554, USA

⁴The American School of Madrid, Apartado 80, 28080, Madrid, Spain

⁵Botanical Institute and Botanical Garden, Ernst-Moritz-Arndt University Greifswald, Grimmer Str. 88, D-17487 Greifswald, Germany

Lado, C., Estrada-Torres, A., Stephenson, S.L., Wrigley de Basanta, D. and Schnittler, M. (2003). Biodiversity assessment of myxomycetes from two tropical forest reserves in Mexico. *Fungal Diversity* 12: 67-110.

This paper presents the results of surveys carried out in two tropical forest reserves, El Edén (Quintana Roo) and Los Tuxtlas (Veracruz), in Mexico. A total of 857 collections of myxomycetes yielded 99 different taxa. One of these (*Diderma yucatanensis*) is described as a new species, two (*Licea poculiformis* and *Stemonitis lignicola*) are new records for the Neotropics, and 14 species and 2 varieties are new records for Mexico. Our data support the presence of a distinct assemblage of myxomycetes in tropical regions and substantiate the value of using the moist chamber technique as a complement to fieldwork in biodiversity studies. These same data also suggest that a number of different niches are exploited by myxomycetes in the tropics.

Key words: distribution, Mycetozoans, new species, plasmodial slime moulds, SEM, species inventory, taxonomy.

Introduction

A major portion of the biodiversity of the planet is concentrated in tropical regions (Davis *et al.*, 1997), but the relative abundance and taxonomic richness of myxomycetes in these regions have thus far only been estimated. For this reason, a research project was carried out to survey the myxomycetes associated with several different Neotropical forest types. Ecological Reserves in four different countries were chosen as study areas. Two of these (El Edén and Los Tuxtlas Ecological Reserves) are in Mexico, two (Maquipucuna

* Corresponding author: C. Lado; e-mail: lado@ma-rjb.csic.es

Reserve and Yasuní National Park and Biosphere Reserve) in Ecuador, one (Area de Conservación Guanacaste) in Costa Rica, and one (Luquillo Experimental Forest) in Puerto Rico. The purpose of this paper is to provide results and taxonomic details relating to the two Mexican forest reserves investigated. This component of the overall survey was funded by the National Science Foundation (USA) and the Spanish Government. An analysis of the distribution and ecology of these species along with some complementary information about the study areas can be found in Stephenson *et al.* (2003).

Materials and methods

In this project, special attention was directed towards three different types of tropical forests: the primary tropical rain forest of the Los Tuxtlas Tropical Biology Station (Veracruz, México), the tropical semideciduous forest and the seasonally flooded lowland tropical forest (called ‘tintal’) of the El Edén Ecological Reserve (Quintana Roo, Mexico). The forests selected for study were visited for seven days of field work each during 1999 (from November 22 to December 4), and all microhabitats in which myxomycetes are known or suspected to occur were subjected to an intensive survey. In addition, Los Tuxtlas was visited on two other occasions (February 1998 and September 2000), and the collection data incorporated into this paper. Collection methods were those described by Stephenson (1989), Rossman *et al.* (1998), and Schnittler *et al.* (2002). Types of substrates sampled are abbreviated as follows:

- b* : bark of living trees.
- w* : decaying, formerly solid wood in various stages of decay.
- lw* : decaying stems of woody lianas at a height of 1.5-2.5 m.
- ll* : leafy litter from the forest floor.
- lg* : grass litter.
- lh* : aerial litter consisting of fleshy but still herbaceous plant parts.
- lc* : aerial litter of cactus.
- lp* : aerial litter of palm.
- li* : decaying corolla parts and bracts of inflorescences of living plants.
- ep* : epiphyllic liverworts on living mostly leathery leaves of understory shrubs and small trees.

A total of 244 moist chamber (mc) cultures were prepared with samples of the various substrates in the manner described by Mitchell (1977). Water was added every few days as required to maintain the humidity for the entire observation period of up to three months. The type of substrate and the pH of each moist chamber culture (recorded at 24 hours) are provided in each instance. Details of the methods used can be found in Stephenson *et al.* (2003).

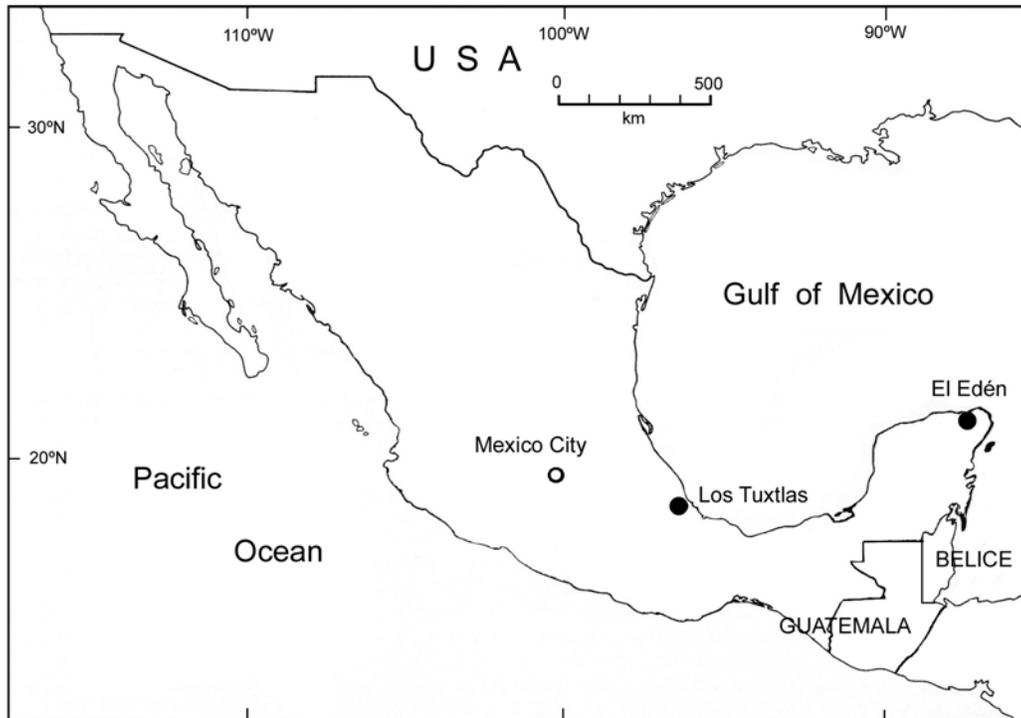


Fig. 1. Location of study areas.

A species recorded from a one moist chamber culture was regarded as a single collection, irrespective of the number of sporophores appearing or the days separating their appearance.

All of the numbers cited herein (for field or moist chamber collections) refer to specimens deposited in the respective herbaria (MA-Fungi sub Lado, and FWVA sub Stephenson), with duplicates in TLXM (sub AET) and private collections (dwb, SC). All microscopic measurements and observations were made with material mounted directly in Hoyer's medium and polyvinyl alcohol. Differential interference microscopy was used to obtain descriptive data. For all SEM-photographs the critical-point dried material technique was employed. Colour notations in parentheses are from the ISCC-NBS Color-Name Charts Illustrated with Centroid Colors (Anonymous, 1976).

Study areas

The El Edén Ecological Reserve (Lázaro Cárdenas, Quintana Roo) is situated on the Yucatan Peninsula, at 21°12'N 87°12'W (Fig. 1). This Reserve of approximately 1492 ha is entirely flat, with a mean height of about 30 m. The underlying bedrock is mainly Cretaceous limestone, with numerous

Karstic sinkholes (locally called 'cenotes') present. The predominate vegetation types are tropical semi-deciduous forests and seasonally flooded lowland tropical forests (locally called 'tintal'). Among the most common trees of these forests are *Brosimum alicastrum*, *Bursera simaruba*, *Manilkara zapota*, *Sabal jaca* or *Thrinax radiata*, and *Haematoxylon campechianum*, *Erythroxylon campechianum* or *Acoelorrhaphe wrightii*. The mean annual temperature oscillates between 24-25°C and the annual precipitation ranges from 1500-1700 mm. This region is frequently affected by hurricanes and cyclones originating in the Caribbean. The El Edén Ecological Reserve was established in 1990 and is a private protected area founded by a group of scientists and ecologists interested in the conservation of the biodiversity of the Yucatan Peninsula.

The Tuxtla Tropical Biology Station (Catemaco Municipality, Veracruz) is situated on a coastal mountain range of recent volcanic origin, at 18°35'N 95°04'W (Fig. 1). Elevations at the Station range from 150-1700 m above sea level. Located on the coastal plain of the Gulf of Mexico, this mountain range constitutes the eastern tip of the chain of ridges that form Mexico's Transverse Neovolcanic Belt. The Reserve has approx. 640 ha. of well preserved primary tropical rain forest with various climbing plants and epiphytes a prominent feature. Among the more characteristic trees are two palms (*Astrocaryum mexicanum* and *Chamaedorea tepejilote*) along with *Brosimum alicastrum*, *Bursera simaruba*, *Ceiba pentandra*, *Nectandra ambigens* and *Ocotea dendrodaphne*. The mean annual temperature oscillates between 22-24°C and the annual precipitation, which follows an elevation gradient, ranges from 1500-4000 mm (González *et al.*, 1997). The Station has been managed by the Universidad Nacional Autónoma de México (UNAM) since its foundation in 1968.

List of localities

MEXICO: Quintana Roo, Lázaro Cárdenas, El Edén Ecological Reserve.

- Loc. 1: Trail to observatory house, 21°12'58"N 87°12'24"W, 30 m, 22 November 1999. Medium semi-deciduous forest on shallow soil over limestone.
- Loc. 2: El Cenote area, 21°13'52"N 87°11'49"W, 30 m, 23 November 1999. Seasonally flooded, semi-deciduous forest around a large cenote.
- Loc. 3: Trail from the Station to observatory house, 21°12'58"N 87°12'24"W, 30 m, 24 November 1999. Medium semi-deciduous forest.
- Loc. 4: Access road to the station buildings, 21°12'36"N 87°11'33"W, 35 m, 25 November 1999. Dry, dense secondary forest never flooded.
- Loc. 5: 'Tintal' area, 21°12'28"N 87°10'44"W, 30 m, 25 November 1999. Seasonally flooded dry forest with palms and scattered deciduous trees (tintal).
- Loc. 6: Reforestation house, 21°12'29"N 87°10'44"W, 30 m, 25 November 1999. Dry, dense secondary forest never flooded.

Fungal Diversity

Loc. 7: Observatory house area, 21°12'33"N 87°12'41"W, 30 m, 26 November 1999. Medium semi-deciduous forest.

MEXICO: Veracruz, Catemaco, Los Tuxtlas Tropical Biology Station, 18°35'03"N 95°04'30"W. Homogeneous primary evergreen rain forest with palms, tropical climbing plants and epiphytes.

Loc. 8: Sendero Darwin, 200 m, 29 November 1999.

Loc. 9: Sendero Vigía 4 and Circuito, 250 m, 30 November 1999.

Loc. 10: Sendero Vigía 5, 300-400 m, 1 December 1999 and 22 September 2000.

Loc. 11: Near to the Station, 18°35'07"N 95°04'50"W, 200 m, 11 March 1998, 2 December 1999 and 20-22 September 2000.

Loc. 12: Sendero Circuito 1, 250 m, 21 September 2000.

Loc. 13: Sendero Vigía 2, 200 m, 21 September 2000.

Loc. 14: Sendero Vigía 4, 250 m, 21 September 2000.

Loc. 15: Education area, 180 m, 12 March 1998.

Results

Visits to these two study areas yielded 76 species (El Eden) and 63 species (Los Tuxtlas) of myxomycetes. These were identified from 456 field and 196 moist chamber culture collections from the first study area and 156 and 49 collections, respectively, from the second study area. (dwb = Diana Wrigley de Basanta collection; mc = moist chamber)

List of species

Arcyria cinerea var. *cinerea* (Bull.) Pers.

Loc. 1 b, Lado11375 (AET5961); w, Lado11380 (AET5966); w, Lado11391 (AET5977); ll of palm, Lado11406 (AET5992); w, Stephenson12348; w, Stephenson12354; ll (pH 6.0) in mc, Stephenson12681; ll (pH 5.9) in mc, Stephenson12683; lp (pH 6.0) in mc, Stephenson12678; ll (pH 6.2) in mc, Stephenson12984; ll (pH 5.9) in mc, Stephenson13101; ll (pH 5.7) in mc, Stephenson13114; ll (pH 5.9) in mc, Stephenson13203; ll (pH 6.3) in mc, Stephenson13233

Loc. 2, w, Lado11431 (AET6020); w, Lado11461 (AET6050); w, Lado11464 (AET6053); w, Lado11467 (AET6056); w, Lado11473 (AET6062); w (pH 6.4), SC15975; dead b (pH 6.4), SC15991.

Loc. 3, dead b, Stephenson12367; w, Stephenson12373; lh (pH 6.0) in mc, Stephenson12600; lc (pH 6.7) in mc, Stephenson12614; lc (pH 6.6) in mc, Stephenson12883; lc (pH 6.6) in mc, Stephenson12884; lh (pH 6.0) in mc, Stephenson12982; b of *Erythroxyllum areolatum* (pH 5.0) in mc, SC16451.

Loc. 4, w, Lado11559 (AET6152).

Loc. 5, w, Stephenson12424 (mouldy); w, Stephenson12433 (mouldy); w, Stephenson12437; w, Stephenson12438; w, SC16105; w (pH 8.1), SC16007 (mouldy); decaying palm frond (pH 6.6), SC16059; ll (pH 7.4), SC16060; decaying palm frond (pH 6.7), SC16089; w (pH 7.9), SC16091; decaying palm frond (pH 7.3), SC16093; b of *Gymnopodium floribundum* in mc, SC16454.

- Loc. 6, w, Stephenson12420 (mouldy); lg (pH 6.6) in mc, Stephenson12625; lg (pH 6.4) in mc, Stephenson12889; ll (pH 6.6) in mc, Stephenson13160; ll (pH 7.0) in mc, Stephenson13162A (cf.); ll (pH 7.0) in mc, Stephenson13196.
- Loc. 7, ll, Lado11587 (AET6180); w, Lado11590 (AET6183); w, Lado11593 (AET6186); w, Lado11597 (AET6190); w, Lado11600 (AET6193); ll of the palm *Sabal jaca*, Lado11621 (AET6214).
- Loc. 8, w, Lado11640 (AET6235); w, Lado11657 (AET6252).
- Loc. 9, w, Lado11664 (AET6259); b, Lado11669 (AET6264); b of *Tuxtla pittieri* in mc, SC16459; ll of *Heliconia schiedeana* in mc, SC16291; b of *Tuxtla pittieri* (pH 7.5) in mc, dwb 1812.
- Loc. 10, w, Lado11688 (AET6283); w, Lado12190 (AET6442).
- Loc. 12, w, Lado12143 (AET6395); w, Lado12146 (AET6398).
- Loc. 14, w, Lado12167 (AET6419).

***Arcyria cinerea* var. *digitata* (Schwein.) G. Lister**

- Loc. 1, w, Lado11410 (AET5996); b, Lado11429 (AET6015), w, Stephenson12350, ll on palm, Stephenson12356.
- Loc. 2, w (pH 5.8), SC15981.
- Loc. 4, w (pH 7.5), SC16024.
- Loc. 5, w, Stephenson12421 (mouldy); w (pH 7.9), SC16092.
- First record for Mexico.

***Arcyria denudata* (L.) Wettst.**

- Loc. 1, w, Lado11393 (AET5979); w, Lado11401 (AET5987); w of *Bursera simaruba*, Lado11413 (AET5999); w, Stephenson12394; w, Stephenson12398; w, Stephenson12400; w, Stephenson12410; ll (pH 6.5) in mc, Stephenson14490.
- Loc. 2, w, Lado11436 (AET6025); w, Lado11453 (AET6042); w, Lado11459 (AET6048); ll of palm, Lado11463 (AET6052); w (pH 5.1), SC15980; dead b (pH 6.5), SC15982; w (pH 6.8), SC15984.
- Loc. 3, w, Lado11495 (AET6088); w, Stephenson, 12366; old fungal sporocarp, Stephenson12375 (very old); w, Stephenson12393.
- Loc. 4, w, Lado11538 (AET6131); w, Lado11544 (AET6137); w, Lado11554 (AET6147); w, Lado11561 (AET6154); w (pH 6.8), SC16033.
- Loc. 5, w, Lado11568 (AET6161); w and old fungal sporocarp, Stephenson12432; dead b, Stephenson12450; ll of *Thrinax radiata* (pH 7.0), SC16057; w (pH 7.4), SC16061; w (pH 7.5), SC16071; w (pH 4.1), SC16074; ll (pH 7.2), SC16083; w (pH 6.2), SC16094.
- Loc. 6, ll (pH 6.6) in mc, Stephenson13137B (cf.); ll (pH 6.8) in mc, Stephenson14503.
- Loc. 7, w, Lado11579 (AET6172); w, Lado11596 (AET6189); ll of the palm *Sabal jaca*, Lado11616 (AET6209); ll of the palm *Sabal jaca*, Lado11623 (AET6216); ll of the palm *Sabal jaca*, Lado11630 (AET6223).
- Loc. 8, w, Lado11647 (AET6242); w, Lado11650 (AET6245); w, Lado11655 (AET6250).
- Loc. 9, w, Lado11672 (AET6277); b, Lado11677 (AET6271).
- Loc. 11, w, Lado12131 (AET6383).
- Loc. 12, w, Lado12152 (AET6404); w, Lado12153 (AET6405).
- Loc. 14, w, Lado12162 (AET6414).

Arcyria obvelata (Oeder) Onsberg

Loc. 9, w, Lado11666 (AET6261).

Badhamiopsis ainoae (Yamash.) T.E. Brooks & H.W. Keller

Loc. 3, b of *Manilkara zapota* (pH 7.8) in mc, dwb 1784.

Only one collection from moist chamber that agrees with the detailed description of Keller and Brooks (1976). First record for Mexico.

Calomyxa metallica (Berk.) Nieuwl.

Loc. 1, b of *Gymnopodium floribundum* (pH 6.6) in mc, SC16452.

First record for Quintana Roo.

Ceratiomyxa fruticulosa* var. *fruticulosa (O.F. Müll.) T. Macbr.

≡ *Famintzinia fruticulosa* var. *fruticulosa* (O.F. Müll.) Lado, the correct name for the taxon according to Lado (2001)

Loc. 1, w, Lado11394 (AET5980); w, Lado11396 (AET5982).

Loc. 2, dead b (pH 6.9), SC16002.

Loc. 3, w, Lado11514 (AET6107); w, Lado11520 (AET6113); dead b, Stephenson12374.

Loc. 4, w (pH 7.5), SC16025.

Loc. 5, w (pH 4.8), SC16108; w (pH 7.9), SC16021; w (pH 5.7), SC16085

Loc. 6, w, Stephenson12418.

Loc. 8, w, Lado11641 (AET6236); lw of *Heliconia*, Lado11642 (AET6237); w, Lado11647 (AET6242); w, Lado11659 (AET6254).

Loc. 9, w, Lado11668 (AET6263); w, Lado11680 (AET6274) (yellow form).

Loc. 10, w, Lado11693 (AET6288).

Loc. 12, w, Lado12150 (AET6402).

Loc. 13, w, Lado12159 (AET6411).

Loc. 15, w, AET4046.

The majority of these specimens have typical macroscopic features. The spores are subglobose instead of oval or ellipsoid and they are also very small, 5-7 µm diam. instead of (9-)10-13 × 6-7 µm as Farr (1976: 18) described for Neotropical material of *Ceratiomyxa fruticulosa* (O.F. Müll.) T. Macbr. Previously reported from El Edén by Ogata and Andrade-Torres (1996).

Ceratiomyxa sphaerosperma Boedijn

≡ *Famintzinia sphaerosperma* (Boedijn) Lado, the correct name for the taxon according to Lado (2001).

Loc. 12, fruit of *Guarea grandifolia*, Lado12139 (AET6391).

The spores of the single specimen studied are very small, 4-6 µm diam., instead of (6-)7-9 µm as described in Farr (1976: 20) and Martin and Alexopoulos (1969: 35). These small dimensions coincide with those observed in unpublished material recorded by us from Ecuador. This species is truly tropical and develops on rotting hard fruits. First record for Veracruz, previously known in Mexico from Jalisco and Quintana Roo (Villarreal, 1990). Ogata and Andrade-Torres (1996) reported it for El Edén.

Clastoderma debaryanum A. Blytt

- Loc. 1, w, Lado11383 (AET5969); w, Lado11385 (AET5971); w, Lado11398 (AET5984); w, Lado11422 (AET6008).
Loc. 2, w, Lado11470 (AET6059); dead b (pH 7.0), SC15995b; w (pH 4.0), SC15997; w (pH 7.7), SC15998; w (pH 5.9), SC16001.
Loc. 3, w, Lado11505 (AET6098); w, Lado11506 (AET6099); w, Lado11507 (AET6100); lc (pH 6.4) in mc, Stephenson13235.
Loc. 4, w, Lado11562 (AET6155); w, Lado11563(AET6156).
Loc. 5, w, Lado11569 (AET6162); w, Lado11570 (AET6163); ll, Stephenson12439; w (pH 8.0), SC16022; w (pH 4.2), SC16041; w (pH 3.9), SC16073; w (pH 5.2), SC16079.
Loc. 6, w, Stephenson12415.
Loc. 7, ll of the palm *Sabal jaca*, Lado11610 (AET6203); ll of the palm *Sabal jaca*, Lado11626 (AET6219).

Abundant at El Edén but not collected from Los Tuxtlas, where it is probably present since this species appears frequently in the whole Neotropical region. Previously reported for El Edén by Ogata and Andrade-Torres (1996).

Collaria arcyronema (Rostaf.) Nann.-Bremek. ex Lado

= *Lamproderma arcyronema* Rostaf.

- Loc. 1, w of *Bursera simaruba*, Lado11411 (AET5997); w of *Bursera simaruba*, Lado11413 (AET5999); w of *Bursera simaruba*, Lado11415 (AET6001); b of *Byrsonima bucidaefolia* (pH 6.7) in mc, SC16456.
Loc. 3, w, Lado11501 (AET6094); lh (pH 6.6) in mc, Stephenson12867; lh (pH 6.3) in mc, Stephenson12902; lh (pH 6.4) in mc, Stephenson12987; lc (pH 7.0) in mc, Stephenson13075B; lh (pH 7.0) in mc, Stephenson13111; lh (pH 7.0) in mc, Stephenson13116; lh (pH 6.3) in mc, Stephenson13118A; lc (pH 6.6) in mc, Stephenson13124; lh (pH 6.8) in mc, Stephenson13166; lc (pH 6.8) in mc, Stephenson13181; lc (pH 6.4) in mc, Stephenson13187; lc (pH 6.7) in mc, Stephenson13199.
Loc. 5, w (pH 6.4), SC16081; w (pH 1.9), SC16096; w (pH 8.1), SC16098.
Loc. 6, w, Stephenson12415; lg (pH 6.5) in mc, Stephenson13104.
Loc. 14, w, AET4049.

Previously (as *Lamproderma arcyronema* Rostaf.) reported for El Edén by Ogata and Andrade-Torres (1996); also reported from Quintana Roo and Veracruz (Illana *et al.*, 2000), and from Belize (Ing and Haynes, 1999).

Collaria lurida (Lister) Nann.-Bremek.

= *Comatricha lurida* Lister

- Loc. 1, b of *Metopium brownei* (pH 7.7) in mc, SC16268.
Loc. 9, b of *Tuxtla pittieri* in mc, SC16266; on *Heliconia schiedeana* leaf (pH 7.6) in mc, dwb 1819, dwb1820, dwb1821.
Loc. 10, ll of *Licaria velutina* (*Lauraceae*) in mc, AET7530.

The specimen AET7530 differs in some respects from published descriptions of *C. lurida*. The spores of this specimen are in the smaller range [6.3-7.1 μm vs. (6-)-7-10 μm cited in Martín and Alexopoulos, 1969: 233], have groups of darker warts, and the peridium is persistent.

First record for Quintana Roo and Veracruz. In Mexico, only one specimen of doubtful identity has been previously cited from Tlaxcala (Rodríguez-Palma and Estrada-Torres, 1996).

Comatricha cf. laxa Rostaf.

Loc. 6, lg (pH 6.5) in mc, Stephenson12618.

Comatricha pulchella (C. Bab.) Rostaf.

Loc. 1, b of *Gymnopodium floribundum* (pH 6.6) in mc, SC16420.

Loc. 2, w, Lado11442 (AET6031); ll (pH 6.6), SC15979.

Loc. 3, b of *Manilkara zapota* (pH 7.8) in mc, dwb1775.

Recorded only from El Edén, where it was collected on wood in the field and on bark of living trees in moist chamber. New record for Quintana Roo.

Comatricha tenerrima (M.A. Curtis) G. Lister

Loc. 3, lh (pH 6.3) in mc, Stephenson12677 (cf.).

Loc. 4, w, Lado11574 (AET6167).

Loc. 6, w, Lado11571 (AET6164).

Loc. 9, on dead *Heliconia schiedeana* leaf (pH 7.8) in mc, dwb1773; b of *Tuxtla pittieri* (pH 7.5) in mc, dwb1785; idem dwb1786; on *Astrocaryum mexicanum* leaf (pH 7.7) in mc, dwb1787; on *Astrocaryum mexicanum* leaf (pH 7.7) in mc, dwb1814; on dead *Heliconia schiedeana* leaf (pH 7.6) in mc, dwb1789.

In moist chamber 20 large mostly dispersed sporocarps of this graceful pink-beige myxomycete were collected. Half of them were dwarf irregular forms with smaller globose sporothecae but with the same curly capillitium and spores characteristic of this species.

First record for Quintana Roo and Veracruz. Previously reported from Belize (Ing and Haynes, 1999).

Craterium leucocephalum (Pers. ex J.F. Gmel.) Ditmar

Loc. 2, ll (pH 6.3), SC15977.

Loc. 3, ll of palm, Lado11484 (AET6077); ll, Stephenson12380.

Loc. 4, ll of palm, Lado11548 (AET6141).

Loc. 5, ll of palm, Lado11405 (AET5991); ll, Stephenson12395; decaying palm frond (pH 7.1), SC16015.

Loc. 7, ll of the palm *Sabal jaca*, Lado11614 (AET6207); ll of the palm *Sabal jaca*, Lado11625 (AET6218).

Not previously reported from Quintana Roo.

Craterium paraguayense (Speg.) G. Lister

Loc. 10, ll of *Ampelocera hottlei*, *Rheedia edulis* and *Licaria velutina*, Lado12189 (AET6441); ll, Lado12191 (AET6443); ll, Lado12192 (AET6444); ll, Lado12209 (AET6461).

The material studied matches Farr's (1976) description of this species exactly. First record for Veracruz. In Mexico, it has previously been cited only from the temperate region in the centre of the country (Hernández-Cuevas and

Estrada-Torres, 1991), but this material shows some variation from the original description.

Cribraria cancellata (Batsch) Nann.-Bremek. var. ***cancellata***

Loc. 1, w, Lado11387 (AET5973).

Loc. 3, w, Lado11493 (AET6086); w, Lado11521 (AET6114).

Loc. 5, w, Stephenson12448; w (pH 7.0), SC16032.

Loc. 12, w, Lado12141 (AET6393).

Previously reported from El Edén by Ogata and Andrade-Torres (1996).

Cribraria cancellata var. ***fusca*** (Lister) Nann.-Bremek.

Loc. 1, w, Lado11421 (AET6007).

First record for Quintana Roo. A membranous calyculus is the distinctive feature of this variety.

Cribraria languescens Rex

Loc. 1, w, Lado11422 (AET6008); w, Lado11426 (AET6012); w, Stephenson12409; ll (pH 6.0) in mc, Stephenson14489; b of *Lysiloma latisiliquum* in mc, SC16271; w (pH 6.6), SC16018; dead b (pH 7.6), SC16054.

Loc. 3, w, Lado11519 (AET6112); w, Lado11527 (AET6120).

Loc. 6, w, Stephenson12416.

Loc. 7, w, Lado11597 (AET6190).

This is one of the most characteristic species of the genus from tropical regions. Previously reported from El Edén by Ogata and Andrade-Torres (1996).

Cribraria microcarpa (Schrad.) Pers.

Loc. 1, lp (pH 6.7) in mc, Stephenson13108; lp (pH 6.0), Stephenson in mc, 13109; ll (pH 6.6) in mc, Stephenson13110; lp (pH 6.7) in mc, Stephenson13115; lp (pH 6.6) in mc, Stephenson13168; lp (pH 6.4) in mc, Stephenson13169; lp (pH 5.9) in mc, Stephenson13179; lp (pH 5.5) in mc, Stephenson14435.

Loc. 2, ll (pH 5.7) in mc, Stephenson13198.

Loc. 3, ll (pH 6.3) in mc, Stephenson12903; lh (pH 6.8) in mc, Stephenson13102; lh (pH 6.3) in mc, Stephenson13118B; lh (pH 6.1) in mc, Stephenson13119; lc (pH 6.7) in mc, Stephenson13163; lh (pH 6.2) in mc, Stephenson13178; lh (pH 6.8) in mc, Stephenson14499.

Loc. 6, ll (pH 6.9) in mc, Stephenson14486.

Previously reported from El Edén by Ogata and Andrade-Torres (1996). Also reported from Belize (Ing and Haynes, 1999).

Cribraria tenella Schrad.

Loc. 1, w, Lado11385 (AET5971).

Loc. 4, lp (pH 7.1), SC16027.

Loc. 7, ll of the palm *Sabal jaca*, Lado11610 (AET6203).

Previously reported from El Edén by Ogata and Andrade-Torres (1996).

***Cribraria violacea* Rex**

- Loc. 1, w and b *Bursera simaruba*, Lado11412 (AET5998); w, Lado11422 (AET6008); ll (pH 6.7) in mc, Stephenson13164.
 Loc. 2, w, Lado11475 (AET6064); ll (pH 6.8) in mc, Stephenson14481.
 Loc. 3, lh (pH 7.0) in mc, Stephenson13125; lh (pH 6.7) in mc, Stephenson14505; b of *Bursera simaruba* (pH 8.0) in mc, dwb1752.
 Loc. 5, b of *Metopium brownei* (pH 8.3) in mc, dwb1755.
 Loc. 6, w, Stephenson12415; ll (pH 6.7) in mc, Stephenson13117; ll (pH 6.6) in mc, Stephenson13137A; ll (pH 6.9) in mc, Stephenson14504.
 Previously reported from El Edén by Ogata and Andrade-Torres (1996).

***Diachea bulbilosa* (Berk. & Broome) Lister**

- Loc. 13, ll of the palm *Astrocaryum mexicanum*, Lado12140 (AET6392).
 The specimen from Veracruz has a stalk and columella of a dark brown colour, which is different from the typical collections of this species; however, both Lister (1925) and Martin and Alexopoulos (1969) have commented on this variation of stalk colour. Ogata and Andrade-Torres (1996) reported this species from El Edén.

***Diachea leucopodia* (Bull.) Rostaf.**

- Loc. 10, ll, Lado12208 (AET6460).
 Loc. 11, ll, Lado12210 (AET6462); living leaves of *Chaemadora* sp. and *Syngonium podaphyllum*, Lado12213 (AET6465).

***Diachea silvaepluvialis* M.L. Farr**

- Loc. 10, ll, Lado12201 (AET6453).
 First record for Veracruz. In Mexico previously known only from Jalisco (Lado *et al.*, 1999), but the species seems to be distributed throughout tropical and subtropical regions of the world (Farr, 1976).

***Diderma chondrioderma* (de Bary & Rostaf.) G. Lister**

- Loc. 10, bryophytes and b, Lado11707 (AET6302).
 First record for Veracruz. Known previously in México only from Yucatán (Keller and Braun, 1977). Ing and Haynes (1999) reported it from Belize.

***Diderma effusum* (Schwein.) Morgan**

- Loc. 1, lp (pH 6.7) in mc, Stephenson13161 (cf.) (poor); lp (pH 6.4) in mc, Stephenson14500; lp (pH 6.6) in mc, Stephenson14501; b of *Haematoxylon campechianum* (pH 7.0) in mc, SC16449.
 Loc. 3, ll, Lado11479 (AET6072); ll, Lado11485 (AET6078); ll, Stephenson12369; ll, Stephenson12376.
 Loc. 5, ll of *Thrinax radiata* (pH 7.0), SC16104.
 Loc. 6, lg (pH 6.4) in mc, Stephenson12899.

Loc. 11, ll, Lado12173 (AET6425); Lado12176 (AET6428); ll, Lado12216 (AET6468) (cf.); ll, Lado12218 (AET6470).

First record for Quintana Roo and Veracruz. Previously reported from Belize by Ing and Haynes (1999).

***Diderma hemisphaericum* (Bull.) Hornem.**

Loc. 1, ll (pH 6.7) in mc, Stephenson12679; ll (pH 6.2) in mc, Stephenson12983; ll (pH 5.9) in mc, Stephenson12699; ll (pH 5.6) in mc, Stephenson12745; ll (pH 6.6) in mc, Stephenson12892.

Loc. 3, lh (pH 7.0) in mc, Stephenson 12868; lc (pH 6.7) in mc, Stephenson12882; lc (pH 6.8) in mc, Stephenson 12885.

Loc. 5, ll (pH 7.0), SC16013.

Loc. 12, ll of the palm *Astrocaryum mexicanum*, Lado12149 (AET6401).

Only one collection was obtained at Los Tuxtlas, but many moist chamber collections were recorded from El Edén, mainly on forest floor litter but also on aerial litter. The collection Stephenson 12885, is an aberrant specimen.

First record for Quintana Roo. Reported from six other states in México (Illana *et al.*, 2000). Estrada-Torres *et al.* (2000) reported this species from Guatemala.

***Diderma rimosum* Eliasson & Nann.-Bremek.**

Loc. 1 w, Lado11374 (AET5960); w, Lado11425 (AET6011), ll, Stephenson12349

Loc. 3, ll of palm, Lado11481 (AET6074); ll of palm, Lado11486 (AET6079); ll, Lado11502 (AET6095); ll, Lado11524 (AET6117).

Loc. 4, w, Lado11541 (AET6134); ll, Lado11545 (AET6138).

Loc. 5, w (pH 7.0), SC16046; w (pH 6.8), SC16067.

Loc. 6, ll (pH 6.4) in mc, Stephenson 13073; ll (pH 6.2) in mc, Stephenson 13074; ll (pH 6.2) in mc, Stephenson13112; ll (pH 6.2) in mc, Stephenson14485.

Loc. 11, ll, Lado12177 (AET6429); live leaves Lado12178 (AET6430); ll, Lado12181 (AET6433); ll, Lado12219 (AET6471).

The Mexican specimens match the original description of the species (Eliasson and Nannenga-Bremekamp, 1983). Buyck (1988) considered it to be conspecific with *D. cingulatum* Nann.-Bremek., because of the similarity of the capillitium, fenestrate at the tips in both species, and the fact that both species have spores that are angular in optical section. The same author suggested that the type specimen of *D. rimosum* was just a poorly developed fructification of *D. cingulatum*, with an apparently reticulate peridium, the result of a very warm and humid atmosphere during fructification. Nannenga-Bremekamp (1991), did not agree with this opinion and she continued to consider *D. rimosum* and *D. cingulatum* as separate species. The various collections listed herein from El Edén and Los Tuxtlas and the specimens obtained from moist chamber cultures of forest floor litter demonstrate the constancy and stability of its characters, and so we also regard *D. rimosum* as distinct from *D.*

cingulatum. The former differs in the wrinkled ridged peridium, which falls apart in polygonal plates (irregular in *D. cingulatum*) and in the globose or hemispherical columella, never cylindrical or clavate (Nannenga-Bremekamp, 1968).

First record for Mexico, known previously only from the type locality in the Galápagos Islands (Ecuador), although Nannenga-Bremekamp (1991) also mentioned a Dutch collection.

***Diderma rugosum* (Rex) T. Macbr.**

Loc. 3, b, Lado11488 (AET6081); w, Lado11492 (AET6085).

Loc. 10, bryophytes and b, Lado11706 (AET6301).

Loc. 11, bryophytes and w, Lado12126 (AET6378); bryophytes, Lado12214 (AET6466).

Of the five specimens studied, only Lado12214 agrees completely with the description of *D. rugosum*. The other four samples are similar macroscopically, but they have white calcareous stipes, cylindrical columellae, a fine filamentous yellowish capillitium with the ends adhering to the peridium and the columella, and very large spores, of 14-16 µm diam., with ornamentation homogeneously distributed over the spore surface. *Diderma rugosum*, in contrast, has a black non-calcareous stipe, clavate columella, brown capillitial filaments with hyaline free ends, and spores from 8-10 µm with ornamentation irregularly distributed over the spore surface. These differences could indicate the presence of two distinct species, a situation that needs to be evaluated in more detail when more abundant material is available, since these collections had few sporocarps. Farr (1957, 1976) cited a specimen (Farr 794) of *D. rugosum* from Jamaica, with spores from 14-14.5 µm and coarsely warted, which may be the same as the above collections, suggesting a wider Neotropical distribution for the taxon. Dehiscence is by preformed ribs, which gives a polygonal appearance to the sporotheca. This feature, along with the spore size, suggests *D. rufum* Nann.-Bremek., but this species is reddish brown in colour and robust (Nannenga-Bremekamp, 1968). First record for México.

***Diderma saundersii* (Masse) Lado**

Loc. 7, ll of the palm *Sabal jaca*, Lado11612 (AET6205).

According to Lado (2001) this is the correct name for *D. platycarpum* var. *berkeleyanum* Nann.-Bremek., which is an illegitimate name. First record for México.

***Diderma spumarioides* (Fr.) Fr.**

Loc. 2, ll, Lado11466 (AET6055); ll (pH 7.6), SC15972; ll (pH 5.9), SC15983; ll (pH 6.7), SC15987.

Loc. 3, II, Lado11476 (AET6069); II of palm, Lado11480 (AET6073); II, Lado11511 (AET6104); II, Lado11531 (AET6124); on clavarioid fungus, Lado11535 (AET6128); II, Stephenson12382; II, Stephenson12384; II, Stephenson12569.

Loc. 5, LL, Stephenson12426; II (pH 6.9), SC16050; II (pH 7.8), SC16086.

New record for Quintana Roo.

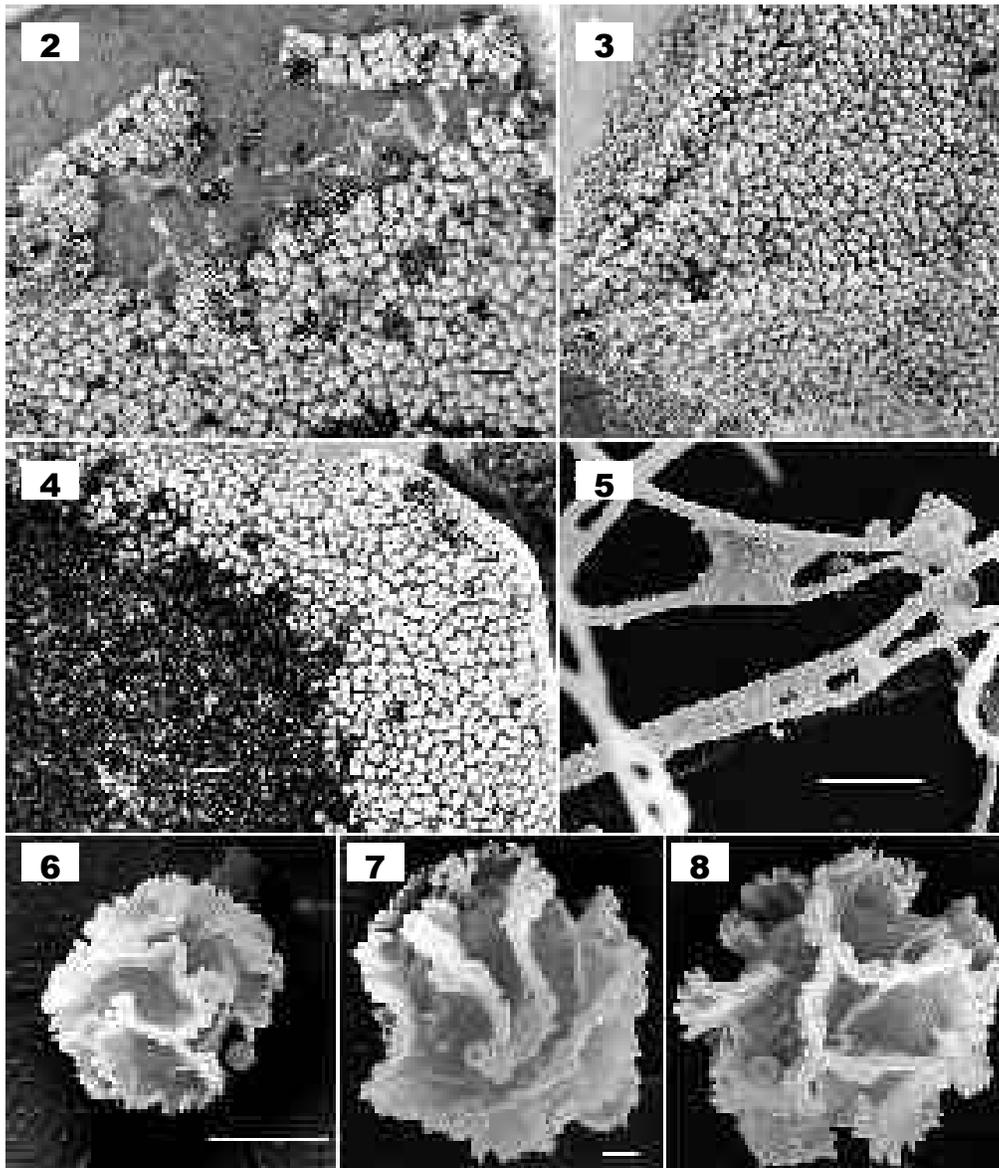
Diderma subdictyospermum (Rostaf.) G. Lister (Figs. 2-8)

Loc. 11, living leaves, Lado12180 (AET6432); II, Lado12184 (AET6436); II of *Cecropia* sp., Lado12187 (AET6439); II, Lado12212 (AET6464); II, Lado12217 (AET6469).

The five collections studied were found in the same place but at different times, on litter of different trees and living herbs on the ground. In each case, the fructifications were very extensive, covering a surface area of up to 15 cm², and containing hundreds to thousands of sporocarps, all with constant and stable characters. Since this is a rare tropical species described from Venezuela (Rostafinsky, 1876) we include a description of our collections.

Sporophores sporocarpic, forming dense colonies. Sporocarps densely grouped or clustered, sessile, subglobose to hemispheric, sometimes irregular, 0.3-0.7 mm diam., sunken into hypothallus (Figs. 2-4). Sporotheca white or grayish (263.White-264.l.Gray). Hypothallus membranous but strongly calcareous, white and crusty due to limy incrustations, extending under the group of sporocarps and firmly closed to their bases. Peridium double, the layers firmly closed and apparently single; outer layer calcareous, thick, crusty, brittle, rough to smooth, white (263.White), the lime granules 1-2 µm diam.; inner layer membranous, colourless; dehiscence irregular to areolate. Columella cylindrical to hemispherical or subconical, reaching the middle of the sporotheca, calcareous, white (263.White). Capillitium abundant, limeless, with threads radiating from the columella, branched and fenestrate at the tips (Fig. 5), straight, smooth, sometimes with small swellings, brown (61.gy.Br-58.m.Br) by transmitted light, colourless at the tips, up to 1 µm diam., 130-200 µm long, sparsely interconnected. Spores free, dark brown to blackish in mass, grayish brown (60.l.gy.Br-61.gy.Br) by transmitted light, subglobose, 11-12 µm diam., with a dark, incomplete reticulum or subreticulated (Figs. 6-8), the ridges up to 1.6 µm height with crested edges (only visible in oil immersion).

Other species of the genus with sessile sporocarps sunken into a calcareous hypothallus are *D. spumarioides* (Fr.) Fr. and *D. rimosum* Eliasson & Nann.-Bremek., also reported for Mexico, from the studied areas, but both species have smaller (8-11 µm diam. vs. 11-12 µm diam.) and warted spores. *Diderma cingulatum* Nann.-Bremek. also has a calcareous hypothallus and a fenestrate capillitium, but the spores are larger (13-16 µm diam.) and warted. Additionally, the spore has a pale cingulum and the columella usually reaches the apex of the sporotheca (Nannenga-Bremekamp, 1968: 191-193), characters absent in our specimens.



Figs. 2-8. *Diderma subdictyospermum* (Lado12180). **2-4.** Clustered, sessile sporocarps. **5.** fenestrate capillitium (SEM) with a group of calcium globules from the peridium lodged in the top right corner. **6-8.** Spores with a prominent incomplete reticulum with crested ridges (SEM). Note small calcium globules from the peridium among spore ridges. Bars: 2-4 = 1 mm; 5, 6 = 5 μ m; 7, 8 = 1 μ m.

Diderma scabrum Eliasson & Nann.-Bremek. and *D. circumscissile* S.D. Patil, R.L. Mishra & Ranade have also crowded, sessile and calcareous sporocarps and spores similar in size (11-12 μ m), but none of them have fenestrate capillitium, and the spores are verrucose or spinulose, but not with

an irregular reticulum or subreticulated (Mishra and Ranade, 1979; Eliasson and Nannenga-Bremekamp, 1983). In addition, *D. circumscissile* has a typical circumscissile dehiscence. *Diderma crustaceum* Peck has been described with spiny spores, sometimes appearing subreticulate and 11-15 μm diam. (Martin and Alexopoulos, 1968: 354), but the peridium is clearly double, with the outer layer usually distinct from the inner layer, the columella is globose or clavate and often lacking, and the sporocarps are crowded, sometimes superimposed, and often forming a pulvinate colony.

***Diderma yucatanense* Estrada, Lado & S.L. Stephenson, sp. nov.** (Figs. 9-12)

Etymology: Referring to the Yucatán Peninsula where the species was found.

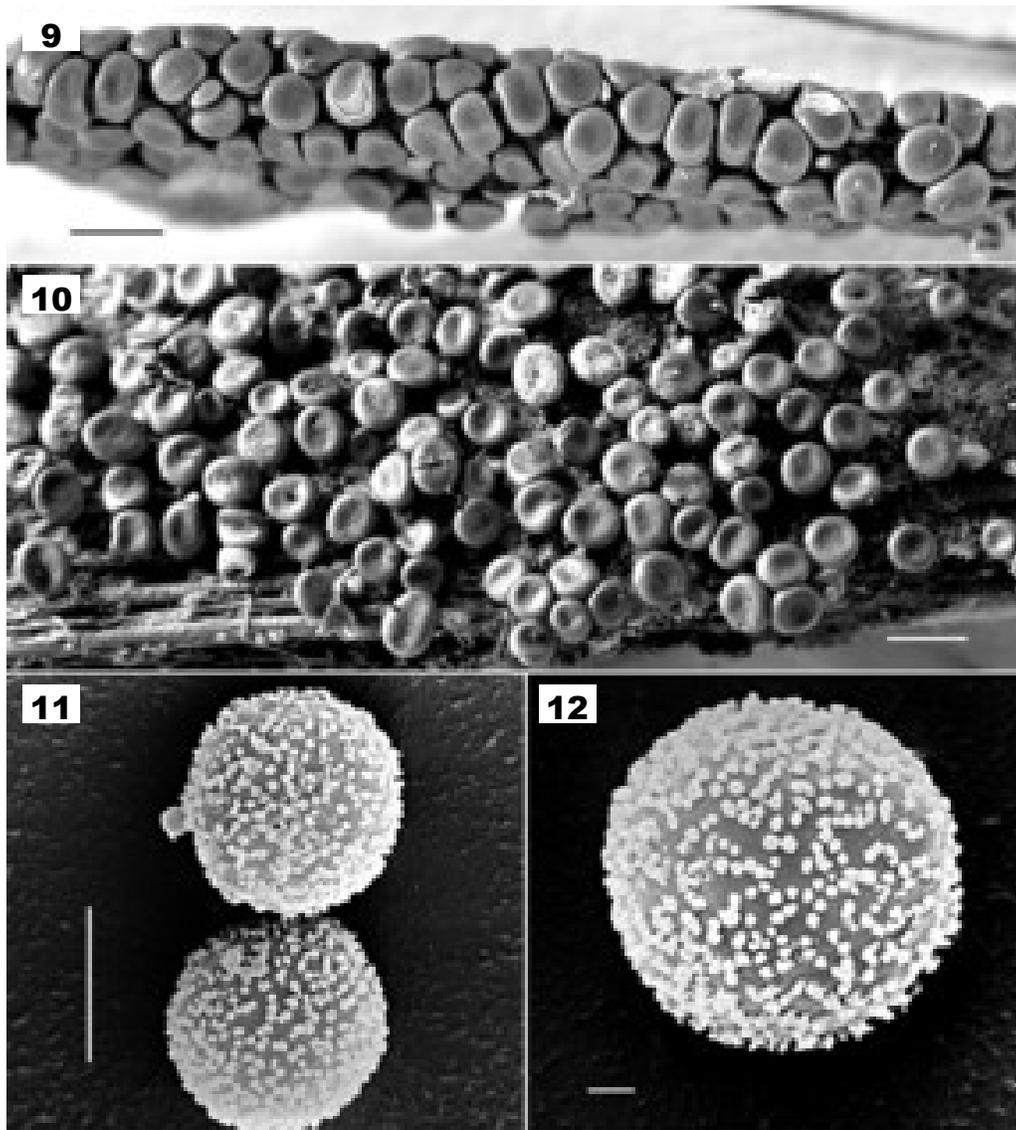
Sporocarp aggregati, stipitati, 0.6-0.9 mm ex toto alti, *sporotheca* discoidea et superne depressa, roseo-lutescenti, dilute fusca vel fusco-rubescenti, *peridio* eius triplici, medio quidem coriaceo, calcareo, *stipite* autem 0.4-0.6 \times 0.3-0.5 mm, nodulis calcareis 18-65 μm diam. impleto, *sporis* 7.5-9.5 μm diam., verrucosis.

Sporophores sporocarpic, forming dense colonies. *Sporocarps* densely grouped to clustered (Figs. 9, 10), stipitate, 0.6-0.9 mm in total height. *Sporotheca* hemispheric-depressed to discoid, slightly umbilicate above (Fig. 10), yellowish pink (31.p.y Pk) to light reddish brown (42.l.r Br) or light brown (57.l.Br), 0.4-1.0 \times 0.2-0.3 mm. *Hypothallus* membranous, with some lime around the stipe, extending under the group of sporocarps. *Peridium* triple, the two outer layers closely adherent, the inner one separate and generally of independent dehiscence; *outer layer* membranous, smooth, shiny, yellowish pink (31.p.y Pk) to light reddish brown (42.l.r Br) or light brown (57.l.Br); *middle layer* slightly coriaceous, white, thick, crusty, brittle, calcareous, with lime granules 1-2 μm diam.; *inner layer* membranous, light gray; dehiscence by irregular fissures. *Columella* low, pulvinate, reaching until 1/5-1/4 of the sporotheca, calcareous, light brownish (57.l.Br-76.l.y Br). *Stipe* sturdy, cylindrical to truncated cone shape, calcareous, white to slightly brownish, 0.4-0.6 \times 0.3-0.5 mm long, filled with white and large crystalline nodules of 18-65 μm diam. *Capillitium* abundant, limeless, with threads radiating from the columella, sparingly branching, straight to wavy, smooth, sometimes with small, darker swellings, grayish brown (61.gy.Br-60.l.gy.Br) by transmitted light, colourless at the tips, up to 1.2 μm diam., 120-170 μm long, sparsely interconnected. *Spores* free, dark brown to blackish in mass, grayish brown (60.l.gy.Br-61.gy.Br) by transmitted light, subglobose, 7.5-9.5 μm diam., warty (Figs. 11, 12).

Habitat: On decayed leaves of palms, in a medium semi-deciduous forest.

Known distribution: Yucatán Peninsula (Mexico).

Material examined: MEXICO, Quintana Roo, Municipality of Lázaro Cárdenas, El Edén Ecological Reserve, trail from the Station to observatory house, 21°22'58"N 87°12'24"W, 30 m, on leaf of palm, 24 November 1999, Lado11483 (MA-Fungi 51220,



Figs. 9-12. *Diderma yucatanense* (from holotype). **9.** Sporocarps clustered. **10.** Sporocarps densely grouped (MA-Fungi 51222). **11, 12.** Warted spores (SEM). Bars: 9, 10 = 1 mm; 11 = 5 μ m; 12 = 1 μ m.

holotype designated here; isotype in TLXM sub AET6076); *ibid.*, on leaves, Lado11504 (MA-Fungi 51221, AET6097); Observatory house area, 21°12'33"N 87°12'41"W, 30 m, on dead leaves of the palm *Sabal jaca*, 26 November 1999, Lado11609 (MA-Fungi 51222, AET6202).

Notes: *Diderma yucatanense* is characterized by its grouped stipitate sporocarps, with depressed or discoid pinkish or light brown sporothecae,

sturdy and calcareous stipe, pulvinate columella and peridium formed by three layers (Figs. 9, 10). The three collections of this species were collected on two different days and from two different localities in El Edén, Quintana Roo. The features of the species were constant among the three studied collections.

Other species with depressed or discoid sporothecae include *D. hemisphaericum* (Bull.) Hornem., *D. acanthosporum* Estrada & Lado, *D. lohogadense* S.D. Patil, R.L. Mishra & Ranade, *D. marieae* S.D. Patil, R.L. Mishra & Ranade, *D. punense* S.D. Patil, R.L. Mishra & Ranade, *D. alpinum* (Meyl.) Meyl., *D. effusum* (Schwein.) Morgan and *D. testaceum* (Schrad.) Pers. The former can be distinguished from *D. yucatanense* for its white sporothecae with double peridium, and its grooved and usually ochraceous stipe. *Diderma acanthosporum* has also pink to pinkish white sporothecae, but additionally has large spores (17-20.5 µm), paler on one side and with long spines, and peridium with two layers (Estrada-Torres *et al.*, 2001). *Diderma lohogadense* has also a peridium with three layers, but the outer one is coriaceous, and *D. lohogadense* has strongly umbilicate sporothecae, which are saucer shaped or inverted bell-shaped unlike *D. yucatanense*, the stipes narrowing downwards, dehiscence circumscissile and the spores spiny and larger (9.5-12 µm in *D. lohogadense* vs. 7.5-9.5 µm in *D. yucatanense*) (Mishra and Ranade, 1979).

Diderma marieae and *D. punense* have white sporothecae, a single peridium and larger spores (12.8-16 µm in *D. marieae*, and 13-15 µm in *D. punense*) marked with different kind of ornamentation (with a broken reticulation in *D. marieae*, and with encircling ridge in *D. punense*) (Mishra and Ranade, 1979). *Diderma alpinum*, *D. effusum* and *D. testaceum* are sessile on a wide base and have a peridium with only two layers. In addition, in both *D. alpinum* and *D. effusum* the peridium is white.

Other species with similar colour in the outer peridium are *Diderma carneum* Nann.-Bremek. and *D. montanum* var. *roseum* Meyl., but they have globose sporothecae, subglobose columellae and a peridium with two layers (Nannenga-Bremekamp, 1968, 1991).

***Didymium bahiense* Gottsb.**

Loc. 11, bryophytes and b, Lado11716 (AET6311); inflorescences, Lado12130 (AET6382).

New record for Veracruz, Illana *et al.* (2000: 176) mention some unpublished material from Baja California, but the species is otherwise unknown in México.

***Didymium clavus* (Alb. & Schwein.) Rabenh.**

Loc. 11, ll, Lado12170 (AET6422).

First record for Veracruz.

Didymium difforme (Pers.) S.F. Gray

Loc. 9, ll of *Astrocaryum mexicanum* in mc, SC16460.

Didymium iridis (Ditmar) Fr.

Loc. 9, lh of *Heliconia schiedeana* leaf (pH 7.6) in mc, dwb 1769, dwb 1774, dwb 1818; lp of *Astrocaryum mexicanum* (pH 7.6) in mc, dwb 1801; ll of *Heliconia schiedeana* in mc, SC16293; ll of *Astrocaryum mexicanum* in mc, SC16274.

More than 50 sporocarps were collected from moist chamber cultures.

Didymium nigripes (Link) Fr.

Loc. 2, ll of *Thrinax radiata* (pH 6.1), SC15978; ll of *Thrinax radiata* (pH 6.8), SC15990; ll of *Thrinax radiata* (pH 7.3), SC15993.

Loc. 5, ll of *Thrinax radiata* (pH 7.1), SC16058.

Loc. 6, ll (pH 6.2) in mc, Stephenson12894.

Loc. 8, lw of *Heliconia*, Lado11643 (AET6238).

First record for Quintana Roo but the species is known from Chiapas and Veracruz (Illana *et al.*, 2000). Estrada-Torres *et al.* (2000) reported it from Guatemala.

Didymium ochroideum G. Lister

Loc. 1, ll (pH 6.9) in mc, Stephenson12674.

Loc. 6, ll (pH 6.7) in mc, Stephenson12702.

Only two collections were made, both from moist chamber cultures of forest litter. This is a rare species, previously known in the Neotropics from Ecuador (Farr *et al.*, 1979), Brazil (Putzke, 1996) and Costa Rica (Schnittler and Stephenson, 2000). First record for Mexico.

Didymium squamulosum (Alb. & Schwein.) Fr.

Loc. 3, lc (pH 6.6) in mc, Stephenson12670; lh (pH 7.0) in mc, Stephenson12672.

Loc. 9, ll of *Astrocaryum mexicanum* (pH 7.6) in mc, dwb 1772, dwb 1782; ll of *Astrocaryum mexicanum* (pH 7.6) in mc, dwb 1776; ll of *Astrocaryum mexicanum* in mc, SC16289; ll of *Astrocaryum mexicanum* in mc, SC16272.

Loc. 10, ll, Lado11696 (AET6291).

Loc. 11, ll, Lado12175 (AET6427); ll, Lado12215 (AET6467); ll, Lado12221 (AET6473).

Large collections of numerous sporocarps appeared in moist chamber cultures. New record for Quintana Roo.

***Didymium* sp.**

Loc. 1, ll (pH 6.5) in mc, Stephenson13120; ll (pH 6.2), Stephenson in mc, 13121.

Both specimens are very poorly developed but do appear to represent the same taxon. The flattened labyrinthiform plasmodiocarps and warted spores possibly suggest *Didymium anellus* Morgan, but the material is too aberrant to constitute a definitive record of this species.

Echinostelium minutum de Bary

Loc. 1, b of *Haematoxylon campechianum* (pH 7.0) in mc, SC16281.

Loc. 3, li (pH 6.1) in mc, Stephenson14497.

Loc. 9, b of *Bursera simaruba* (pH 7.4) in mc, dwb1780.

First record for Quintana Roo and Veracruz. Previously reported from Belize by Ing and Haynes (1999).

Fuligo megaspora Sturgis

Loc. 3, lw, Lado11526 (AET6119); lw, Lado11528 (AET6121).

First record for Quintana Roo.

Hemitrichia calyculata (Speg.) M.L. Farr

≡ *Hyporhamma calyculata* (Speg.) Lado, the correct name for the taxon according to Lado (2001)

Loc. 1 w, Lado11376 (AET5962); w, Lado11378 (AET5964); w and b of *Bursera simaruba*, Lado11412 (AET5998); w of *Bursera simaruba*, Lado11415 (AET6001); w, Stephenson12360; w, Stephenson12406; w, Stephenson12407.

Loc. 2, w, Lado11435 (AET6024); w, Lado11440 (AET6029); w, Lado11456 (AET6045); w, Lado11458 (AET6047); w, Lado11471 (AET6060); w, Stephenson12362; w (pH 5.8) SC15981; dead b (pH 7.5), SC15992.

Loc. 3, w, Lado11527 (AET6120); w, Stephenson12364; w, Stephenson12391.

Loc. 4, w, Lado11546 (AET6139).

Loc. 5, w, Lado11565 (AET6158); w, Stephenson12422; w, Stephenson12424; w, Stephenson12427; w, Stephenson12435; w, Stephenson12436; w, Stephenson12440; w, Stephenson12442; w, Stephenson12451; w (pH 7.6), SC16039; w (pH 8.1), SC16008; dead b, SC16013; w (pH 5.9), SC16048; dead b (pH 8.0), SC16069; w (pH 5.3), SC16106.

Loc. 6, w, Stephenson12415.

Loc. 7, w, Lado11575 (AET6168); w, Lado11576 (AET6169).

Loc. 8, w, Lado11636 (AET6231); w, Lado11652 (AET6247).

Loc. 9, w, Lado11663 (AET6258); w, Lado11682 (AET6276); w, Lado11687 (AET6282).

Loc. 10, w, Lado11691 (AET6285).

Loc. 11, w, AET4037; w, AET4038; w, AET4041; w, AET4043.

Loc. 12, w, Lado12142 (AET6394); w, Lado12148 (AET6400).

Loc. 13, w, Lado12161 (AET6413).

Loc. 14, w, Lado12164 (AET6416).

Loc. 15, w, AET4052 (cf.); w, AET4053; w, AET4054 (cf.); w, AET4055.

The abundance of this species in tropical areas is demonstrated by the fact that it is the only species collected at every single locality. Previously reported for El Edén by Ogata and Andrade-Torres (1996).

Hemitrichia pardina (Minakata) Ing

≡ *Hyporhamma pardina* (Minakata) Lado, the correct name for the taxon according to Lado (2001)

Loc. 1, ll (pH 6.9) in mc, Stephenson12665; ll (pH 7.1) in mc, Stephenson12680; b of *Haematoxylon campechianum* (pH 7.0) in mc, SC16419.

Loc. 3, lh (pH 6.8) in mc, Stephenson12869.

- Loc. 6, ll (pH 6.6) in mc, Stephenson12623; ll (pH 7.0) in mc, Stephenson12627; lg (pH 6.6) in mc, Stephenson12701; ll (pH 6.7) in mc, Stephenson12866A; ll (pH 6.9) in mc, Stephenson12881; lc (pH 7.0) in mc, Stephenson13075A; ll (pH 7.0) in mc, Stephenson13105.
- Loc. 9, b of *Bursera simaruba* (pH 7.4) in mc, dwb 1795; b of *Tuxtla pittieri* (pH 7.4) in mc, dwb 1824.
- Loc. 9, b of *Guarea* sp. in mc, SC16457.
- Loc. 10, fruit of *Astrocaryum mexicanum*, Lado11698 (AET6293) (cf.);
Abundant in moist chamber cultures. First record for México.

***Hemitrichia serpula* (Scop.) Rostaf. ex Lister**

≡ *Hyporhamma serpula* (Scop.) Lado, the correct name for the taxon according to Lado (2001)

- Loc. 1, w, Lado11377 (AET5963); ll palm, Lado11408 (AET5994); b, Lado11427 (AET6013); w, Stephenson12359; w, Stephenson12399; w, Stephenson12400; w, Stephenson12404; w, Stephenson1240; ll (pH 5.9) in mc, Stephenson12722; ll (pH 6.6) in mc, Stephenson12746; ll (pH 6.2) in mc, Stephenson12886.
- Loc. 2, w, Lado11430 (AET6019); w, Lado11433 (AET6022); w, Lado11437 (AET6026); b, Lado11447 (AET6036); w, Lado11462 (AET6051); ll (pH 6.9) in mc, Stephenson12861; ll (pH 6.4) in mc, Stephenson12862; ll (pH 6.8) in mc, Stephenson12863; ll (pH 7.0) in mc, Stephenson12873; ll (pH 6.4) in mc, Stephenson12874; ll (pH 6.2) in mc, Stephenson12875; ll (pH 7.3) in mc, Stephenson12876; ll (pH 6.4) in mc, Stephenson12986; w (pH 7.9), SC15976; dead b (pH 6.0), SC15988; dead b (pH 6.7), SC16003.
- Loc. 3, w, Lado11477 (AET6070); w, Lado11498 (AET6091); w, Lado11513 (AET6106); b of palm, Lado11533 (AET6126); w, Lado11534 (AET6127); w, Stephenson12377; dead b, Stephenson12383; w, Stephenson12392.
- Loc. 4, ll and w of palm, Lado11537 (AET6130); w, Lado11542 (AET6135); ll of palm, Lado11549 (AET6142); dead b (pH 7.7), SC16028; w (pH 7.3), SC16035.
- Loc. 5, on polypore, Lado11567 (AET6160); w, Stephenson12429; w, Stephenson12431; ll, Stephenson12439; dead b, Stephenson12446; w, Stephenson12447; lh (pH 7.0), SC16009; w (pH 7.8), SC16010; dead b (pH 6.5), SC16011; lh (pH 7.0), SC16017; dead b (pH 6.4), SC16019; w (pH 7.0), SC16042; dead b (pH 7.2), SC16043; w (pH 7.3), SC16045; w (pH 7.5), SC16051; decaying palm frond (pH 7.6), SC16055; w (pH 7.8), SC16064; w (pH 7.5), SC16065; w (pH 5.0), SC16078; w (pH 7.5), SC16099; w (pH 2.3), SC16107
- Loc. 6, W and b, Lado11572 (AET6165); w, Stephenson12412; w, Stephenson12413; w, Stephenson12414; w, Stephenson12417; ll, w, Stephenson12419.
- Loc. 7, b, Lado11577 (AET6170); W and b, Lado11584 (AET6177); W and b, Lado11586 (AET6179); ll of the palm *Sabal jaca*, Lado11608 (AET6200); ll of the palm *Sabal jaca*, Lado11617 (AET6210).
- Loc. 8, W and b, Lado11639 (AET6234).
- Loc. 9, w, Lado11675 (AET6269); W and b, Lado11678 (AET6272).
- Loc. 12, ll of the palm *Astrocaryum mexicanum*, Lado12136 (AET6388).
- Loc. 14, ll of the palm *Astrocaryum mexicanum*, Lado12165 (AET6417).

Together with *H. calyculata* and *Ceratiomyxa fruticulosa*, this was one of the most frequently collected myxomycetes in the areas we studied. Previously reported for El Edén by Ogata and Andrade-Torres (1996).

***Lamproderma muscorum* (Lév.) Hagelst.**

Loc. 11, ll, Lado12172 (AET6424).

The spores are 8.8-9.6 μm diam., with dispersed warts that are less obvious than in the material studied by us from Ecuador (*SC12941*, *SC13112*) (Schnittler *et al.*, 2002). The capillitium is rigid, brown, with sharp hyaline ends and it arises mainly from the apex of the cylindrical columella. This is the second record for the country. Previously reported by Villarreal (1990), also from Veracruz.

***Lamproderma scintillans* (Berk. & Broome) Morgan**

Loc. 1, ll (pH 6.6) in mc, Stephenson12619; ll (pH 6.3) in mc, Stephenson12887; ll (pH 6.3) in mc, Stephenson12898.

First record for Quintana Roo.

***Licea biforis* Morgan**

Loc. 2, w, Lado11475 (AET6064).

First record for Quintana Roo.

***Licea operculata* (Wingate) G.W. Martin**

Loc. 3, aerial litter (pH 6.8) in mc, Stephenson12671.

Loc. 9, b of *Guarea* sp., in mc, SC16288.

First record for Quintana Roo. In Veracruz previously reported by Braun and Keller (1986).

***Licea poculiformis* Ukkola**

Loc. 12, b of *Haematoxylon campechianum* (pH 8.0) in mc, dwb 1759.

Tiny squat goblet-shaped stipitate sporocarps with a shiny pale lid. We were able to compare our material with the type material of both *Licea operculata* (BPI 826296) and *Licea poculiformis* (Ukkola 319A in H). This species is closest to *L. operculata* but is much smaller, different in colour, and has a double peridium. The lid of *L. poculiformis* has a clear edge by TL and is wider than that of *L. operculata*, occupying the total diam. of the sporotheca and is distinctly papillose by LM whereas the lid of the *L. operculata* type specimen appears smooth. Finally, the ratio of stalk width to height is different, with *L. poculiformis* much shorter and squatter and with a straight wide stalk not tapered like *L. operculata*. Previously known only from the type locality in Tanzania (Ukkola, 1998). First record for the Western Hemisphere.

***Licea* sp. 1**

Loc. 9, b of *Tuxtla pittieri* (pH 7.4) in mc, dwb 1783; b of *Porteroni viridescens* (pH 7.4) in mc, dwb 1793; b of *Nectandra ambigens* (pH 7.1) in mc, dwb 1798; b of *Porteroni viridescens* (pH 7.2) in mc, dwb 1808; dwb 1836.

Loc. 11, bryophytes and b, Lado11715 (AET6310).

This stipitate *Licea* does not fit the description of any other species in the genus described in the literature and its taxonomic identity is still under study. The collection dwb 1836 was made from a repeat culture of bark which produced dwb 1808.

***Licea* sp. 2**

(Figs. 13-16)

Loc. 1, ll (pH 6.7) Stephenson14496.

A single but plentiful collection of sessile sporocarps resembling *L. minima* Fr. with platelets joined along clear ridges of dehiscence which form wavy crests on the sporotheca surface (Fig. 13). Sporocarps open in a petaloid fashion. The peridium is double, and the inner surface of the platelets is heavily papillate all over including larger protruberances at the edges (Fig. 14). The spores are 11-12 µm, reddish gold in mass, pale yellowish pink and smooth by LM. They are densely but minutely warted by SEM. There are 'bald' areas over the surface of the spores by SEM devoid of ornamentation (Figs. 15, 16). This character of fugaceous warts is noted for *Licea chelonoides* Nann.-Bremek. which is also a similar species to this collection. It differs from the Yucatan material in its larger spores and darker colour. The Yucatan material also has very obvious warts on the inner peridial surface and that of *L. chelonoides* is usually smooth (Nannenga-Bremekamp, 1965). This may represent a new species but until more material has been collected and the constancy of the characters can be confirmed, it is premature to formally describe it.

***Lycogala conicum* Pers.**

Loc. 8, w, Lado11651 (AET6246).

This is the second record for the country. Previously reported by Villarreal (1985) also from Veracruz.

***Lycogala exiguum* Morgan**

Loc. 1, w, Lado11373 (AET5959); W and b of *Bursera simaruba*, Lado11412 (AET5998); w, Lado11428 (AET6014).

Loc. 2, w (pH 6.8), SC15985; w (pH 6.8), SC15989.

Loc. 3, w, Lado11532 (AET6125).

Loc. 4, w, Lado11560 (AET6153).

Loc. 5, w, Stephenson12423.

Loc. 7, w, Lado11592 (AET6185); w, Lado11606 (AET6199).

Loc. 8, w, Lado11662 (AET6257).

Loc. 9, w, Lado11673 (AET6267).

First record for Quintana Roo.

***Macbrideola martinii* (Alexop. & Beneke) Alexop.**

Loc. 1, b of *Erythroxylum areolatum* (pH 5.2) in mc, SC16924.

Loc. 3, lh (pH 6.8) in mc, Stephenson13122; b of *Lysiloma latisiliquum* (pH 8.1) in mc, dwb 1762.

Loc. 5, b of *Byrsonima bucidaefolia* (pH 7.8) in mc, dwb1766; b of *Lysiloma latisiliquum* (pH 8.1) in mc, dwb 1762; b of *Lysiloma latisiliquum* (pH 7.6) in mc, SC16295; b of *Bursera simaruba* in mc, SC16284/2; b of *Vitis gaumeri* (pH 7.6) in mc, SC16283.

Loc. 9, on bark of *Tuxtla pittieri* (pH 7.4) in mc, dwb 1779; on bark of *Porteroni viridescens* (pH 7.4) in mc, dwb 1792, dwb1797; on *Bursera simaruba* bark (pH 7.4) in mc, dwb 1802; b of *Guarea* sp. in mc, SC16458.

Two of these samples (dwb 1792, dwb 1802) differ from the normal in being taller and more slender, and having a slightly anastomosed capillitium instead of the usual free ends. The spores with clustered warts and the other characters however are typical for this species.

First record for Mexico. Also reported from Hawaii (Eliasson, 1991), Belize (Ing and Haynes, 1999) and Costa Rica (Schnittler and Stephenson, 2000)

Macbrideola scintillans* var. *verrucosa (Nann-Bremek. & Y. Yamam.) Y. Yamam.

Loc. 1, b of *Vitex gaumeri* (pH 7.6) in mc, SC16282.

Loc. 3, b of *Vitex gaumeri* (pH 8.0) in mc, dwb 1788; b of *Gymnopodium floribundum* (pH 8.3) in mc, dwb1794.

Loc. 9, on bark of *Porteroni viridescens* (pH 7.2) in mc, dwb 1799; on bark of *Porteroni viridescens* (pH 7.2) in mc, dwb 1830.

Macbrideola scintillans was reported by Ing and Haynes (1999) from Belize as the first record from the Neotropics. Since then this variety of the species has been reported from Costa Rica (Schnittler and Stephenson, 2000) and may represent a truly tropical form. First record for Mexico.

Metatrichia horrida Ing

Loc. 2, w, Lado11432 (AET6021); b, Lado11446 (AET6035).

Loc. 3, dead b, Stephenson12379; w, Stephenson12386; w, Stephenson12387.

Loc. 4, w, Lado11555 (AET6148).

Loc. 7, w, Lado11600 (AET6193) (cf.); ll of the palm *Sabal jaca*, Lado11634 (AET6227).

Loc. 10, w, Lado11695 (AET6290).

First record for Quintana Roo and Veracruz.

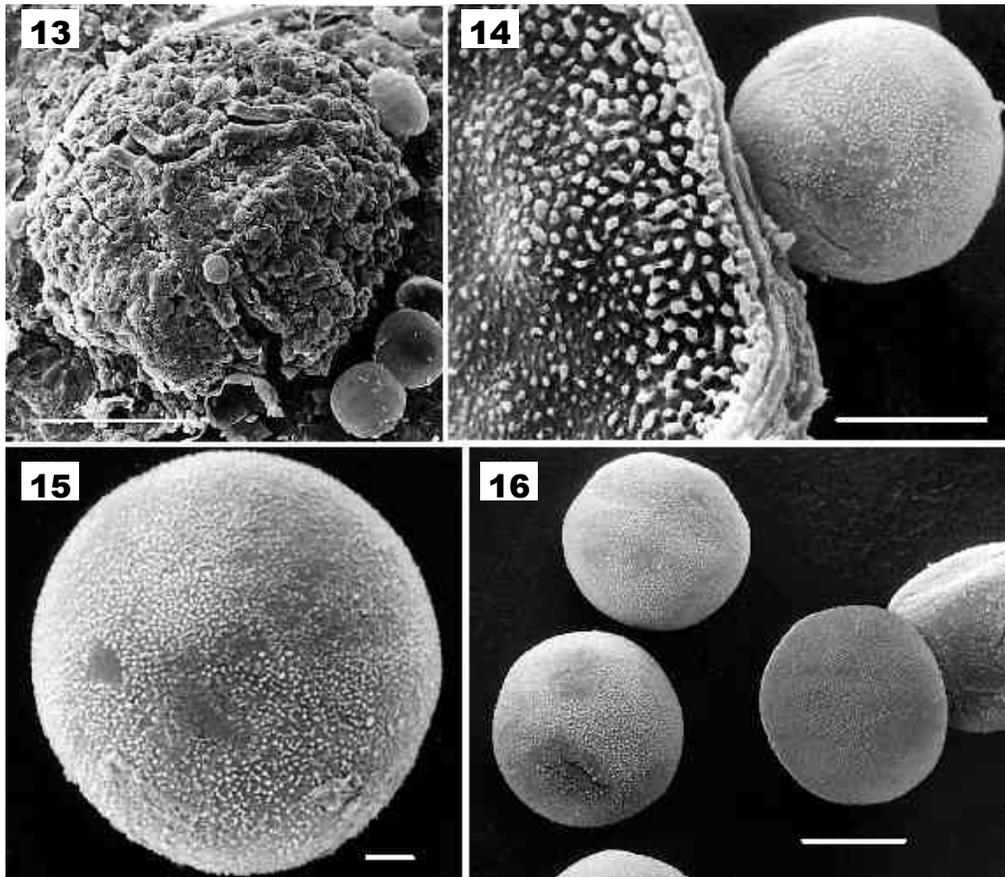
Perichaena chrysosperma (Curr.) Lister

Loc. 1, w of *Bursera simaruba*, Lado11416 (AET6002); ll (pH 6.6) in mc, Stephenson 12682; ll (pH 6.6) in mc, Stephenson 12896; ll (pH 6.7) in mc, Stephenson 13140B; ll (pH 5.9) in mc, Stephenson13167; ll (pH 6.7) in mc, Stephenson14492.

Loc. 2, b, Lado11454 (AET6043).

Loc. 3, aerial litter (pH 7.2) in mc, Stephenson 12612B; cactus aerial litter (pH 6.6) in mc, Stephenson14495.

Loc. 5, b of *Manilkara zapota* (pH 7.9) in mc, dwb1754.



Figs. 13-16. *Licea* sp. 2 (Stephenson 14496) (SEM). **13.** Sessile sporocarp with clear ridges of dehiscence which form wavy crests on the sporotheca surface. **14.** Inner side of the peridium heavily papillate all over including larger protruberances at the edges. **15, 16.** Spores densely and minutely punctate with smooth areas. Bars: 13 = 50 μm ; 14, 16 = 5 μm ; 15 = 1 μm .

Loc. 6, ll (pH 7.0) in mc, Stephenson 12624; ll (pH 6.7) in mc, Stephenson 12866B; ll (pH 6.8) in mc, Stephenson 12870; ll (pH 6.9) in mc, Stephenson 12871; ll (pH 6.9) in mc, Stephenson 12872; aerial litter (pH 7.0) in mc, Stephenson 12878; ll (pH 6.6) in mc, Stephenson 12879; ll (pH 6.5) in mc, Stephenson 12895; ll (pH 7.1) in mc, Stephenson 12981; lg (pH 6.6) in mc, Stephenson13182; ll (pH 6.7) in mc, Stephenson13183.

Loc. 8, bract of the fruit of *Astrocaryum mexicanum*, Lado11660 (AET6255).

Loc. 9, w, Lado11684 (AET6279); b of *Porteroni viridescens* (pH 7.2) in mc, dwb 1796, dwb 1807; b of *Nectandra ambigens* (pH 7.3) in mc, dwb 1810; b of *Porteroni viridescens*, dwb 1825; b of *Guarea* sp. (pH 7.5) in mc, dwb 1839; b of *Nectandra ambigens* in mc, SC16287.

Loc. 10, w, Lado11694 (AET6289); b, Lado11703 (AET6298).

Loc. 11, w, AET4042; lw of *Urera* sp., Lado11711 (AET6306).

Loc. 15, w, AET4054.

The collection dwb1825 was found already fruited on the bark before it was put into culture. Previously reported for El Edén by Ogata and Andrade-Torres (1996).

***Perichaena depressa* Lib.**

- Loc. 1, ll (pH 6.0) in mc, Stephenson12891.
- Loc. 2, w, Lado11457 (AET6046).
- Loc. 4, dead b (pH 7.5), SC16030; dead b (pH 7.9), SC16036.
- Loc. 5, decaying palm frond (pH 5.0), SC16016
- Loc. 6, lh (pH 7.0) in mc, Stephenson12737; ll (pH 6.7) in mc, Stephenson12864; ll (pH 6.6) in mc, Stephenson12880; ll (pH 7.0) in mc, Stephenson13130; ll (pH 6.9) in mc, Stephenson13162B.
- Loc. 8, bract of the fruit of the palm *Astrocaryum mexicanum*, Lado11660 (AET6255).
- Loc. 9, on bark of *Porteroni viridescens* (pH 7.4) in mc, dwb 1844.
- Loc. 10, b, Lado11704 (AET6299).

First record for Quintana Roo.

***Perichaena vermicularis* (Schwein.) Rostaf.**

- Loc. 1, ll (pH 6.7) in mc, Stephenson13140A; b of *Erythroxyllum areolatum* (pH 5.0) in mc, SC16450.
- Loc. 3, lh (pH 7.2) in mc, Stephenson12612A; lh (pH 7.0) in mc, Stephenson12622A; lh (pH 7.0) in mc, Stephenson12704; lh (pH 6.2) in mc, Stephenson13103.
- Loc. 5, b of *Vitis gaumeri* in mc, SC16455.
- Loc. 9, on *Astrocaryum mexicanum* leaf base (pH 7.7) in mc, dwb 1806; b of *Bursera simaruba* in mc, SC16286.

Specimen dwb 1806 has a capillitium that resembles a rope and lacks spines. New record for Quintana Roo.

***Physarella oblonga* (Ber. & M. A. Curtis) Morgan**

- Loc. 1, w of *Bursera simaruba*, Lado11414 (AET6000).
- Loc. 2, w, Lado11439 (AET6028); w, Lado11443 (AET6032); dead b (pH 7.0), SC15994.
- Loc. 3, w, Lado11515 (AET6108).
- Loc. 8, W and b, Lado11637 (AET6232).
- Loc. 9, W and polypore, Lado11679 (AET6273).
- Loc. 10, w, Lado11702 (AET6297).
- Loc. 14, w, Lado12168 (AET6420).

Previously reported from El Edén by Ogata and Andrade-Torres (1996).

***Physarum aeneum* (Lister) R.E. Fr.**

- Loc. 3, b, Lado11489 (AET6082).

Farr (1976) cited this species from other Neotropical countries but this is the first record for Mexico.

***Physarum album* (Bull.) Chevall.**

= *Physarum nutans* Pers., see Lado (2001)

- Loc. 1, ll, Stephenson12397.

- Loc. 2, b (pH 4.8), SC15996b; w (pH 7.7), SC16000.
 Loc. 3, ll, Lado11478 (AET6071); b, Lado11525 (AET6118).
 Loc. 7, ll of the palm *Sabal jaca*, Lado11613 (AET6206).
 Loc. 10, bryophytes and b, Lado11708 (AET6303).
 Loc. 11, w, Lado11709 (AET6304); W and bryophytes, Lado12132 (AET6384).

According to Lado (2001), *Physarum album* is the accepted name for the well known *Physarum nutans* Pers. The material ascribed to this species falls into two groups. Specimens Lado11478, Lado11525, Lado11613 and Lado11709 are typical and agree with the description of *Ph. album* provided by Martin and Alexopoulos (1969) and Nannenga-Bremekamp (1991), but the other group, represented by specimens Lado11708 and Lado12132, have larger spores (10.7-11.0 μm diam. vs. 7-10 μm in *Ph. album*) and larger flatter sporothecae. These specimens are identical in all characters to those ascribed below to *Ph. alvoradianum* except for the lack of the typical pseudocolumella. Perhaps they truly belong to *Ph. alvoradianum*, but if that is the case, the description of the latter would have to be amended to include samples without a pseudocolumella.

First record for Quintana Roo. Previously reported from Belize by Ing and Haynes (1999), and from Guatemala by Estrada-Torres *et al.* (2000).

***Physarum alvoradianum* Gottsb.**

- Loc. 3, dead bryophytes and b, Lado11488 (AET6081).
 Loc. 11, bryophytes, Lado12214 (AET6466).

Previously known only from the type locality in Alvorada do Norte (Goiás, Brazil) (Gottsberger, 1968: 363). It is different from the related *Ph. stellatum*, also found in the areas sampled, in having a discoid pseudocolumella instead of a spherical one, and slightly flattened sporothecae instead of globose ones, rugose, black and lime-encrusted stipes instead of completely limey ones, and spores of 11.0-11.8 μm diam. instead of 8-10 μm . For differences with *Ph. album* see comments on this species. It is interesting to note that the two collections of *Ph. alvoradianum* were found on moss associated with *Diderma rugosum*. First record for México.

***Physarum bogoriense* Racib.**

- Loc. 4, ll of palm, Lado11551 (AET6144).
 Loc. 10, ll, Lado12206 (AET6458).
 Loc. 11, ll, Lado12179 (AET6431).

First record for Quintana Roo and Veracruz.

***Physarum cinereum* (Batsch.) Pers.**

- Loc. 1, ll, Stephenson12396 (cf.).
 Loc. 3, ll of palm, Lado11512 (AET6105) (cf.).
 Loc. 11, ll, Lado12185 (AET6437).

First record for Quintana Roo.

Physarum compressum Alb. & Schwein.

Loc 9, ll of *Heliconia schiedeana* in mc, SC16292.

Loc. 10, fruit of *Astrocaryum mexicanum*, Lado11697 (AET6292); li of *Astrocaryum mexicanum*, Lado11699 (AET6294).

Loc. 15, ll, AET4044; w, AET4051.

Physarum crateriforme Petch

Loc. 1, b of *Jacquinia aurantiaca* (pH 7.6) in mc, SC16278; b of *Metopium brownei* (pH 7.7) in mc, SC16279; b of *Haematoxylon campechianum* (pH 7.0) in mc, SC16280; b of *Byrsonima bucidaefolia* (pH 6.7) in mc, SC16270; b of *Byrsonima bucidaefolia* (pH 6.2) in mc, SC16285.

Loc. 3, b of *Vitex gaumeri* (pH 8.0) in mc, dwb1771 cf.; b of *Lysiloma latisiliquum* (pH 8.1) in mc, dwb1778 cf.; b of *Manilkara zapota* (pH 8.0) in mc, dwb1813, b of *Manilkara zapota* (pH 7.9) in mc, dwb1815; b of *Crescentia cujete*, SC16005.

Loc. 5, b of *Lysiloma latisiliquum* (pH 7.6) in mc, SC16296.

Loc. 11, W and bryophytes, Lado12133 (AET6385).

The sporophores from some of the moist chamber cultures were often minute atypical forms and are tentatively assigned to this species, but others and the field collection are very typical. First record for Mexico. Previously reported from Belize by Ing and Haynes (1999).

Physarum didermoides (Pers.) Rostaf.

Loc. 8, ll of the palm *Astrocaryum mexicanum*, Lado11638 (AET6233).

Loc. 10, li of *Heliconia schiedeana*, Lado12195 (AET6447).

Loc. 11, bryophytes and b, Lado11718 (AET6313).

Physarum flavicomum Berk.

Loc. 1, w, Lado11402 (AET5988); w, Lado11420 (AET6006).

Loc. 2, w, Lado11470 (AET6059).

Loc. 3, w, Lado11487 (AET6080).

Loc. 5, w (pH 4.7), SC16020; w (pH 7.0), SC16049.

Loc. 7, w, Lado11601 (AET6194); ll of the palm *Sabal jaca*, Lado11605 (AET6198).

The specimens included under *Ph. flavicomum* fit the description of this species by Lister (1925) and Martin and Alexopoulos (1969). Specimens Lado11470 and Lado11605 have a yellow brown sporotheca, stipe and capillitial nodes like the Canadian material deposited in DAOM and identified by Hagemstein. The rest of the samples have yellow sporotheca and capillitial nodes and long slender stipes, black at the base but red or bright yellow at the apex, and thus translucent, a variation already noted by Lister (1925); the stipes of this material always leave a red pigment in the mounting medium. New record for Quintana Roo. Previously reported from Belize by Ing and Haynes (1999).

Physarum globuliferum (Bull.) Pers.

Loc. 1, w, Lado11400 (AET5986).

First record for Quintana Roo.

Physarum lateritium Berk. & Ravenel

Loc. 5, b of *Byrsonima bucidaefolia* (pH 7.8) in mc, dwb1758.

First record for Quintana Roo.

Physarum melleum (Berk. & Broome) Masee

Loc. 1, lp (pH 6.7) in mc, Stephenson12601; lp (pH 5.5) in mc, Stephenson 12622B; lp (pH 6.4) in mc, Stephenson 12626; ll (pH 6.8) in mc, Stephenson13107 (cf.); ll (pH 6.2) in mc, Stephenson13135; ll (pH 6.6) in mc, Stephenson13159.

Loc. 3, lh (pH 6.8) in mc, Stephenson14498.

Loc. 6, lg (pH 5.5) in mc, Stephenson12602.

Loc. 5, decaying palm frond (pH 7.5), SC16090; lp (pH 6.9), SC16066.

Loc. 9, li of *Astrocaryum mexicanum*, Lado11683 (AET6278);

Loc. 14, ll of the palm *Astrocaryum mexicanum*, Lado12163 (AET6415).

First record for Quintana Roo. Estrada-Torres *et al.* (2000) reported it from Guatemala.

Physarum nucleatum Rex

Loc. 1, w, ll Lado11388 (AET5974).

Loc. 5, w (pH 4.7), SC16076.

First record for Quintana Roo.

Physarum penetrale Rex

Loc. 9, w, Lado11681 (AET6275).

New record for Veracruz.

Physarum pusillum (Berk. & M.A. Curtis) G. Lister

Loc. 3, lh (pH 6.7) in mc, Stephenson12599; lh (pH 6.5) in mc, Stephenson12603 (cf.); lh (pH 7.0) in mc, Stephenson12604; lc (pH 6.7) in mc, Stephenson12668 (cf.) (yellow form); lc (pH 6.0) in mc, Stephenson12669 (cf.); lh (pH 7.1) in mc, Stephenson12865 (yellow form); lc (pH 6.7) in mc, Stephenson14488 (cf.) (yellow form).

First record for Quintana Roo. Previously reported from Belize by Ing and Haynes (1999).

Physarum roseum Berk. & Broome

Loc. 1, w, Lado11423 (AET6009).

Loc. 2, b, Lado11469 (AET6058).

Loc. 3, W and b, Lado11508 (AET6101).

First record for Quintana Roo.

Physarum stellatum (Masee) G.W. Martin

Loc. 1, w, Lado11381 (AET5967); w, Lado11395 (AET5981); w, Stephenson12351; dead b, Stephenson12401; w, Stephenson12402; w, Stephenson12403.

- Loc. 2, w, Lado11434 (AET6023); w, Lado11455 (AET6044).
- Loc. 3, w, Lado11491 (AET6084); w, Lado11492 (AET6085); w, Lado11494 (AET6087); w, Lado11500 (AET6093); w, Lado11516 (AET6109); w, Lado11518 (AET6111); w, Lado11530 (AET6123); w, Lado11534 (AET6127); W and stones, Lado11536 (AET6129); dead b, Stephenson12372.
- Loc. 4, lp (pH 7.8), SC16037.
- Loc. 5, w, Stephenson12425 (very old); w, Stephenson12449; w, Stephenson12452; w, ll, Stephenson12453; w (pH 7.51), SC16040; w (pH 7.17), SC16044; lp (pH 7.32), SC16084; w (pH 7.41), SC16102; w (pH 7.97), SC16068; w (pH 6.32), SC16070; w (pH 6.6), SC16072; w (pH 6.5), SC16077; w (pH 6.5), SC16023.
- Loc. 7, w, Lado11583 (AET6176); w, Lado11589 (AET6182); w, Lado11591 (AET6184); w, Lado11594 (AET6187); b, Lado11595 (AET6188); ll of the palm *Sabal jaca*, Lado11610 (AET6203).
- Loc. 8, w, Lado11644 (AET6239); w, Lado11646 (AET6241); w, Lado11653 (AET6248).
- Loc. 12, w, Lado12137 (AET6389).
- Loc. 13, w, Lado12160 (AET6412).
- First record for Veracruz. Previously reported for El Edén by Ogata and Andrade-Torres (1996).

***Physarum tenerum* Rex**

- Loc. 1, w of palm, Lado11407 (AET5993), w, Stephenson12353; lp, Stephenson12357.
- First record for Quintana Roo.

***Physarum vernum* Sommerf.**

- Loc. 3, ll of palm, Lado11482 (AET6075); ll of palm, Lado11490 (AET6083); ll, Lado11499 (AET6092).
- New record for Quintana Roo. Estrada-Torres *et al.* (2000) reported it from Guatemala.

***Physarum viride* var. *viride* (Bull.) Pers.**

- Loc. 5, lp (pH 5.7), SC16014.
- Loc. 7, ll of the palm *Sabal jaca*, Lado11618 (AET6211); ll of the palm *Sabal jaca*, Lado11629 (AET6222).
- Loc. 8, w, Lado11656 (AET6251).
- Previously reported for El Edén by Ogata and Andrade-Torres (1996).

***Physarum viride* var. *aurantium* (Bull.) Lister**

- Loc. 7, ll of the palm *Sabal jaca*, Lado11632 (AET6225).
- First record for Quintana Roo.

***Reticularia lycoperdon* Bull.**

- Loc. 10, w, Lado11701 (AET6296).

***Reticularia jurana* Meyl.**

- Loc. 5, w, Lado11564 (AET6157).
- First record for Mexico.

Stemonaria longa (Peck) Nann.-Bremek., R. Sharma & Y. Yamam.

Loc. 1, w, Lado11389 (AET5975).

Loc. 2, w, Lado11448 (AET6037).

Loc. 9, w, Lado11676 (AET6270).

First record for Quintana Roo.

Stemonitis axifera (Bull.) T. Macbr.

Loc. 2, w (pH 7.7), SC15999.

Loc. 5, w (pH 7.9), SC16029; w (pH 6.2), SC16082; w (pH 3.6), SC16088; w (pH 4.1), SC16075; w (pH 7.5), SC16012.

Loc. 9, w, Lado11685 (AET6280).

Loc. 10, w, Lado11692 (AET6287).

Loc. 11, dead b, AET4040.

Previously reported from El Edén by Ogata and Andrade-Torres (1996).

Stemonitis flavogenita E. Jahn

Loc. 7, w, Lado11599 (AET6192).

Loc. 11, bryophytes and b, Lado11714 (AET6309) (cf.).

Previously reported from El Edén by Ogata and Andrade-Torres (1996).

Estrada-Torres *et al.* (2000) reported it from Guatemala.

Stemonitis fusca Roth

Loc. 1 w, Lado11379 (AET5965); w, Lado11399 (AET5985); w, Lado11424 (AET6010); lp, Stephenson12355 (cf.); lp, Stephenson12358; ll (pH 6.9) in mc, Stephenson12985; ll (pH 6.2) in mc, Stephenson13123; ll (pH 6.5) in mc, Stephenson13138; ll (pH 6.3) in mc, Stephenson14494.

Loc. 2, w, Lado11450 (AET6039); w, Lado11465 (AET6054); w, Lado11474 (AET6063); ll (pH 5.7) in mc, Stephenson14483; w (pH 6.8), SC15986.

Loc. 3, w, Stephenson12368; w, Stephenson12371.

Loc. 4, w (pH 5.1), SC16031.

Loc. 5, dead b, Stephenson12445; w (pH 5.7), SC16053; w (pH 7.6), SC16062.

Loc. 6, ll (pH 6.2) in mc, Stephenson14484.

Loc. 7, ll of the palm *Sabal jaca*, Lado11611 (AET6204).

Loc. 11, w, Lado12128 (AET6380) (cf.).

Loc. 15, ll, w, AET4045; w, AET4048.

Sample Lado12128 has spores (5.6-)6.7-7.1 μm diam. but coincides in all other characters with *S. fusca*. Since Castillo *et al.* (1997: 1335) demonstrated that *S. nigrescens* Rex is synonymous with *S. fusca*, we have included specimens previously separated into these two species under the name *S. fusca*. First record for Quintana Roo. Previously reported from El Edén by Ogata and Andrade-Torres (1996).

Stemonitis inconspicua Nann.-Bremek.

Loc. 9, on dead *Heliconia schiedeana* leaf (pH 7.6) in mc, dwb 1781, dwb 1791, dwb 1791a; dwb 1805.

This is a smaller form of *S. inconspicua* with a height of 1.0-1.8 mm. The rest of the characters coincide with this taxon. Some sporophores are on a common hypothallus and others have a conspicuous large membranous hypothallus. The spores are 7-9 μm and have a reticulate ornamentation. There were 34 sporocarps in total collected from one culture. First record for Mexico.

Stemonitis lignicola Nann.-Bremek.

Loc. 3, w, Lado11509 (AET6102).

Only one collection consisting of 20 sporocarps of 6-9 mm long, with angular meshes in the capillitial surface net, and minutely, densely warted spores, that agree with the description of this species by Nannenga-Bremekamp (1973, 1991). Macroscopically, it resembles *S. fusca* and especially the variety *S. fusca* var. *papillosa* Meyl., which has strongly papillate spores instead of spinose-banded-reticulate spores. The status of this variety, as Martin and Alexopoulos (1969: 194) commented, is uncertain however, and the relationship between this variety and *S. lignicola* have yet to be elucidated. Our sample represents the first record for the Neotropics.

Stemonitis* cf. *mussooriensis G.W. Martin, K.S. Thind & Sohi

Loc. 9, b of *Porteroni viridescens* (pH 7.4) in mc, dwb 1809.

In this single collection there were 11 well formed mature sporocarps 2.2 mm tall. The lax lilac brown capillitium had some membranous expansions like *S. mussooriensis*, and although these specimens have smaller spores (9-10 μm diam.), they have long spines of up to 0.5 μm . For this reason we have included the collection in this taxon. If this is confirmed, it is a first record for Mexico.

Stemonitis smithii T. Macbr.

Loc. 1, w, Lado11382 (AET5968); w, Lado11386 (AET5972); w, Lado11403 (AET5989); w, Lado11409 (AET5995), w, Stephenson12405.

Loc. 2, w, Lado11438 (AET6027); w, Lado11445 (AET6034); w, Lado11460 (AET6049).

Loc. 3, w, Lado11529 (AET6122).

Loc. 4, w, Lado11558 (AET6151).

Loc. 5, w, Lado11566 (AET6159); w, Stephenson12444.

Loc. 6, w, Lado11573 (AET6166).

Loc. 8, w, Lado11649 (AET6244).

Previously reported for El Edén by Ogata and Andrade-Torres (1996).

Stemonitis splendens Rostaf.

Loc. 10, w, Lado11705 (AET6300).

Stemonitopsis hyperopta (Meyl.) Nann.-Bremek.

= *Stemonitis hyperopta* Meyl.

Loc. 3, w, Stephenson12365.

Loc. 5, w, Stephenson12434.

In Mexico previously known only from Tlaxcala (Rodríguez-Palma and Estrada-Torres, 1996). First record for Quintana Roo. Estrada-Torres *et al.* (2000) reported it from Guatemala.

Stemonitopsis cf. subcaespitosa (Peck) Nann.-Bremek.

= *Comatricha subcaespitosa* Peck

Loc. 5, b of *Gymnopodium floribundum* (pH 7.7) in mc, dwb1761.

A scant collection consisting of two sporocarps, each with netted fibres at the base of the stipe. The capillitium with membranous expansions, the overall size (1.8 mm tall) and slightly warted spores are typical characters of this species. The spores, however, are 7-9 µm diam., and so are at the lower limits of the range described by Nannenga-Bremekamp (1991), and the capillitium has a few spines on the upper surface net.

If the identity of this species is confirmed, it will be the first record for Mexico.

Stemonitopsis typhina (F.H. Wigg.) Nann.-Bremek.

= *Comatricha typhoides* (Bull.) Rostaf.

Loc. 3, w, Stephenson12378.

Loc. 7, ll of the palm *Sabal jaca*, Lado11619 (AET6212); ll of the palm *Sabal jaca*, Lado11622 (AET6215); ll of the palm *Sabal jaca*, Lado11627 (AET6220).

Loc. 8, w, Lado11648 (AET6243).

Loc. 10, W and b, Lado11700 (AET6295).

Loc. 11, w, Lado12134 (AET6386).

Loc. 15, w, AET4047.

Previously reported from El Edén by Ogata and Andrade-Torres (1996). Estrada-Torres *et al.* (2000) reported it from Guatemala.

Trichia affinis de Bary

Loc. 1, w, Lado11419 (AET6005); w, Stephenson12411; w (pH 6.2), SC16006; w (pH 5.7), SC16047; w (pH 4.6), SC16052; w (pH 7.2), SC16056; w (pH 7.4), SC16101.

Loc. 2, w (pH 5.0), SC15974.

Loc. 5, w, Stephenson12428.

The Mexican material is homogeneous and typical of the description of this species in Nannenga-Bremekamp (1991) except that the capillitium is very spiny. In addition, specimen SC16006 has prolate sporothecae like *Trichia favoginea*. First record for Quintana Roo.

Trichia cf. favoginea (Batsch) Pers.

Loc. 7, ll of the palm *Sabal jaca*, Lado11628 (AET6221).

This specimen agrees with the description of the species in Nannenga-Bremekamp (1991) except for the presence of tiny spines dispersed over the spirals of the capillitium. It differs from the material ascribed to *Trichia affinis*

in its prolate sporothecae (globose in *T. affinis*) and the simple bands of the spores (pitted in *T. affinis*). Farr (1958) pointed out the existence of various intermediate forms between these two species, which she felt should be considered conspecific. Because of the distinctly different appearance of the Mexican material, we prefer to maintain them as two separate species.

***Trichia* sp.**

(Figs. 17-21)

Loc. 4, w, Lado11539 (AET6132).

Macroscopically, this specimen resembles a minute *T. favoginea*, but it has some relevant and distinguishing features that exclude this possibility. This specimen may represent an undescribed species, but we have only a single collection, which is insufficient for a formal description. Our material is characterized by the minute sporocarps, 0.3-0.5 mm diam., these crowded, sessile, deep yellow brown (75.deep yr Br); the peridium is single, with the inner surface ornamented with faint striations orientated in different directions (Fig. 17). The capillitium is tubular, elastic, elateriform, yellow (83.brill.Y-87.m.Y) by transmitted light with tubes 5-7.5 μm diam., flexuous, simple, entangled, with sharp and short free ends (Fig. 18), 3-10 μm long, decorated with 4-6 spiny spiral bands, longitudinally striated (Fig. 20), and the spores are in groups that break apart rather easily, yellowish brown (74.s.y Br) in mass, light yellow (86.l.Y) by transmitted light, subglobose, 10-12.5 μm diam., smooth or slightly wrinkled (Fig. 19, 21).

***Tubulifera microsperma* (Berk. & M.A. Curtis) Lado**

Loc. 9, w, Lado11686 (AET6281).

Reported from El Edén by Ogata and Andrade-Torres (1996).

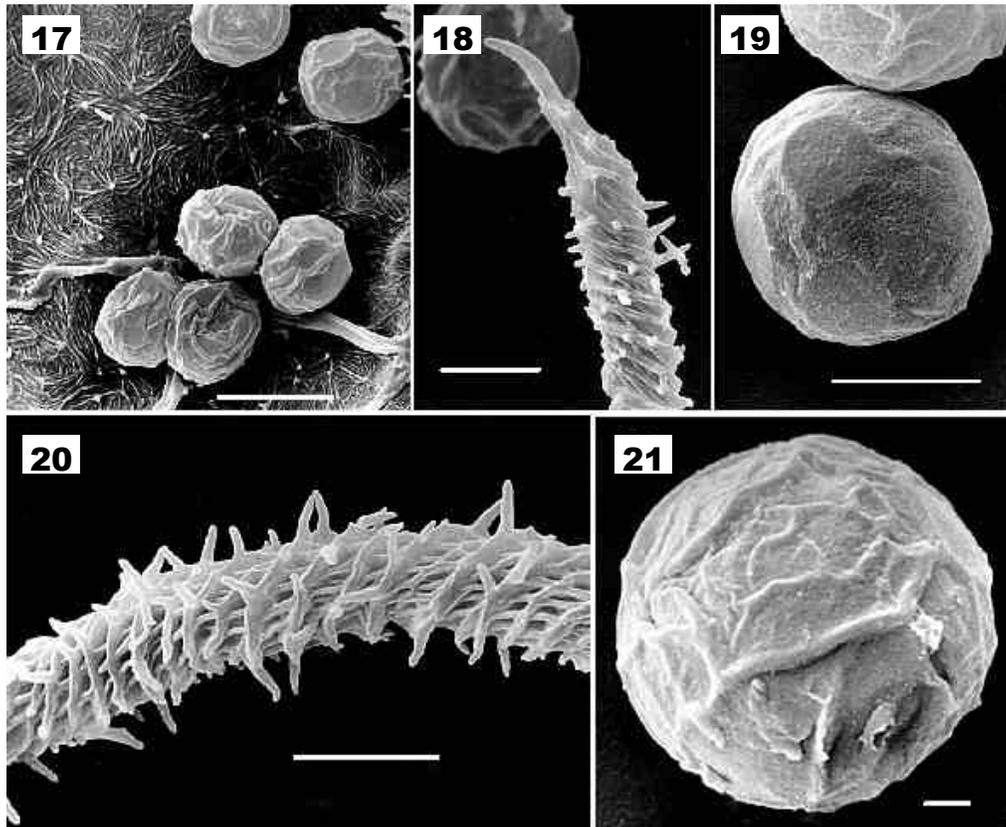
***Willkommlangea reticulata* (Alb. & Schwein.) Kuntze**

Loc. 4, w (pH 7.3), SC16035.

First record for Quintana Roo. Previously reported from Belize by Ing and Haynes (1999).

Discussion

One previously unknown species of myxomycete (*Diderma yucatanense*) is described in this paper. Four other specimens could not be identified completely, since their characteristics do not coincide with any described species. In addition, the taxon listed herein as *Diderma rugosum* could well represent two distinct species, one of which would be new. However, these taxa have not been formally described in this paper since the constancy of their characters has yet to be supported by larger and more representative collections. Of the species studied, the specimens of *Licea poculiformis* and



Figs. 17-21. *Trichia* sp. (Lado 11539) (SEM). **17.** Inner surface of the peridium with faint striations orientated in different directions and spores. **18.** Sharp and short free end of the capillitium. **19.** Smooth spore. **20.** Capillitial thread decorated with spiny spiral bands longitudinally striate. **21.** Slightly wrinkled spore. Bars: 17 = 10 μm ; 18-20 = 5 μm ; 21 = 1 μm .

Stemonitis lignicola are the first records of these species for the Neotropics, and 15 additional species (*Arcyria cinerea* var. *digitata*, *Badhamiopsis ainoae*, *Diderma rimosum*, *D. rugosum*, *D. saundersii*, *D. subdictyospermum*, *Didymium ochroideum*, *Hemitrichia pardina*, *Macbrideola martinii*, *M. scintillans* var. *verrucosa*, *Physarum aeneum*, *Ph. alvoradianum*, *Ph. crateriforme*, *Reticularia jurana* and *Stemonitis inconspicua*) are new records for Mexico. Collections from the two study areas yielded a total of 99 taxa (Table 1). Of the 76 taxa from El Eden, 39 represent new records for the state of Quintana Roo, and 14 of the 63 taxa from Los Tuxtlas are new records for the state of Veracruz. The number of species known from Quintana Roo has been increased from the 35 taxa reported by Ogata and Andrade-Torres (1996) and Illana *et al.* (2000), to 74 with the addition of the present data, and in Veracruz from 101 (Illana *et al.*, 2000) to 115.

The number of taxa (76) collected in El Eden was larger than the corresponding number for Los Tuxtlas. Moreover, the former study area is represented by considerably more field (456) and moist chamber (196) collections (total collections = 652), in spite of the fact that El Eden was visited only once (although with more than twice the number of collectors), and Los Tuxtlas was visited three times. The weather in Los Tuxtlas was unusually wet during the fieldwork carried out in November-December 1999 and unusually dry during February 1998 and September 2000. This may account, at least in part, for the lower number of collections. Field collections represented approximately 70% of the material considered in both study areas, whereas collections from moist chamber cultures represented 24% of the total from Los Tuxtlas and 30% from El Eden. These results reflect the much larger number of cultures from El Eden and thus suggest that the species total for Los Tuxtlas would be higher if this technique had been used to study more substrates in the reserve. The fact that about a quarter of the species recorded at El Eden were found only in moist chamber cultures demonstrates the importance of this technique as a complement to field studies of the biodiversity of myxomycetes. The significance of combining sampling from the field with samples using moist chamber cultures also has been apparent from work in Costa Rica (Schnittler and Stephenson, 2000) and Ecuador (Schnittler *et al.*, 2002). Only three species (*Collaria arcyronema*, *Perichaena depressa* and *P. chrysosperma*) were recorded as both field and moist chamber culture collections in both reserves.

Of the 99 taxa recorded from the two study areas, 25 were represented by more than 10 collections, including field collections and moist chamber cultures. Almost all of these abundant species were present in both study areas, but *Clastoderma debaryanum*, *Cribraria languescens*, *C. microcarpa*, *C. violacea* and *Diderma spumarioides* were collected only at El Eden. Of the species found in both study areas, the most common were *Arcyria denudata*, *A. cinerea* var. *cinerea*, *Ceratiomyxa fruticulosa* var. *fruticulosa*, *Hemitrichia calyculata*, *H. serpula*, *Perichaena chrysosperma* and *Physarum stellatum*. However, the order of relative abundance differed when Los Tuxtlas and El Eden were compared. The most abundant at the latter site in descending order were *H. serpula*, *A. cinerea*, *A. denudata*, *H. calyculata*, *Ph. stellatum* and *Clastoderma debaryanum*. At Los Tuxtlas, the order of abundance was *H. calyculata*, *Comatricha tenerrima*, *P. chrysosperma*, *Ceratiomyxa fruticulosa* var. *fruticulosa*, *A. cinerea* and *A. denudata*.

As has been pointed out by Wrigley de Basanta (2000), Schnittler (2001) and Stephenson *et al.* (2003), pH is an important factor in determining distribution patterns of myxomycetes. These authors reported that the pH of

Fungal Diversity

Table 1. Taxa reported from different Neotropical areas. ¹Schnittler *et al.* (2002); ²Lado *et al.* (2002); ³Schnittler and Stephenson (2000); ⁴Novozhilov *et al.* (2001).

Species	El Edén	Los Tuxtlas	Ecuador: Maquipucuna ¹ and Yasuni ²	Costa Rica ³	Puerto Rico, Luquillo ⁴	No. areas taxon collected
<i>Arcyria cinerea</i> var. <i>cinerea</i>	+	+	+	+	+	6
<i>A. cinerea</i> var. <i>digitata</i>	+			+		2
<i>A. denudata</i>	+	+	+	+	+	5
<i>A. obvelata</i>		+				1
<i>Badhamiopsis ainoae</i>	+					1
<i>Calomyxa metallica</i>	+					1
<i>Ceratiomyxa fruticulosa</i> var. <i>fruticulosa</i>	+	+	+	+	+	6
<i>Ceratiomyxa sphaerosperma</i>		+		+	+	3
<i>Clastoderma debaryanum</i>	+			+	+	4
<i>Collaria arcyrionema</i>	+	+	+	+	+	6
<i>C. lurida</i>	+	+	+		+	4
<i>Comatricha</i> cf. <i>laxa</i>	+					1
<i>C. pulchella</i>	+		+	+		3
<i>C. tenerrima</i>	+	+	+	+	+	5
<i>Craterium leucocephalum</i>	+		+	+	+	4
<i>C. paraguayense</i>		+			+	2
<i>Cribraria cancellata</i>	+	+	+	+		4
<i>C. cancellata</i> var. <i>fusca</i>	+			+		2
<i>C. languescens</i>	+		+	+	+	4
<i>C. microcarpa</i>	+			+	+	4
<i>C. tenella</i>	+		+	+	+	4
<i>C. violacea</i>	+		+	+	+	4
<i>Diachea bulbillosa</i>		+				1
<i>D. leucopodia</i>		+	+		+	4
<i>D. sylvaepluvialis</i>		+		+		2
<i>Diderma chondrioderma</i>		+				1
<i>D. effusum</i>	+	+	+	+	+	6
<i>D. hemisphaericum</i>	+	+	+	+	+	5
<i>D. rimosum</i>	+	+				2
<i>D. rugosum</i>	+	+				2
<i>D. saundersii</i>	+					1
<i>D. spumarioides</i>	+					1
<i>D. subdictyospermum</i>		+				1
<i>D. yucatanense</i>	+					1
<i>Didymium bahiense</i>		+	+	+		3
<i>D. clavus</i>		+	+	+	+	4

Table 1. (continued).

Species	El Edén	Los Tuxtlas	Ecuador: Maquipucuna ¹ and Yasuni ²	Costa Rica ³	Puerto Rico, Luquillo ⁴	No. areas taxon collected
<i>D. difforme</i>		+	+			2
<i>D. iridis</i>	+	+	+	+	+	6
<i>D. nigripes</i>	+	+	+	+	+	5
<i>D. ochroideum</i>	+			+		3
<i>D. squamulosum</i>	+	+	+	+		5
<i>Echinostelium minutum</i>	+	+	+	+		4
<i>Fuligo megaspora</i>	+					1
<i>Hemitrichia calyculata</i>	+	+	+	+	+	5
<i>H. pardina</i>	+	+		+		4
<i>H. serpula</i>	+	+	+	+	+	5
<i>Lamproderma muscorum</i>		+	+			2
<i>L. scintillans</i>	+		+	+	+	5
<i>Licea biforis</i>	+					1
<i>L. operculata</i>	+	+	+	+	+	5
<i>L. poculiformis</i>		+				1
<i>Lycogala conicum</i>		+				1
<i>L. exiguum</i>	+	+		+	+	4
<i>Macbrideola martinii</i>	+	+		+		3
<i>Macbrideola scintillans</i> var. <i>verrucosa</i>	+	+		+		3
<i>Metatrichia horrida</i>	+	+				2
<i>Perichaena chryosperma</i>	+	+	+	+	+	5
<i>P. depressa</i>	+	+		+	+	4
<i>P. vermicularis</i>	+	+	+	+	+	5
<i>Physarella oblonga</i>	+	+	+	+		4
<i>Physarum aeneum</i>	+					1
<i>Ph. album</i>	+	+	+	+	+	5
<i>Ph. alvoradianum</i>	+	+				2
<i>Ph. bogoriense</i>	+	+	+	+	+	5
<i>Ph. cinereum</i>	+	+	+	+	+	6
<i>Ph. compressum</i>		+	+	+	+	4
<i>Ph. crateriforme</i>	+	+			+	3
<i>Ph. didermoides</i>		+	+	+	+	4
<i>Ph. flavicomum</i>	+			+		2
<i>Ph. globuliferum</i>	+		+	+	+	4
<i>Ph. lateritium</i>	+					1
<i>Ph. melleum</i>	+	+	+	+	+	6
<i>Ph. nucleatum</i>	+			+		2
<i>Ph. penetrale</i>		+	+	+		3
<i>Ph. pusillum</i>	+		+	+	+	4
<i>Ph. roseum</i>	+		+	+		3

Table 1. (continued).

Species	El Edén	Los Tuxtlas	Ecuador: Maquipucuna ¹ and Yasuni ²	Costa Rica ³	Puerto Rico, Luquillo ⁴	No. areas taxon collected
<i>Ph. stellatum</i>	+	+	+	+	+	6
<i>Ph. tenerum</i>	+		+	+	+	4
<i>Ph. verum</i>	+			+		2
<i>Ph. viride</i> var. <i>viride</i>	+	+	+	+	+	5
<i>Ph. viride</i> var. <i>aurantium</i>	+			+		2
<i>Reticularia lycoperdon</i>		+				1
<i>R. jurana</i>	+					1
<i>Stemonaria longa</i>	+	+		+		3
<i>Stemonitis axifera</i>		+	+	+		3
<i>S. flavogenita</i>	+	+				2
<i>S. fusca</i>	+	+	+	+	+	6
<i>S. inconspicua</i>		+				1
<i>S. lignicola</i>	+			+		2
<i>S. cf. mussooriensis</i>		+				1
<i>S. smithii</i>	+	+	+	+	+	5
<i>S. splendens</i>		+	+		+	3
<i>Stemonitopsis hyperopta</i>	+					1
<i>S. cf. subcaespitosa</i>	+					1
<i>S. typhina</i>	+	+	+	+	+	5
<i>Trichia affinis</i>	+		+			2
<i>T. cf. favoginea</i>	+			+	+	3
<i>Tubulifera microsperma</i>		+	+	+	+	4
<i>Willkommllangea reticulata</i>	+			+		2
Total: 99	76	63	49	61	34	32

substrates, especially bark, in the cultures from El Eden was higher than those reported in most other studies. This is probably due to the Cretaceous limestone geology of this study area and could account for the lower productivity of the Yucatan bark, for which some 50% of the cultures were positive for myxomycetes. The substrates from Los Tuxtlas were characterized by a range in pH of 7.1-7.8 and 88% of these were positive for myxomycetes. Härkönen and Ukkola (2000) reported lower productivity in their results from tropical Gambia (71%) and Tanzania (64%). The bark substrates that yielded the greatest number of collections in all moist chamber cultures were the bark of living vines *Porteroni viridescens* and *Tuxtla pittieri*.

The proportionally high level of biodiversity in the second collecting area is notable, however, with 63 species (representing 22 genera) recorded from 156 field collections and 49 collections from moist chamber cultures. This gives a S/G value of 2.86, almost the same as that reported for El Eden (Stephenson *et al.*, 2003) although the latter were from three times as many

collections. It seems likely that this is related to the predominant forest type, a primary evergreen rain forest. Presumably, the physical characteristics of this type of forest, with the humid conditions, low light intensity, and little decaying organic matter on the forest floor, force myxomycete species to find new niches, thus increasing the variety of microhabitats in which these organisms can be found. This working hypothesis appears to be supported by the abundance of specimens collected from lianas, inflorescences and other microhabitats above the ground previously not known to support myxomycetes, as discussed in papers reporting the results of studies carried out in Ecuador and Costa Rica (Schnittler and Stephenson, 2002; Schnittler *et al.* 1999, 2002). In addition, the variety of different species and the extent of the morphological variation exhibited by particular species in series of collections (particularly moist chamber culture collections) from tropical areas at least may suggest the possibility of increased pressure for more instances of sexual reproduction and fewer apomictic clonal lines (Clark and Mires, 1999; Clark, 2000), since the former would serve to introduce more genetic variability into the populations of myxomycetes present. If this is the case, it would be consistent with what is known about other inhabitants of tropical forests, where variety and not quantity is the successful biological strategy that enables organisms to subdivide the abundant and varied resources available (Forsyth, 1990). This would not preclude the formation of apomictic clonal lines within a given microhabitat, as suggested by Schnittler and Stephenson (2002), since this would depend upon how favourable or unfavourable the prevailing conditions of the microhabitat in question were for the species of myxomycetes involved.

It is clear from the data reported herein that the tropical forests considered in the present study are very rich habitats for myxomycetes, as shown by the 99 species represented among more than 850 collections made during a few weeks of field work. Only 39 species were common to both study areas, and 31 species were represented by only a single collection, which suggests a high degree of specificity for certain microhabitats by some groups of species. The seven species found most abundantly in both study areas seem to be the most characteristic species of Neotropical forests. Each was represented among the 23 species recorded from at least 5 of the Neotropical study areas listed in Table 1.

It is interesting to note that many of the species collected in the two reserves under study appear to have a distribution that is predominantly or exclusively tropical. This is the case for *Ceratiomyxa sphaerosperma*, *Craterium paraguayense*, *Diachea silvaepluvialis*, *D. bulbilosa*, *Diderma rimosum*, *D. subdictyospermum*, *D. yucatanense*, *Lamproderma muscorum*,

Licea poculiformis, *Macbrideola scintillans* var. *verrucosa*, *Metatrichia horrida*, *Physarella oblonga*, *Physarum aeneum*, *Ph. alvoradianum*, *Ph. crateriforme*, *Ph. roseum*, *Ph. stellatum*, *Stemonaria longa* and *Tubulifera microsperma*. Moreover, many other species of wider distribution appear frequently or abundantly in the tropics. Prominent examples include *Arcyria cinerea*, *A. denudata*, *Collaria arcyrionema*, *Comatricha tenerrima*, *Cribraria languescens*, *C. tenella*, *Diderma spumarioides*, *Hemitrichia calyculata*, *H. serpula*, *Lycogala conicum*, *L. exiguum*, *Physarum melleum*, *Ph. viride* var. *aurantium*, *Stemonitis fusca*, *S. smithii* and *Willkommlangea reticulata*. These data would seem to refute the widely held concept that most species of myxomycetes are cosmopolitan. Instead, they suggest that there is indeed a particular assemblage of myxomycetes associated with tropical zones. This assemblage is made up of species of wide distribution that are more common in the tropics along with species of narrower distribution restricted to the particular conditions of the tropical environment.

Acknowledgements

We are indebted to Maribeth Overking and Adam Rollins (Fairmont State College) and Martín Ramírez Ortega and Mirna Díaz Ramírez (Universidad Autónoma de Tlaxcala) for their invaluable assistance in the fieldwork. We thank Gonzalo Pérez Higuera, Los Tuxtlas Tropical Biology Station (UNAM), and Arturo Gómez-Pompa, El Edén Ecological Reserve, for the authorization to visit these study areas and the use of all the facilities at these Biological Reserves. We are grateful to Manuel Láinz for the Latin diagnosis. We also thank Nisao Ogata and Juan Castillo Rivero for on-site help at the El Edén Ecological Reserve, and Alvaro Campos Villanueva for his help at Los Tuxtlas Tropical Biology Station. This project was supported by the National Science Foundation (Grant #DEB-9705464); the US-Spain Science and Technology Program (Fulbright Program) (Grant #99075), and the Spain-Mexico Convenio Bilateral CSIC-CONACyT (Grant #2001MX0014).

References

- Anonymous (1976). *ISCC-NBS color-name charts illustrated with centroid colors*. Inter-Society Color Council, National Bureau of Standards, Washington, DC, USA.
- Braun, K.L. and Keller, H.W. (1986). Myxomycetes of Mexico III. *Revista Mexicana de Micología* 2: 25-39.
- Buyck, B. (1988). The *Diderma spumarioides-globosum* complex (Myxomycetes). *Bulletin du Jardin Botanique National de Belgique* 58: 169-218.
- Castillo, A., Moreno, G., Illana, C. and Lago, J. (1997). A critical study of some Stemonitales. *Mycological Research* 101: 1329-1340.
- Clark, J. (2000). The species problem in the Myxomycetes. *Stapfia* 73: 39-53.
- Clark, J. and Mires, A. (1999). Biosystematics of *Didymium*: The non-calcareous, long-stalked species. *Mycotaxon* 71: 369-382.
- Davis, S.D., Heywood, V.H., Herrera-MacBryde, O., Villa-Lobos, J. and Hamilton, A.C. (1997). *Centres of Plant Diversity. A guide and strategy for their conservation*. WWF and IUCN Publish, 3 vols.

- Eliasson, U. (1991). The myxomycete biota of the Hawaiian Islands. *Mycological Research* 95: 257-267.
- Eliasson, U. and Nannenga-Bremekamp, N.E. (1983). Myxomycetes of the Scalesia forest, Galapagos Islands. *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen, Series C*, 86: 143-153.
- Estrada-Torres, A., Lado, C. and Flores, R. (2000). Myxomycetes de Guatemala. *Stapfia* 73: 159-165.
- Estrada-Torres, A., Lado, C. and Rodríguez-Palma, M.M. (2001). Two new species of Myxomycetes from a tropical deciduous forest of México. *Mycologia* 93: 744-750.
- Farr, M.L. (1957). A checklist of Jamaican slime moulds (Myxomycetes). *Bulletin of the Institute of Jamaica. Science Series* 7: 1-67.
- Farr, M.L. (1958). Taxonomic studies in the Myxomycetes. I. The *Trichia favoginea* complex. *Mycologia* 50: 357-369.
- Farr, M.L. (1976). *Flora Neotropica. Monograph 16. Myxomycetes*. New York Botanical Garden, USA.
- Farr, M.L., Eliasson, U. and Dumont, K. (1979). Myxomycetes from Ecuador. *Mycotaxon* 8: 127-134.
- Forsyth, A. (1990). *Portraits of the Rainforest*. Camden House, Ontario, Canada.
- González, E., Dirzo, R. and Vogt, R.C. (1997). *Historia natural de Los Tuxtlas*. Universidad Nacional Autónoma de México, México.
- Gottsberger, G. (1968). Myxomyceten aus Bahia und Goias. *Nova Hedwigia* 15: 361-368.
- Härkönen, M. and Ukkola, T. (2000). Conclusions on Myxomycetes compiled over twenty-five years from 4793 moist chamber cultures. *Stapfia* 73: 105-112.
- Hernández-Cuevas, L. and Estrada-Torres, A. (1991). Mexican Didymiaceae (Myxomycetes, order Physarales): Three new records and comments on *Mucilago crustacea*. *Mycotaxon* 62: 319-335.
- Illana, C. Moreno, G. and Lizárraga, M. (2000). Catálogo de Myxomycetes de México. *Stapfia* 73: 167-186.
- Ing, B. and Haynes, C. (1999). Corticolous myxomycetes from Belize. *Kew Bulletin* 54: 723-730.
- Keller, H.W. and Braun, K.L. (1977). Myxomycetes of Mexico II. *Boletín de la Sociedad Mexicana de Micología* 11: 167-180.
- Keller, H.W. and Brooks, T.E. (1976). Corticolous Myxomycetes IV: *Badhamiopsis*, a new genus for *Badhamia ainoae*. *Mycologia* 68: 834-841.
- Lado, C. (2001). Nomenmyx. A nomenclatural taxabase of Myxomycetes. *Cuadernos de Trabajo de Flora Micológica Ibérica* 16: 1-221.
- Lado, C., Estrada-Torres, A., Schnittler, M., Wrigley de Basanta, D. and Stephenson, S.L. (2002). Rapid biodiversity assessment of the myxomycetes from the Yasuni Biosphere Reserve (Ecuador). *Scripta Botanica Belgica* 22: 59.
- Lado, C., Rodríguez-Palma, M.M. and Estrada-Torres, A. (1999). Myxomycetes From a seasonal tropical forest on the Pacific coast of México. *Mycotaxon* 61: 157-165.
- Lister, A. (1925). *A Monograph of the Mycetozoa: A Descriptive Catalogue of the Species in the Herbarium of the British Museum*. 3rd edn. (revised by G. Lister). British Museum, London, UK.
- Martin, G.W. and Alexopoulos, C.J. (1969). *The Myxomycetes*. University of Iowa Press, Iowa City, Iowa. USA.
- Mishra, R.L. and Ranade, V.D. (1979). Myxomycetes of Maharashtra. II. The genus *Diderma* Pers. *Maharashtra Vidnyan Mandir Patrika* 14: 33-41.

Fungal Diversity

- Mitchell, D.W. (1977). The bark Myxomycetes: their collection, culture and identification. *School Science Review* 58: 444-454.
- Nannenga-Bremekamp, N.E. (1965). Notes on Myxomycetes IX. The genus *Licea* in the Netherlands. *Acta Botanica Neerlandica* 15: 131-147.
- Nannenga-Bremekamp, N.E. (1968). Notes on Myxomycetes XVI: Remarks on some species of *Diderma*. *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen. Series C*, 71: 189-200.
- Nannenga-Bremekamp, N.E. (1973). Notes on Myxomycetes XIX. *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen. Series C*, 76: 476-488.
- Nannenga-Bremekamp, N.E. (1991). *A Guide to temperate Myxomycetes*. Biopress Limited, Bristol, UK.
- Novozhilov, Y.K., Schnittler M., Rollins, A.W. and Stephenson, S.L. (2001). Myxomycetes from different forest types in Puerto Rico. *Mycotaxon* 77: 285-299.
- Ogata, N. and Andrade-Torres, A. (1996). Los Myxomycetes de la Reserva Ecológica "El Edén" Quintana Roo, Mexico. http://maya.ucr.edu/pril/el_eden/research/papers/elec_publ.html.
- Putzke, J. (1996). Myxomycetes no Brasil. *Caderno de Pesquisa, Série Botânica* 8: 3-85.
- Rodríguez-Palma, M.M. and Estrada-Torres, A. (1996). Some Stemonitales (Myxomycetes) from the state of Tlaxcala, Mexico. *Mycotaxon* 60: 79-102.
- Rossmann, A.Y., Tulloss, R.E., O'Dell, T.E. and Thorn, R.G. (1998). *Protocols for an all taxa biodiversity inventory of fungi in a Costa Rican conservation area*. Parkway, North Carolina.
- Rostafinsky, J.T. (1876). Dodatek I do monografii Sluzowców. *Pamiętnik Towarzystwa Nauk Scislych w Paryżu* 8: 1-43.
- Schnittler M. (2001). Ecology of Myxomycetes from a winter-cold desert in western Kazakhstan. *Mycologia* 93: 653-669.
- Schnittler M., Lado, C. and Stephenson, S.L. (2002). Rapid biodiversity assessment of a tropical myxomycete assemblage - Maquipucuna Cloud Forest Reserve, Ecuador. *Fungal Diversity* 9: 135-167.
- Schnittler M. and Stephenson, S.L. (2000). Myxomycete biodiversity in four different forest types in Costa Rica. *Mycologia* 92: 626-637.
- Schnittler M. and Stephenson, S.L. (2002). Inflorescences of Neotropical herbs as a newly discovered microhabitat for Myxomycetes. *Mycologia* 94: 6-20.
- Schnittler M., Stephenson, S.L. and Lado, C. (1999). Myxomycetes of the Maquipucuna Cloud Forest Reserve in Ecuador. In: *Third International Congress on the Systematics and Ecology of Myxomycetes*: 49. [abstract]
- Stephenson, S.L. (1989). Distribution and ecology of myxomycetes in temperate forests. II. *Mycologia* 81: 608-621.
- Stephenson, S.L., Estrada-Torres, A., Schnittler, M., Lado, C., Wrigley de Basanta, D. and Ogata, N. (2003). Distribution and ecology of Myxomycetes in the forest of Yucatán. In: *Lowland Maya Area: Three Millennia at the Human-wildland Interface* (eds. A. Gómez-Pompa, M.F. Allen, S. Fedick and J.J. Jiménez-Osornio). The Haworth Press, New York, London, Oxford: (In press).
- Ukkola, T. (1998). Myxomycetes of the Usambara Mountains, NE Tanzania. *Acta Botanica Fennica* 160: 1-37.
- Villarreal, L. (1985). Nuevos registros de myxomycetes en el estado de Veracruz. *Revista Mexicana de Micología* 1: 363-377.
- Villarreal, L. (1990). Estudios sobre los Myxomycetes de México. I. Nuevos registros. *Micología Neotropical Aplicada* 3: 67-79.

Wrigley de Basanta, D. (2000). Acid deposition in Madrid and corticolous Myxomycetes.
Stapfia 73: 113-120.

(Received 12 June 2002; accepted 30 October 2002)