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A Review of Neotropical Myxomycetes (1828-2008)

by

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Abstract

Lado, C. & Wrigley de Basanta, D. 2008. A Review of Neotropical Myxomycetes (1828-2008). *Anales Jard. Bot. Madrid* 65(2): 211-254.

A synthesis of the accumulated knowledge on myxomycetes recorded from the Neotropical region is presented in this paper. The biodiversity of these microorganisms in the Neotropics has been underestimated, and this paper shows that half the known species in the world have been recorded from the region. The monograph by M.L. Farr, for the series Flora Neotropica, published in 1976, has been taken as a baseline. The records produced after this date, some older obscure records, and data from recently published catalogues, monographs and other papers have been incorporated. The information is presented in a table format by species and countries. Species names are listed with synonyms that have been used in Neotropical literature and nomenclature has been updated. A comprehensive list of references by country has been included. A characteristic assemblage of myxomycetes from the Neotropics has been identified. The richness of myxobiota in different countries has been evaluated, and gaps in current information and unexplored areas have become evident from the results. Use of the compiled information to direct conservation plans, and to serve as a starting point to establish and develop future strategies for the study of myxomycetes in this area of the world, is discussed. The importance of prioritizing this research on microorganismal biodiversity, in view of accelerated habitat destruction, is stressed.

Keywords: biodiversity, microorganisms, protists, Mycetozoa, tropics, geographical distribution, catalogue, Central America, Caribbean, South America.

Introduction

The biodiversity of microorganisms is a topic that is becoming increasingly important since they are the very basis of ecosystems. Myxomycetes are eukaryotic microorganisms, with unicellular and coenocytic

Resumen

Lado, C. & Wrigley de Basanta, D. 2008. Revisión de los Myxomycetes del Neotrópico (1828-2008). *Anales Jard. Bot. Madrid* 65(2): 211-254 (en inglés).

Se realiza una síntesis sobre el conocimiento actual de los Myxomycetes en el Neotrópico. La biodiversidad de estos microorganismos en la región neotropical ha sido subestimada, pero este trabajo demuestra que la mitad de las especies conocidas en el mundo se han citado de esta región. La monografía que M.L. Farr publicó en 1976, para la serie Flora Neotrópica, se ha tomado como punto de partida para la realización de este trabajo. A ella se han incorporado las citas publicadas después de esta fecha, algunas más antiguas pero raras, y datos de catálogos, monografías y otros trabajos recientes. La información se presenta en una tabla de doble entrada, por orden alfabético de especies y por países. La nomenclatura de las especies se ha actualizado y se han añadido los sinónimos con los que han sido citadas en la bibliografía neotropical. También se incluye una lista de referencias bibliográficas por países. Se ha podido identificar un conjunto de especies de Myxomycetes que, por su abundancia de citas en los países neotropicales, parecen características de la región. Se evalúa, por países, la riqueza de su mixobiota y se ponen de manifiesto la falta de información y los escasos estudios que se han llevado a cabo en determinados territorios de esta región biogeográfica. Se discute y comenta el uso que se puede dar a esta información recopilada, como punto de partida para establecer y desarrollar estrategias de estudio sobre los Myxomycetes en esta parte del mundo. Por último, se llama la atención sobre la importancia y prioridad que se debe dar a la investigación sobre biodiversidad de microorganismos, a la hora de valorar la acelerada destrucción de hábitat.

Palabras clave: biodiversidad, microorganismos, protistas, Mycetozoa, trópicos, distribución geográfica, catálogo, América Central, Caribe, América del Sur.

phagotrophic phases. They inhabit all terrestrial ecosystems, feeding on bacteria and other microorganisms, in and on plant parts and plant remains. Some are known to be associated with specific ecosystems, while others are more cosmopolitan, and research into their diversity and their specific relation-

ships within certain ecosystems is an emerging focus of recent research. This is especially critical in areas like the Neotropics, where rapid habitat loss endangers all components of the various biomes. The Neotropical region is one of the biogeographical regions with the highest biodiversity in the world. Estimates by Davis & al. (1997), show that more than 70.000 endemic plant species exist in the Neotropics, and the Tropical Andean region alone, contains about a sixth of all plant life in less than 1% of the world's land area. More than a third of the centres of plant diversity and endemisms recognized by Davis & al. (1997) and eight of the designated biodiversity "hot spots", where "exceptional concentrations of endemic species are undergoing exceptional loss of habitat" (Myers & al., 2000), are located in this area (Mittermeier & al., 2004). In contrast, the knowledge of myxomycetes of the Neotropics is far from complete. The first record of myxomycetes in the Neotropics was in 1828, from Chile (Bertero, 1828). In the 19th Century there were various publications from the region. Farr (1976), included these in a monograph published in the series *Flora Neotropica*, in which she compiled all the information available up to the year 1975. In this monograph, 250 of the almost 900 myxomycete species known in the world (Lado, 2008), were reported for this region. This is about the same as in single, possibly less diverse, but well studied countries, like the United Kingdom, the Netherlands, Ireland, France or Spain, which have 250-350 species recorded (Nanenga-Bremekamp, 1991; Lado, 1994; Ing, 1999).

Several research projects on Neotropical myxomycetes, supported by science foundations or research institutions from different countries such as Spain, USA, Brazil or Mexico, have been developed over the last decade and some are currently in progress. The objectives and outcomes of these projects are different but complementary. Some are devoted to the study of pristine tropical forest (Novozhilov & al., 2000; Schnittler & al., 2002; Lado & al., 2003; Stephenson & al., 2003), others to special microhabitats (Schnittler, 2001; Schnittler & Stephenson, 2002a; Maimoni-Rodella & Cavalcanti, 2006; Wrigley de Basanta & al., 2008), others to the knowledge of the myxobiota of specific environments (Mosquera & al., 2000b; Lado & al., 2007b; Estrada-Torres & al., in press), and others make inventories of regions (Hochgesand & Gottsberger, 1996; Pando, 1997; Lizárraga & al., 1997; Estrada-Torres & al., 2001; Putzke, 2002; Cavalcanti, 2002; Maimoni-Rodella, 2002). Additionally, some recent checklists and catalogues of Myxomycetes, from regions or countries such as Colombia (Uribe-Meléndez, 1995), French Guayana (Courtecuisse & al., 1996), Brazil (Putzke, 1996), Mexico (Ogata & al., 1994; Illana & al., 2000; Moreno & al., 2007), the Caribbean (Minter

& al., 2001) or Argentina (Crespo & Lugo, 2003), have been published, and new species or genera have been described from the region (Hochgesand & Gottsberger, 1989; Lado & al., 1999a, 2007b; Mosquera & al., 2003; Estrada-Torres & al., 2001, 2003). All these projects, and their resulting publications have provided, in a short time, an important and valuable body of information, on the myxobiota of this bioregion, but much of the data is dispersed and, in some cases, is difficult to obtain.

The objective of this paper is to compile and synthesize all the accumulated information on the presence of Myxomycetes, in this part of the world. Apart from providing an up to date view of the knowledge of myxomycetes from the Neotropics, it can be used to show gaps of information, and areas currently unexplored. In addition, it can be used to evaluate the richness of the myxobiota in different countries, and so provide information for future conservation and protection plans, and also serve as a starting point to establish and develop future strategies for the study of myxomycetes in this area of the world.

Geographic area covered

The geographic area covered by this review includes all of the American territories between the Tropic of Cancer and the Tropic of Capricorn, and encompasses all the Mesoamerica and Caribbean bioregions as well as South America. We consider whole countries in a political sense, even when the limits of all the territory of the country are not included between the limits of the Neotropical region in a strict sense, as is the case of Mexico, Argentina and Chile. Uruguay, the only country out of the limits of the tropics, but with subtropical features, is also included. With these criteria the paper includes all of the territories between Mexico (Fig. 1), as the northern limit, and Tierra del Fuego (Fig. 2), as the southern limit.

The area has been divided, for practical reasons, into thirty regions, which largely conform to political circumscriptions. But the designations of geographical entities do not imply the expression of any opinion whatsoever concerning the legal status of any country, territory or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. The countries are designated with the three-letter code of Botanical Countries established by Brummitt (2001) in the World Geographical Scheme for Recording Plant Distributions. Some exceptions were made, to enable an easier interpretation of the data, and so a single code is used for all the continental territory of Mexico (MEX) as well as its Pacific and Caribbean Islands, and for all of the territories of Brazil (BZI). Those of Argentina (AGA) and Chile (CLI), include each country's area of Tierra del



Fig. 1. Central America and the Caribbean.

Fuego. Tiny enclaves of one country in another have been ignored, and geographical disjunctions such as major or remote islands have been included in their countries of political dependence. According to these criteria, the Desventurados Islands and Juan Fernandez Islands are also included in Chile (CLI), the Galapagos Islands are included in Ecuador (ECU), and the Fernando de Noronha and Trindade Islands in Brazil (BZI).

Due to the large number of islands and to avoid too much division of the territory, the Leeward Islands of the Caribbean bioregion, such as Anguilla, Antigua-Barbuda, Guadalupe, Montserrat or the American Virgin Islands, have been considered as one territory (LEE). The same criteria have been applied to the Bahama Islands (BAH) and the Windward Islands (WIN), that include Barbados, Dominica, Grenada, St. Lucia, Martinique and St. Vincent. The little islands making up the Central American Pacific Islands such as Cocos, Coiba and Malpelo, are included in the countries of political dependence (Costa Rica, Panama or Colombia), as have the Southwest Caribbean Islands of Colombian, Honduran and Nicaraguan Islands. The Dutch territories of Aruba, Bonaire and Curaçao Islands, are included in Venezuela as well as the Venezuelan Antilles. The Turks and Caicos Islands have been included with the Bahamas, and the

Cayman Islands jointly with Cuba. Abbreviations used herein are listed and shown on figs. 1-2.

Central America

MEX Mexico (Guadalupe Island, Rocas Alijos Islands and Revillagigedo Islands included)

BLZ Belize

GUA Guatemala

HON Honduras (Honduran Caribbean Islands included)

ELS El Salvador

NIC Nicaragua (Nicaraguan Caribbean Islands included)

COS Costa Rica (Cocos Island included)

PAN Panama (Coiba Island included)

Caribbean

BAH Bahamas (Turks and Caicos Islands included)

CUB Cuba (Cayman Islands included)

JAM Jamaica

HAI Haiti (Navassa Island included)

DOM Dominican Republic

PUE Puerto Rico

LEE Leeward Islands (Antigua-Barbuda, Anguilla, Aves Island, British Virgin Islands, Guadeloupe, Montserrat, Netherlands Leeward Islands, St. Kitts-Nevis, St. Martin-St. Barthélemy and Virgin Islands)

WIN Windward Islands (Barbados, Dominica, Grenada, Martinique, St. Lucia, St. Vincent)

TRT Trinidad and Tobago



Fig. 2. South America.

South America

CLM Colombia (Colombian Caribbean Islands and Malpelo Island included)

VEN Venezuela [Venezuelan Antilles and Netherlands Antilles (Curaçao and Bonaire), the island of Aruba included]

GUY Guyana

SUR Suriname

FRG French Guiana

ECU Ecuador (Galápagos Islands included)

PER Peru

BOL Bolivia

BZI Brazil (Fernando de Noronha and Trindade Island included)

PAR Paraguay

URU Uruguay

AGA Argentina (Tierra del Fuego and other islands included)

CLI Chile (Desventurados Islands, Juan Fernández Islands, Tierra del Fuego and other islands included)

Other criteria followed

To present the data, the same basic format employed by Lado (1994) in the checklist of Myxomycetes of the Mediterranean countries, has been followed. The review is similar to a checklist, basically a species listing (Table 1), including synonyms, of myxomycetes from the Neotropics cited in the literature, with species distribution by countries. With regard to nomenclature used, the generic and species treatment are those accepted by Lado (2001, 2008) and Hernández-Crespo & Lado (2005), the generic names *Amaurochaete*, *Ceratiomyxa* (traditionally considered a myxomycete until recently) and *Hemitrichia* are conserved according to Lado & al. (2005) (see also, Gams, 2005). Intraspecific taxa have not been considered, due to the inconsistency of distinctive characters in many of the cases, and are treated under their respective species. All the species names utilised in the consulted sources have been verified. Spelling variations and transcriptional errors have been corrected. The accepted names appear in bold, and the synonyms (homo or heterotypic synonyms), which have been used for species in the literature from the Neotropics, appear in italics. Records cited herein are compiled from the literature and no attempt has been made, for this paper, to examine or authenticate material.

The taxa, in the Table 1, are arranged alphabetically by genera and species. A query after a species under a certain country, means doubts as to its presence in that country, which is usually due to imprecision by the author of the paper, or the collector of the specimen. The countries or geographical units have been arranged more-or-less in order from the North to the South, in three major bioregions, starting with Central America, continuing with the Caribbean Islands and ending with South America. The totals for the number of species by countries and countries for each species have been given at the end and the side of the table. Doubtful excluded or species have been listed in a separate table (Table 2).

Sources of information

The monograph by Farr (1976) for the series *Flora Neotropica*, has been taken as a baseline for this review, and the reference has been included in all the countries for which she gave citations. This may lead to some duplication in the numbers of references for a country, but this has not caused duplication in the records of Myxomycetes, which have been listed only once. All the literature references of Farr's monograph have been incorporated into the list of references below, except those general works that re-

compile records or references, such as Lister (1911, 1925), Hagelstein (1944) or Macbride (1899, 1922). Some pre-1975 papers, omitted by Farr (1976), are also included. In addition, checklists, inventories, catalogues as well as more obscure papers with valuable information, published after 1975, have been perused for myxomycete records, and used as sources of information for this review. All the sources of information used for the myxomycete records listed in Table 1 are given below, arranged by countries and date. Compilation of this data by country should assist future researchers, and be useful as a guideline for future government initiatives. The sources are:

Argentina (AGA): Spegazzini (1880a, 1880b, 1880c, 1881, 1882, 1886, 1887b, 1889, 1896a, 1896b, 1899a, 1899b, 1909a, 1909b, 1912, 1913, 1919a, 1926, 1927), Berlese (1888), Masee (1889), Saccardo (1892), Saccardo & Sydow (1899, 1902), Fries (1903), Torrend (1908), Saccardo & Trotter (1913), Sturgis (1916), Digilio (1946, 1950), Farr (1971, 1973, 1974, 1976), Arambarri (1972, 1973, 1975), Deschamps (1972, 1974, 1975, 1976a, 1976b), Castillo & al. (1996), Crespo & Lugo (2003), Wrigley de Basanta & Stephenson (2005), Wright & Albertó (2006).

Bahamas (BAH): Britton & Millspaugh (1920).

Belize (BLZ): Ing & Haynes (1999).

Bolivia (BOL): Fries (1903), Saccardo & Saccardo (1906), Torrend (1908), Stevenson & Cardenas (1949), Farr (1976).

Brazil (BZI): Montagne (1837), Berkeley & Cooke (1876), Spegazzini (1881, 1888, 1889, 1919b, 1926), Berlese (1888), Masee (1889), Saccardo (1892, 1895), Hennings (1896, 1902a), Bresadola (1896), Pazschke (1896), Saccardo & Sydow (1899), Jahn (1902, 1904), Saccardo & Saccardo (1906), Höhnell (1907), Sydow & Sydow (1907), Torrend (1908, 1915, 1916), Batista (1949), Hashimoto (1953), Hertel (1954a, 1954b, 1955), Farr & Martin (1958), Farr (1959, 1960, 1968, 1973, 1974, 1976, 1985), Fidalgo & al. (1965), Ing (1967), Gottsberger (1968, 1971), Mariz (1968), Cavalcanti (1970, 1974a, 1974b, 1976, 1977, 1985, 1996a, 1996b, 2002), Dennis (1970), Gottsberger & Nannenga-Bremekamp (1971), Mariz & Cavalcanti (1970), Maimoni-Rodella & Gottsberger (1980), Bononi & al. (1981), Cavalcanti & al. (1982, 1985, 1993, 1999, 2005, 2006), Pôrto & Cavalcanti (1984, 1986), Pôrto & al. (1982), Cavalcanti & Araújo (1985), Cavalcanti & Dias Filha (1985), Cavalcanti & Marinho (1985), Cavalcanti & Oliveira (1985), Cavalcanti & Porto (1985), Cavalcanti & Silva (1985), Rodrigues (1985), Santos & al. (1986), Muchovej & Muchovej (1987), Capelari & Mazeiro (1988), Silva & Cavalcanti (1988), Santos & Cavalcanti (1988, 1991a, 1991b, 1995), Hochgesand & Gottsberger (1989, 1996), Hochgesand & al. (1989), Cavalcanti & Brito (1990), Mendes & Guerrero (1990), Rodrigues & Guerreiro (1990), Rogerson & al. (1990), Cavalcanti & Santos (1991), Gottsberger & al. (1992), Cavalcanti & Fortes (1994, 1995), Góes Neto (1996), Barbosa (1996), Putzke (1996, 2002), Alves & Cavalcanti (1996), Cavalcanti & Putzke (1998), Mobin & Cavalcanti (1998, 1999a, 1999b, 2000, 2001), Yamamoto & al. (2000), Cavalcanti & Mobin (2001, 2002, 2004), Góes Neto & Cavalcanti (2002), Maimoni-Rodella (2002), Matsumoto (2002), Chiappeta & al. (2003), Ponte & al. (2003), Maimoni-Rodella & Cavalcanti (2006), Bezerra & al. (2007), Rufino & Cavalcanti (2007).

Chile (CLD): Bertero (1828), Montagne (1837, 1852a, 1852b),

Berlese (1888), Masee (1889), Saccardo (1892), Johov (1896), Saccardo & Sydow (1899), Torrend (1908), Sturgis (1916), Spegazzini (1887b, 1917, 1921), Fries (1920), Mújica & Vergara (1945), Lazo (1966), Farr (1976), Lado & al. (2007a).

Colombia (CLM): Leveille (1863), Masee (1889), Saccardo (1892), Torrend (1908), Chardon (1928), Muenschler (1930), Martin (1932, 1938a), Dennis (1970), Farr (1976), Guzmán & Varela (1978), Uribe-Meléndez (1995).

Costa Rica (COS): Hennings (1902b), Spegazzini (1919b), Welden (1954), Alexopoulos (1967), Alexopoulos & Sáenz (1975), Farr (1976), Edmunds & Stephenson (1996), Schnittler & Stephenson (2000, 2002a, 2002b), Schnittler (2001), Moore & Stephenson (2003), Stephenson & al. (2004b), Wrigley de Basanta & Lado (2005), Rojas & Stephenson (2007, 2008).

Cuba (CUB): Montagne (1837, 1838), Berkeley (1868), Berlese (1888), Masee (1889), Torrend (1908), Saccardo & Trotter (1913), Farr (1976), Camino (1991, 1996, 1998a, 1998b), Camino & Pérez (2000, 2001), Pérez & Camino (2000), Minter & al. (2001), Camino & Eliasson (2002), Camino & Moreno (2002), Camino & Rodríguez (2002), Krivomaz (2003), Wrigley de Basanta & al. (2003), Camino & al. (2005, 2007, in press), Wrigley de Basanta & Lado (2005).

Dominican Republic (DOM): Ciferri & González-Fragoso (1926), Toro (1926), Gonzalez-Fragoso & Ciferri (1927, 1928), Ciferri (1929, 1961), Farr (1976), Minter & al. (2001).

Ecuador (ECU): Patouillard & Lagerheim (1891, 1892, 1893, 1895a, 1895b), Saccardo (1895), Saccardo & Sydow (1899), Torrend (1908), Bonar (1939), Martin (1948), Harling (1967), Dennis (1970), Eliasson (1971, 2000), Farr (1974, 1976), Farr & al. (1979), Reid & al. (1981), Schinner (1981), Eliasson & Nannenga-Bremekamp (1983), Nannenga-Bremekamp (1989), Stephenson & Mitchell (1994), Schnittler (2001), Estrada & al. (2002c), Lado & al. (2002b), Schnittler & al. (2002), Schnittler & Stephenson (2002a, 2002b), Stephenson & al. (2004a, 2004b), McHugh (2005).

French Guiana (FRG): Farr (1976), Courtecuisse & al. (1996).

Guatemala (GUA): Farr (1976), Estrada-Torres & al. (2000).

Guyana (GUY): Montagne (1855), Cooke (1877), Berlese (1888), Torrend (1908), Gilbert (1928), Farr (1976), Rogerson & al. (1990).

Haiti (HAD): Benjamín & Slott (1969), Farr (1976), Minter & al. (2001).

Honduras (HON): Davis & Butterfield (1967), Alexopoulos (1970), Clark & Collins (1973), Farr (1976).

Jamaica (JAM): Saccardo (1895), Torrend (1908), Alexopoulos & Beneke (1954a, 1954b), Farr (1957, 1974, 1976), Alexopoulos (1967, 1970), Minter & al. (2001).

Leeward Islands (LEE): Lister (1898a, 1898b), Saccardo & Sydow (1902), Duss (1903, 1904), Seaver & Chardon (1926), Raunkiaer (1928), Hagelstein (1932), Alexopoulos (1970), Stevenson (1975), Farr (1976), Minter & al. (2001).

Mexico (MEX): Saccardo & Sydow (1902), Torrend (1908), Emoto (1933), Welden & Lemke (1961), Alexopoulos & Blackwell (1968), Martínez-Murillo & Ochotorena (1970), Guzmán (1972, 1983), Farr (1976), Braun & Keller (1976, 1986), Keller & Brooks (1976), Keller & Braun (1977), Welden & Guzmán (1978), Welden & al. (1979), Guzmán & Varela (1979), López & al. (1979, 1981a, 1981b, 1981c, 1982), Pérez-Silva (1979), Gómez-Sánchez & Castillo (1981), Dávalos & Guzmán (1981), Guzmán & Guzmán-Dávalos (1981), Mapes & al. (1981), López & Sosa (1982), Martínez-Alfaro & al. (1983), Villarreal (1983, 1985, 1990), Chacón & Guzmán (1984), Gómez-Pompa & al. (1984),

Guzmán & Villarreal (1984), Pérez-Silva & Aguirre-Acosta (1985), Trujillo-Flores & al. (1986), Trujillo-Flores (1988), Pérez-Moreno & Villarreal (1988), Heredia (1989), Capello-García & Hernández-Trejo (1990), Hernández-Cuevas & al. (1991), Galindo-Flores (1992), Galindo-Flores & Estrada-Torres (1993), Galindo-Flores & al. (1993), Ogata & al. (1994, 1996), Estrada-Torres (1996), Illana (1996), Lizárraga & al. (1996, 1997, 1998, 1999a, 1999b, 1999c, 2003a, 2003b, 2004a, 2004b, 2005a, 2005b, 2006, 2007, 2008), López & García (1996a, 1996b, 1996c, 1996d, 1996e, 1996f, 1996g, 1996h, 1996i, 1996j, 2001a, 2001b, 2001c, 2001d, 2002a, 2002b, 2002c, 2002d, 2002e, 2002f, 2002g, 2005a, 2005b), Ogata & Andrade-Torres (1996), Rodríguez-Palma & Estrada-Torres (1996a, 1996b), Hernández-Cuevas & Estrada-Torres (1993a, 1993b, 1997), Rodríguez-Palma & al. (1996, 2002, 2005), Moreno & al. (1997a, 1997b, 1997c, 2000, 2001, 2004, 2006a, 2006b, 2007), Andrade-Torres (1998), Rodríguez-Palma (1998), Illana & al. (1999, 2000), Lado & al. (1999a, 1999b, 2002a, 2003, 2007b), Pérez-Silva & Bárcenas (1999), Mosquera & al. (2000a, 2000b, 2003), Yamamoto (2000), Estrada-Torres & al. (2001, 2002a, 2002b, 2002c, 2002d, 2003, 2005, in press), Pérez-Silva & al. (2001), Andrade-Torres & al. (2002a, 2002b), Lizárraga (2002), Stephenson & al. (2003, 2004a, 2004b), Wrigley de Basanta & al. (2002, 2003, 2008, in press), Wrigley de Basanta & Lado (2005).

Nicaragua (NIC): Macbride (1893), Saccardo (1895), Macbride & Smith (1896), Torrend (1908), Farr (1976).

Panama (PAN): Standley (1927, 1933), Weston (1933), Martin (1936, 1938b, 1957), Welden (1954), Davis & Butterfield (1967), Dennis (1970), Ling & Collins (1970), Farr (1974, 1976), Wheeler (1980), Pando (1997).

Paraguay (PAR): Hennings (1896), Saccardo & Trotter (1913), Spegazzini (1886, 1888, 1919b, 1923, 1926), Farr (1973, 1976).

Peru (PER): Rudolphi (1829), Farr (1976), Stephenson & Mitchell (1994), Wrigley de Basanta & Lado (2005), Wrigley de Basanta & al. (2008).

Puerto Rico (PUE): Klotzsch (1852), Seaver & Chardon (1926), Hagelstein (1927, 1932), Alexopoulos (1970), Stevenson (1975), Farr (1976), Stephenson & al. (1999, 2004b), Novozhilov & al. (2000), Minter & al. (2001), Schnittler (2001), Nieves-Rivera & Darrah (2002a, 2002b), Schnittler & Stephenson (2002a, 2002b), Nieves-Rivera (2003), Wrigley de Basanta & Lado (2005), Wrigley de Basanta & al. (2008).

Surinam (SUR): Gilbert (1928), Nannenga-Bremekamp (1961), Farr (1976), Rogerson & al. (1990).

Trinidad and Tobago (TRT): Rorer (1911), Baker & Dale (1951), Barnes (1963), Alexopoulos (1970), Dennis (1970), Farr (1976), Minter & al. (2001).

Uruguay (URU): Spegazzini (1881, 1926), Herter (1907, 1933, 1939), Farr (1976), García-Zorrón (1967, 1977).

Venezuela (VEN): Berlese (1888), Patouillard & Gaillard (1888), Masee (1889), Saccardo (1892, 1895), Torrend (1908), Saccardo & Trotter (1913), Heim (1928), Muenschler (1934), Rodríguez (1955, 1957), Dennis (1960, 1970), Farr & Kowalski (1974), Farr (1974, 1976), Buyck (1984), Verde de Millán & Jaimes (1987), Rogerson & al. (1990).

Windward Islands (WIN): Cooke (1889), Lister (1898a), Duss (1903, 1904), Chardon (1926), Hagelstein (1932), Alexopoulos (1967, 1970), Farr (1969, 1976), Dennis (1970), Minter & al. (2001).

Table 1. List of species by countries.

	MEX	BIZ	GUA	HON	ELS	NIC	COS	PAN	BAH	CUB	JAM	HAI	DOM	PUE	LEE	WIN	TRT	CLM	VEN	GUY	SUR	FRG	BZI	ECU	PER	BOL	PAR	URU	CLI	AGA	Argentina	Total	
<i>Arcyria affinis</i> Rostaf.	MEX																						ECU								2		
<i>Arcyria afroalpina</i> Rammeloo = <i>A. afroalpina</i> var. <i>mexicana</i> Lizárraga, G. Moreno & Illana	MEX		CUB			COS							PUE										ECU									5	
<i>Arcyria cinerea</i> (Bull.) Pers. = <i>A. digitata</i> Schwein. = <i>A. cinerea</i> var. <i>digitata</i> (Schwein.) G. Lister = <i>A. albidata</i> Pers. = <i>A. cookei</i> Masseur = <i>A. cinerea</i> f. <i>rubella</i> Y. Yamam.	MEX	BIZ	GUA	HON	ELS	NIC	COS	PAN	BAH	CUB	JAM	HAI	DOM	PUE	LEE	WIN	TRT	CLM	VEN	GUY	SUR	FRG	BZI	ECU	PER	BOL	URU	CLI	AGA			28	
<i>Arcyria corymbosa</i> M.L. Farr & G.W. Martin																							BZI						AGA			2	
<i>Arcyria denudata</i> (L.) Wettst. = <i>A. punicea</i> Pers.	MEX	BIZ		HON		NIC	COS	PAN	BAH	CUB	JAM		DOM	PUE	LEE	WIN	TRT	CLM	VEN	GUY	SUR	FRG	BZI	ECU	PER	BOL	URU	CLI	AGA			26	
<i>Arcyria ferruginea</i> Sauter	MEX																						BZI				PAR	URU	AGA			5	
<i>Arcyria fuegiana</i> Aramb.																													AGA			1	
<i>Arcyria glauca</i> Lister																													AGA			1	
<i>Arcyria globosa</i> Schwein.	MEX									CUB				PUE				CLM					BZI	ECU								6	
<i>Arcyria incarnata</i> (Pers. ex J.F. Gmel.) Pers.	MEX					COS				CUB	JAM	HAI		PUE	LEE	WIN	TRT	CLM	VEN			BZI	ECU			PAR	CLI	AGA			16		
<i>Arcyria insignis</i> Kalchbr. & Cooke	MEX					COS	PAN			CUB	JAM			PUE	LEE		TRT	CLM	VEN			BZI	?			BOL	URU	CLI	AGA			16	
<i>Arcyria magna</i> Rex = <i>A. magna</i> var. <i>rosea</i> Rex	MEX					COS	PAN			CUB						WIN						BZI										6	
<i>Arcyria major</i> (G. Lister) Ing																						BZI	ECU									2	
<i>Arcyria minuta</i> Buchet = <i>A. carneae</i> (G. Lister) G. Lister	MEX					COS	PAN															BZI							AGA			5	
<i>Arcyria nigella</i> Emoto	MEX																															1	
<i>Arcyria obvelata</i> (Oeder) Onsberg = <i>A. nutans</i> (Bull.) Grev. = <i>A. flava</i> Pers.	MEX					COS	PAN			CUB	JAM				LEE		TRT		VEN			BZI	ECU			PAR			AGA			12	

Table 2. Doubtful and Excluded species.

Doubtful species
<i>Arcyodes incarnata</i> (Alb. & Schwein.) O.F. Cook [= <i>Lachnobolus incarnatus</i> Alb. & Schwein.] — cited by Spegazzini (1921) from Chile but Farr (1976: 280) doubted the identification. Also recorded by Lazo (1966) but probably based on Spegazzini's record.
<i>Arcyria carletae</i> Hertel — described from Brazil (Hertel, 1954). No material available for examination (Farr, 1976: 80).
<i>Arcyria fonsecae</i> Hertel — described by Hertel (1954) from Brazil. No material available for examination (Farr, 1976: 81).
<i>Arcyria occidentalis</i> (T. Macbr.) G. Lister — reported from Brazil by Teixeira (1971), probably based on the uncertain listing by Martin & Alexopoulos (1969), fide Farr (1976: 82).
<i>Arcyria ramulosa</i> (F. Rudolphi) Wigand [= <i>Trichia ramulosa</i> F. Rudolphi] — described by Rudolphi (1829) from Peru. According to Martin & Alexopoulos (1969) could represent a new genus.
<i>Arcyria stellfeldii</i> Hertel — described by Hertel (1954) from Brazil. No material available for examination (Farr, 1974: 82).
<i>Arcyria versicolor</i> W. Phillips — cited by Torrend (1915) from Brazil and Spegazzini (1909) and Digilio (1946) from Argentina. Highly improbable, fide Farr (1976: 83).
<i>Chondrioderma frustulosum</i> Pat. & Lagerh. — cited by Patouillard & Lagerheim (1895a) from Ecuador, probably a synonym of <i>Diderma globosum</i> , fide Farr (1976: 205).
<i>Comatricha fluminensis</i> (Speg.) & Torrend [= <i>Stemonitis fluminensis</i> Speg.] — described by Spegazzini (1881) from Brazil. Identity uncertain, fide Farr (1976: 279).
<i>Comatricha suksdorfii</i> Ellis & Everh. — cited by Torrend (1915) from Brazil. Identity uncertain, fide Farr (1976: 266).
<i>Comatricha typhoides</i> var. <i>cinerea</i> Hertel — described by Hertel (1955) from Brazil. No material available for examination (Farr, 1976: 267).
<i>Cribraria colosseae</i> Speg. — described by Spegazzini (1909) from Argentina, probably a synonym of <i>C. tenella</i> Schrad., fide Farr (1976: 54).
<i>Cribraria staminiformis</i> Speg. — described by Spegazzini (1880) from Argentina. Identity uncertain, fide Farr (1976: 56).
<i>Didymium discoideum</i> Torrend — described from Brazil by Torrend (1915). No material available for study, fide Farr (1976: 235).
<i>Didymium ossicola</i> Pat. & Gaillard — described by Patouillard & Gaillard (1888) from Venezuela. Identity uncertain, fide Farr (1976: 236).
<i>Didymium platense</i> Speg. — described by Spegazzini (1899) from Argentina. Identity uncertain.
<i>Didymium pruinosum</i> Berk. & M.A. Curtis — described in Berkeley (1868) from Cuba. Identity uncertain, fide Farr (1976: 236)
<i>Enteridium antarcticum</i> Speg. — described from Chile by Spegazzini (1887b) and cited from Argentina (Spegazzini, 1912), probably a synonym of <i>Reticularia olivacea</i> , fide Farr (1976: 40).
<i>Hemitrichia insignis</i> Torrend — described by Torrend (1916) from Brazil. Identity uncertain.
<i>Hemitrichia pusilla</i> Speg. [= <i>Hemiarcyria pusilla</i> (Speg.) Berl. = <i>Arcyria pusilla</i> (Speg.) Masee] — described by Spegazzini (1881a) from Argentina. Identity uncertain, fide Farr (1976: 101).
<i>Lamproderma inconspicuum</i> J. Schröt. — reported from Brazil by Hennings (1896). Identity uncertain, fide Farr (1976: 253).
<i>Lamproderma sauteri</i> Rostaf. — reported from Brazil by Farr (1960, 1968). Identity uncertain, moldy material, fide Farr (1976: 253).
<i>Licea floriformis</i> T.N. Lakh. & R.K. Chopra [= <i>Licea floriformis</i> var. <i>aureospora</i> M.T.M. Willemsse & Nann.-Bremek. = <i>L. longa</i> Flatau] — reported from Ecuador by McHugh (2005). Identity uncertain.
<i>Licea schoenleinii</i> Johow — described by Johow (1896) from Chile. Identity uncertain, fide Farr (1976:28).
<i>Lycogala platense</i> Speg. — described from Argentina by Spegazzini (1899a) but identity uncertain, fide Farr (1976: 36).
<i>Paradiacheopsis erythropodia</i> Ing; reported from Mexico by Estrada-Torres & al., (in press). Identity uncertain.
<i>Physarum albescens</i> Ellis ex T. Macbr. — reported from Brazil by Cavalcanti (2002). Identity uncertain.
<i>Physarum chlorinum</i> Cooke — cited by Cooke (1877) from Guyana. Identity uncertain, fide Farr (1976: 173).
<i>Physarum conglomeratum</i> (Fr.) Rostaf. — cited by Lister (1898a) from Antigua and Torrend (1908) from "Antilles". Identity uncertain, fide Farr (1976: 173).
<i>Physarum anomalum</i> (Masee) Torrend [= <i>Tilmadoche anomala</i> Masee] — cited by Masee (1889) from Venezuela. Identity uncertain.
<i>Physarum crustiforme</i> Speg. — described by Spegazzini (1899b) from Argentina. Identity uncertain, fide Farr (1976: 281).
<i>Stemonitis confluens</i> var. " <i>minuta</i> ?" Batista — described by Batista (1949) from Brazil. Identity uncertain, fide Farr (1976: 279).
<i>Stemonitis curitbensis</i> Hertel — described by Hertel (1955) from Brazil. Identity uncertain, fide Farr (1976: 279).
<i>Stemonitis fluminensis</i> Speg. — described by Spegazzini (1881a) from Brazil. Identity uncertain fide Farr (1976: 279).
<i>Trichia turbinata</i> (Bolton) Whit. [= <i>T. chrysosperma</i> var. <i>turbinata</i> "Hds."] — cited by Berkeley (1868) from Cuba, by Spegazzini (1886) from Paraguay and by Montagne (1852a, 1852b) from Chile. Identity uncertain.
Excluded species
<i>Chondrioderma andinum</i> Speg. — an unpublished species, fide Farr (1976: 280), cited from Argentina.
<i>Colloderma pustulatum</i> G.W. Martin — the name apparently has remained unpublished, fide Farr (1976: 246), cited from Mexico.
<i>Comatricha platensis</i> Speg. — apparently an unpublished name, fide Farr (1976: 266), cited from Argentina.
<i>Cornuvia minutula</i> Speg. — described from Brazil. Identity uncertain fide Farr (1976: 280).
<i>Licea berteriana</i> Mont. — described from Chile. Not a myxomycete, fide Martin & Alexopoulos (1969).
<i>Licea guaranitica</i> Speg. — described from Paraguay. Not a myxomycete, fide Farr (1976: 28).
<i>Tubulina guaranitica</i> (Speg.) Speg. — based on <i>Licea guaranitica</i> Speg. See comments under this species
<i>Reticularia affinis</i> Berk. & M.A. Curtis — described from Cuba. Not a myxomycete, fide Martin & Alexopoulos (1969).
<i>Reticularia atrorufa</i> Berk. & M.A. Curtis — described from Cuba. Not a myxomycete, fide Farr (1976: 41).
<i>Reticularia pyrrosopora</i> Berk. — described from Cuba, not a myxomycete, fide Farr (1976: 41).
<i>Reticularia venulosa</i> Berk. & M.A. Curtis — described from Cuba. Not a myxomycete, fide Martin & Alexopoulos (1969).
<i>Rostafinskia australis</i> Speg. — described from Argentina. Not a myxomycete, fide Farr (1976: 281).
<i>Physarum areolatum</i> Bertero — apparently an unpublished name, fide Farr (1976: 173), cited from Chile.
<i>Physarum argentinense</i> Speg. — apparently and unpublished name, fide Farr (1976: 173), cited from Argentina.

Discussion

This review includes 431 myxomycete taxa from 51 genera reported from countries of the Neotropics. This is almost half of the total number of species known in the world (Lado, 2008), and in four decades of research, nearly double the number previously published from the region by Farr (1976). It includes 86% of known genera, most (71%) represented by more than one species. Of the thirty countries included in Table 1, Mexico, with 323 species, has by far the largest number of myxomycete species registered, and El Salvador has the least, since no myxomycetes have yet been published from this country. Although eleven countries have over 100 species published, twelve of the countries have recorded fewer than 10% of the total (Table 1). Very few species can be considered pan-neotropical as only 22 of the species (5%) were found in 20 countries or more, whereas 144 species (33%) have been reported from only one country in the Neotropics. Some of the latter have only been found in a single country worldwide, such as *Arcyriatella congregata*, *Calomyxa synspora*, *Diderma robustum*, or *Physarum bubalinum*, but others have been reported from other countries in different parts of the world, and still others have been recently described, and may well be found to be more widely distributed in the future.

Arcyria cinerea has been reported from 28 of the 30 countries. This species, and many of the others that make up the 5%, such as *Arcyria denudata*, *Cribraria cancellata*, *Didymium nigripes*, *D. squamulosum*, *Fuligo septica*, *Hemitrichia calyculata*, *H. serpula*, *Lycogala epidendrum*, *Perichaena chryso sperma*, *Physarum album*, *Ph. viride*, *Stemonitis fusca* or *Trichia favoginea*, are the most common species in many environments, and considered to be generalists, with the ability to exploit the conditions in both temperate and tropical habitats. In addition, there seem to be ecotypes or varieties of some species in the tropics which future work may show are species complexes, but they are all included at present under the same name. The assemblage of myxomycetes which does appear to be characteristically Neotropical, in that they have been recorded from many of the strictly tropical countries, includes *Ceratiomyxa morchella*, *C. sphaerosperma*, *Comatricha tenerrima*, *Craterium paraguayense*, *Cribraria microcarpa*, *C. tenella*, *Diachea bulbilosa*, *Diderma chondrioderma*, *Didymium intermedium*, *Lycogala conicum*, *L. exiguum*, *Physarella oblonga*, *Physarum aeneum*, *Ph. crateriforme*, *Ph. fulgens*, *Ph. javanicum*, *Ph. nicaraguense*, *Ph. nucleatum*, *Ph. oblatum*, *Ph. roseum*, *Ph. stellatum*, *Ph. superbum*, *Stemonaria longa*, *Stemonitis herbatica*, *S. pallida*, *Tubifera bombardata* and *T. microsperma*.

The list also includes 13 new species that have been described in the last decade from material from the Neotropics, which are *Calonema foliicola* Estrada, J.M. Ramirez & Lado, *Cribraria fragilis* Lado & Estrada, *C. zonatispora* Lado, Mosquera & Beltrán-Tej., *Diderma acanthosporum* Estrada & Lado, *D. yucatanensis* Estrada, Lado & S.L. Stephenson, *Didymium tehuacanense* Estrada, D. Wrigley & Lado, *D. umbilicatum* D. Wrigley, Lado & Estrada, *D. wildpretii* Mosquera, Estrada, Beltrán-Tej., D. Wrigley & Lado, *Licea succulenticola* Mosquera, Lado, Estrada & Beltrán-Tej., *Macbrideola herrerae* Lizárraga, G. Moreno & Illana, *M. lamprodermoides* G. Moreno, Lizárraga & Illana, *Perichaena stipitata* Lado, Estrada & D. Wrigley, and *Trichia agaves* (G. Moreno, Lizárraga & Illana) Mosquera, Lado, Estrada & Beltrán-Tej. (described as *Hemitrichia agaves*).

The most representative order from the Neotropics was the Physarales, which is also the order with the greatest number of species. However, if the size of each order is looked at as a percentage of the total number of myxomycete species (Fig. 3) and compared to the percentage of each order found in the Neotropics, it can be seen that the Physarales are indeed more prevalent and more diverse in this area. Among these were 75 species of *Physarum* and 42 species of *Didymium*, the most representative genera. Almost 50% of the species in arid areas of Chile or Mexico (Lado & al, 2007, Estrada & al, in press) and over 40% in a cloud forest in Ecuador (Schnittler & al., 2002) were also from this order. Not all tropical areas are the same, however, since very few species of these genera were found in the high elevation forests of Costa Rica (Rojas & Stephenson, 2007). The orders Trichiales and Echinosteliales also seem to be better represented in the Neotropics than are the Stemonitales or Liceales (Fig. 3).

Myxomycetes have been found to date in all major biomes (Ing, 1994), living on decaying remains of all types of vegetation. Information on vegetation, and particularly vascular plants, as the habitats and substrates for all myxomycetes, is therefore fundamental to understanding their distribution. In the Neotropical region, even specific parts of plants have been shown to be new microhabitats for myxomycetes, such as the inflorescences of tropical plants (Schnittler & Stephenson, 2002a, 2002b), living and dead lianas (Wrigley de Basanta & al., 2008), or the interior of succulent plants (Estrada-Torres & al., in press). Other potential microhabitats probably exist too in poorly studied vegetation, such as the mangrove swamps or the grasslands of the pampa. In addition to information on the vegetation, other factors must be taken into consideration when analyzing the data compiled above in Table 1. The geographical exten-

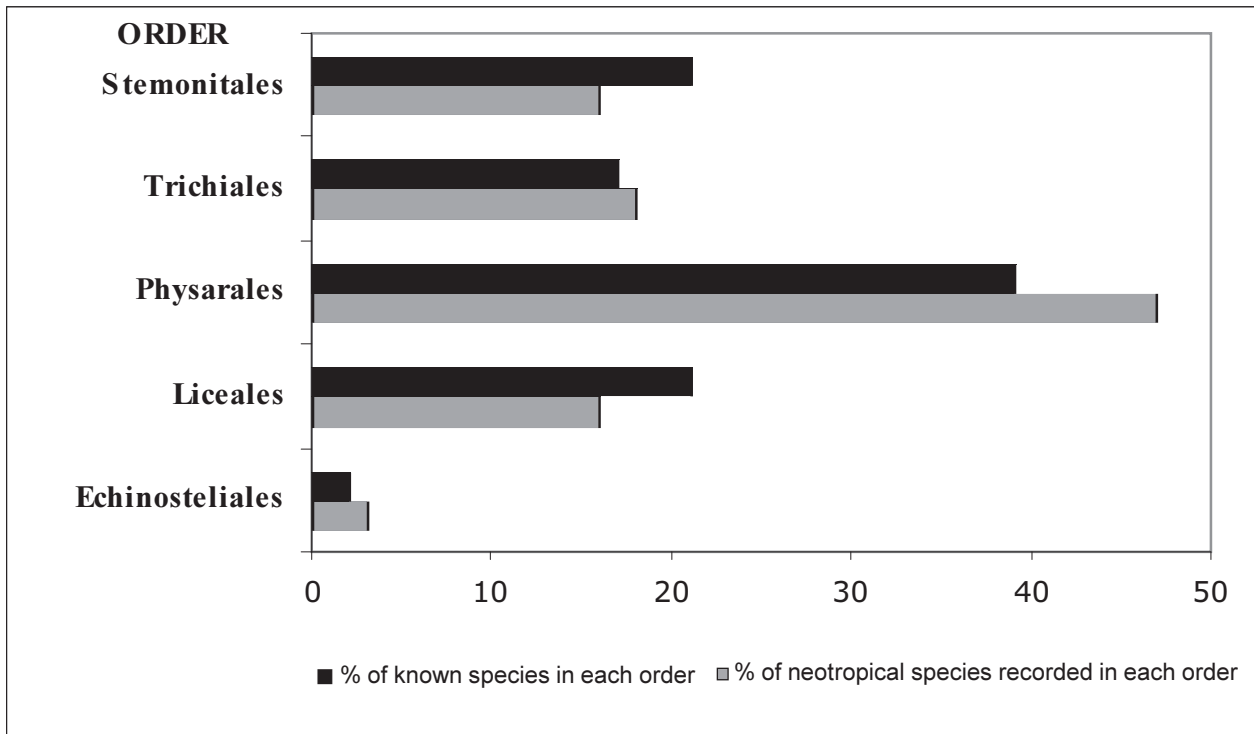


Fig. 3. Percentage of known Myxomycetes in different Orders compared to the percentage of species from the Neotropics in each order.

sion of each country obviously affects the potential number of myxomycetes to be found, and also the extent to which the country has been studied. The problem with any biogeographical analyses, as mentioned by Morawetz & Raedig (2007), is the difficulty in measuring the sampling effort. As the authors note, there can be insufficient sampling in places which are difficult to access, and intense sampling in easily accessible places. In order to enable a more realistic evaluation of the data in Table 1 to be made, a comparison of some of this information is given in Table 3.

Mexico, with the greatest number of myxomycetes, including all thirteen of the new species described from the region in the last decade, has been surveyed in a number of recent projects. Records appear in 138 papers, of which almost 100 are since 1990 (Table 3), but its myxomycete richness is also because it is so geographically diverse. It is the area where Boreal, Neotropical and Caribbean vegetation overlap. Some of these areas do not strictly belong to the Neotropics, as mentioned earlier, but for the purposes of this paper the records from all parts of the countries like Mexico and Argentina have been included, since records of some surveys did not include specific locations. Some parts of Mexico are in Central America, but others pertain to North America. For this reason we treat it alone. Mexico is also a

country of varied relief with the trans-Mexican volcanic belt perpendicular to the two north-south mountain chains. This creates a profusion of different microclimates and vegetation islands in the valleys and consequently many varied habitats for myxomycetes. Its diversity of vegetation according to Davis & al. (1997) is comparable only to India and Peru. Rzedowski (1991) also highlights the high level of plant endemism particularly in arid or semi-arid areas and subhumid montane highlands. Recent surveys have been done in arid areas of the country, such as the Tehuacán-Cuicatlán Valley in Puebla and Oaxaca (Estrada-Torres & al., in press) or Sonora (Lizárraga & al., 2007, 2008), in tropical moist forests such as El Eden in Quintana Roo, and Los Tuxtlas in Veracruz (Lado & al., 2003) or in a dry forest in Chamela, Jalisco (Lado & al., 1999), among others. Many areas of interest remain to be studied in Mexico, however, including the Lacandona region (Chiapas), the Upper Mezquital River region (Durango), or the Sierra de Juárez (Oaxaca).

Central America is of particular interest as it is the land bridge between North and South America, literally closing the circulation between the Pacific and the Atlantic oceans during its formation, and permitting the exchange of organisms between the two land masses. The region has a very varied topography, with

Table 3. Neotropical countries included in this paper: A comparison of land area, vascular plant species richness, myxomycete species richness and number of publications; *na* = information not available. Sources: Gentry (1982, 1992); Davis & al. (1997).

Country	Area (km ²)	Vascular plants (approx.)	Myxomycete species	Publications
Mexico	1,972,546	30,000	323	138
Central America				
Belize	22,800	4,400	41	1
Costa Rica	51,060	10,500	143	16
El Salvador	20,720	2,500	0	0
Guatemala	108,430	8,000	26	2
Honduras	111,890	6,000	12	4
Nicaragua	118,750	7,000	33	5
Panama	75,990	9,000	106	14
Caribbean				
Bahamas	14,260	1,300	10	1
Cuba	108,722	7,000	101	25
Dominican Republic	48,441	5,500	39	8
Haiti	27,749	with Dominican Republic	20	3
Jamaica	11,425	3,700	119	10
Leeward Islands	na	na	83	12
Puerto Rico	8,897	2,900	93	19
Trinidad and Tobago	4,838	2,600	62	7
Windward Islands	na	na	106	12
South America				
Argentina	2,736,690	9,370	160	46
Bolivia	1,084,380	17,350	42	5
Brazil	8,456,510	56,000	206	114
Chile	748,800	5,200	102	19
Colombia	1,038,700	45,000	96	12
Ecuador	276,840	21,000	136	31
French Guiana	90,976	4,000	37	2
Guyana	196,850	6,400	12	7
Paraguay	397,300	8,000	20	9
Peru	1,280,000	19,000	31	5
Surinam	156,000	5,000	9	4
Uruguay	174,810	2,270	52	8
Venezuela	882,050	21,070	111	19

mountains, valleys and high plateaus, which affects the climate and vegetation types. Although it is made up of small countries, it contains up to 8% of the world's plant species (Davis & al., 1997) many of which are endemic (Gentry, 1992). Some of the Central American countries have been sampled in several surveys recently, most notably Costa Rica (Schnittler & Stephenson, 2000) and Panama (Pando, 1997) which have more than 100 species of myxomycete recorded, but others such as El Salvador have not

been studied at all. The three largest countries Guatemala, Honduras and Nicaragua are only cited in a total of 11 publications and have fewer than 50 myxomycete species recorded between them of the 195 different species recorded from Central America, apart from Mexico (Table 3). Even in well studied countries there are vegetation types or specific areas which have received little or no attention. For instance in Costa Rica (16 publications), a recent study (Rojas & Stephenson, 2007) in high elevation oak for-

est apported 11 new species to the country record, as previously there had been very little work done in that type of forest. Of the great variety of vegetation in Central America from lowland rain forest and swamps to arid areas full of cacti, the Petén region of Guatemala or the Darién Province of Panama are unexplored endangered areas and of great interest for future work.

The Caribbean Islands are a group of islands with different origins, and some are remains of continents, others of recent volcanoes. Each major tropical island cluster has independently evolved its own native flora, influenced by the fact that some of the islands, such as Hispaniola, have been formed from several territories, which separated and rejoined various times in their geologic history (Davis & al., 1997). Myxomycetes from the Caribbean have been relatively well studied (Table 3) and cited in 98 publications, 26% of them from Cuba, the largest island with the greatest number of vascular plant species. In addition, other islands, such as Jamaica or the Windwards which have been the site of intensive surveys, have as many or more myxomycetes, although reported in fewer papers. A total of 174 different myxomycete species have been recorded from these islands. Some areas of high plant diversity as yet understudied for myxomycetes in these islands, are the Oriente in Cuba, the Morne Trois Pitons National Park in Dominica, the Central Highlands and Sierra de Neiba in the Dominican Republic, the Pic Macaya or the Morne La Visite in Haiti, the Blue and John Crow Mountains, or the Cockpit Country in Jamaica and the Aripo Savannas Scientific Reserve in Trinidad.

The continent of South America has about one-eighth of the Earth's land surface. It has been an island continent during most of the period of angiosperm evolution, and it has been joined to North America by the Isthmus of Panama, and then separated, more than once in its geologic history. The topography of South America is varied and ranges from the Brazilian lowland with its tropical rain forest to the snow-covered Andes. The Andes is the longest mountain range in the world, and stretches for over 7,000 km forming the backbone of the continent from Colombia to Tierra del Fuego. It has the highest mountain in the Western Hemisphere, the Aconcagua. Most of the continent of South America is in the tropics, but the elevation of the Andes and the presence of cold ocean currents, like the Humboldt stream, cause cool temperatures even at the equator. The combined effect of these environmental factors accounts for the variety of vegetation in this area, which in turn provides multiple substrates, and distinct macro and microhabitats for myxomycetes. In South America, Brazil with the

largest land area (Table 3) has by far the largest number of vascular plants. It has also been intensively studied for myxomycetes (114 publications), but mainly in the northeastern area of the country. Vast areas of the Amazon have never been surveyed, and geographic areas of special scientific interest such as the Pantepui region, the Gran Chaco, the Transverse Dry Belt, have not been sampled. Some areas of distinct vegetation are also of great interest such as the Atlantic moist forest, the Tabuleiro forest, the Caatinga of north-eastern Brazil, or the Cerrado of central Brazil.

Argentina has the second largest land mass and the third number of myxomycete species of the region to date. It was initially studied for these organisms over a hundred years ago, but until recently little intensive work has been done since (only 46 publications). A recent research project, Myxotropic, was undertaken to study the Myxomycetes that develop on endemic succulent plants (Cactacea and sclerophyllous shrubs) of the Neotropical region. The first phase of the project was directed towards the study of this group of organisms from arid regions of Mexico (Estrada Torres & al., in press). The second phase of the Project, involves the unexplored arid areas of Argentina and the North of Chile, specifically the desert areas of El Monte and Atacama, which are among the most arid of the planet (Lado & al., 2007a). This study extends and complements a current International project "Global Biodiversity of Eumycetozoa" supported by the National Science Foundation (NSF) of the United States, developed to investigate unexplored regions of the world (Stephenson & al., 2005). To date the Myxotropic project has provided more than 1200 myxomycete collections from Argentina which are currently under study.

The number of different myxomycete species recorded from all of South America is 328. It is evident from the list that several countries are totally undersurveyed. For example, considering their land-mass and richness in vascular plants, Peru, Colombia, and Bolivia have relatively few myxomycete records. Some of the specific areas of interest in these countries would be the Iquitos region, or the eastern slopes of the Andes in Peru, the Chocó or the Chiribiquete-Araracuara-Cahuinarí region in Colombia, and the Gran Chaco or the Madidi-Apolo region of Bolivia. There are a number of ecosystems and types of vegetation, that span several countries on the continent, and which would provide interesting data and analyses on the role of specific microhabitats or plant species in the distribution of myxomycetes. Some of these are mangrove swamps, dry forest, the cerrado and caatinga, open grass savanna, the Patagonian steppe, and the Valdivian forest.

If the number of publications is taken as an indication of the amount of research done in a country, the suggestion that apparent distribution of myxomycetes follows the distribution pattern of research efforts (Stephenson & Stempen, 1994) is supported by these data. The research intensity, however, is not always related to the number of papers since some papers listed may have only a few records while others, such as the Bahamas or Belize, may have the total for the country in one paper. Myxomycete records have appeared in fewer than ten publications from over half (16) of the 30 countries listed (Table 3), which gives an idea of the enormous amount of research still to be done.

This paper indicates that almost half the known species of myxomycetes have been recorded from the Neotropics. It also indicates that there are many areas that remain under studied, or not investigated at all. This can be seen graphically on the map (Fig. 4), generated by the GBIF (Global Biodiversity Information Facility) network, from their database of geo-referenced records of myxomycetes in major herbaria, which shows sparse points in many of the areas of the Neotropics and none in vast areas of the South American continent. The biodiversity occurrence data for the area mapped from this database, is provided by: University of Arkansas (2008), Staatliche Naturwissenschaftliche Sammlungen Bayerns (2008), GBIF-Sweden, Gothenburg Herbarium (2008), Real Jardín Botánico, Madrid (2008), Utah State University (2008).

The importance and urgency attached to the completion of more biodiversity surveys for these microorganisms in the Neotropics lies in the fact that this area contains some of the most threatened environments on earth. Habitat loss and destruction of the vegetation, to which the myxomycetes are so intimately linked, is on the increase. As Mittermeier & al., (2004) have pointed out, the tropical Andes is the richest and most diverse biodiversity hotspot on earth, and yet only 25% of the original primary vegetation of the tropical Andes remained when Myers & al., (2000) went to press. Approximately 100 Neotropical plant narrowendemics per year are now being lost due to forest conversion (Morawetz & Raedig, 2007). The importance of the conservation of these habitats is not limited to the larger flora or fauna of major conservation efforts. Microorganisms, such as the myxomycetes, with unknown ecological importance and unsuspected species richness are subject to the same, or greater, risks. Protection of their gene pools, and investigation into their ecological importance, before their threatened habitats shrink further, should give high priority to biodiversity research on myxomycetes in the Neotropics.

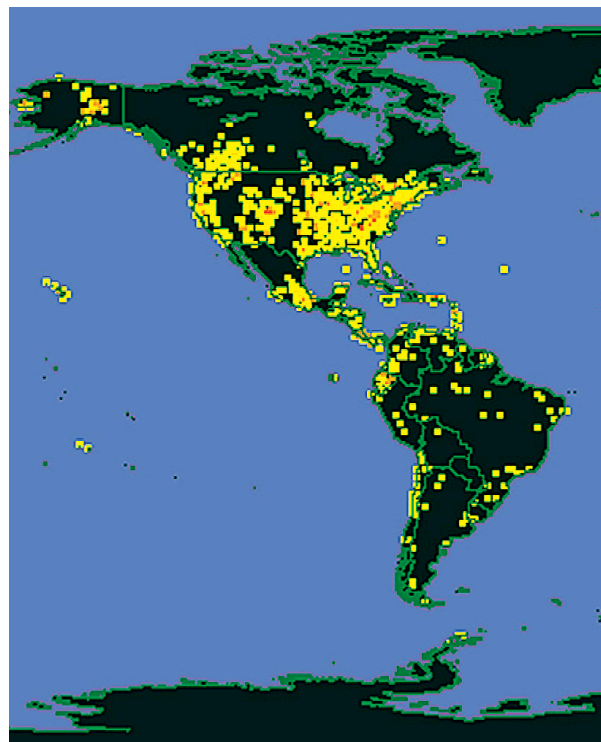


Fig. 4. Myxomycete biodiversity occurrence data from North and South America. This map only shows records with coordinates from the GBIF network and may not properly represent the total distribution of Myxomycetes.

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