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An update on the myxomycete biota (Amoebozoa: Myxogastria) of Colombia

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Abstract: Twelve new records of myxomycetes are reported for Colombia. These additions increase the number of myxomycetes known from this country to 108 species. Since the Colombian territory is part of a biodiversity-rich region in the heart of the Neotropics, the present effort may be considered as a minor contribution. However, due to scarcity of myxomycete research in this country and the importance of inventories involving microorganisms for such purposes as restoration ecology and ecosystem functioning projects, the data presented herein represent a necessary contribution to an understudied aspect of tropical ecology.

Introduction

The myxomycetes, also known as myxogastrids or plasmodial slime molds (Stephenson and Stempen 1994), comprise a monophyletic group of amoeboid protists (see Pawlowski and Burki 2009) known to occur in most if not all terrestrial ecosystems (Stephenson 2003). Although myxomycetes are characterized by a complex life cycle that involves two different trophic (feeding) stages and one reproductive (spore-producing) stage, studies of the group invariably have been centered on the latter (see Spiegel *et al.* 1995). In fact, the taxonomy of this group of organisms is based almost exclusively on the morphology of the fruiting bodies in which the spores are produced (*e.g.* Martin and Alexopoulos 1969).

The development of molecular techniques has resulted in a significant increase in our knowledge of phylogenetic relationships among higher taxa within the myxomycetes (*e.g.* Fiore-Donno *et al.* 2008) and revealed the rather artificial nature of the system of classification traditionally used within the group (see Fiore-Donno *et al.* 2010). These techniques also have been useful in developing an understanding that some morphospecies may consist of several biological entities (Winsett and Stephenson 2008). In spite of such advancements, a complete molecular-based phylogeny for the myxomycetes is still not available (Stephenson 2011).

In this context, the distribution of myxomycetes around the world is still based on the occurrence of distinct species that can be recognized on the basis of their morphological features. Using this approach, Lado and Wrigley de Basanta (2008) reported 431 species for the entire Neotropics. However, more recent studies (*e.g.* Rojas *et al.* 2010a, Rojas *et al.* 2010b) have resulted in a moderate increase in that figure. In any case, it is likely that additional records for the region will be generated as more research is carried out in understudied areas. Recently, an increasing number of efforts, focused on including such areas in the global study of myxomycetes, has contributed significantly to the improvement and understanding of myxomycete occurrence and distribution at both local (*e.g.* Ko Ko *et al.* 2010) and regional (*e.g.* Ndiritu *et al.* 2009) levels.

In Colombia, the most recent inventory of myxomycetes was published by Uribe-Meléndez (1995) more than a decade ago. However, active research on myxomycetes has not been carried out in this country for at least two decades (see Uribe-Meléndez 1995). In fact, for Colombia as a whole, only a handful of studies have been carried out on myxomycetes (see Lado and Wrigley de Basanta 2008). Fortunately, some additional research has taken place recently (*e.g.* Herrera *et al.* 2011). However, a more active effort directed towards studying the myxomycete biota of the country is still lacking.

In order to contribute to our knowledge of myxomycetes in Colombia, the study described herein was carried out. The main objective of this paper is to report species that to our knowledge and according to information in the available literature have not been recorded previously for Colombia. The importance of these additions is related to the fact that updated distribution ranges for species of myxomycetes in the Neotropical region provide a more complete body of data on which to design more complex ecology-based projects in the future.

Materials and Methods

The results presented herein were generated from both a series of rapid assessments of myxomycete biodiversity carried out in Colombia during the period 2006-2008 as well as from an examination of records of specimens deposited in the United States National Fungus Collection (BPI), as accessed through the Global Biodiversity Information Facility portal. In all cases, the morphological concept of species has been used and the nomenclatural treatment followed is that of Lado (2005-2012). All specimens obtained during the rapid assessments have been deposited in the mycological herbarium (UARKM) of

the University of Arkansas.

For records collected by the authors, the specimens representing the sources of the records were obtained using a combination of both field and a laboratory-based methodology. In the first instance, fruiting bodies of myxomycetes were searched for on dead plant material according to the opportunistic protocol described by Cannon and Sutton (2004). For the laboratory-based methodology, the moist chamber culture technique outlined by Stephenson and Stempen (1994) was used. In both instances, when myxomycete fruiting bodies were found, small portions of the substrate with the specimens present were glued onto pieces of paper placed in small pasteboard boxes and then allowed to dry out at room temperature. After this process, identification of particular specimens was carried out using standard monographs (e.g., Martin and Alexopoulos 1969), after which they were placed in the herbarium.

Results and Discussion

In the list that follows, species are arranged alphabetically by genus and then species. After the name of the species, the name of the collector is included along with the accession number for the herbarium where the specimen is deposited. The United States National Fungus Collections is abbreviated as BPI, whereas the mycological herbarium of the University of Arkansas as UARKM. Other relevant information such as collection date, location, elevation and coordinates also have been included. Finally, the administrative Colombian department in which the collection was made is listed at the end. Those georeferences that include information in the form of degrees, minutes and seconds represent measurements obtained directly in the field using a portable GPS unit, whereas those including only information in the form of degrees and seconds correspond to a centroid-based georeference derived by the authors using the information on the original herbarium label.

Species with a synonym provided represent records of previously unpublished taxa for Colombia for which the currently recognized name is different from the original name listed on the herbarium collection. Names marked with one asterisk correspond to species collected as part of the rapid assessments carried out by the authors. Names without an asterisk correspond to species for which records were found in the United States National Fungus Collections but which have not been reported for Colombia previously.

A total of 12 new records of myxomycetes for Colombia are reported as a result of the combined methodology used in the present study. Seven records are for specimens collected directly by the authors, whereas five were located in the database of the United States National Fungus Collections. All of these records of myxomycetes for Colombia are provided below.

Arcyria obvelata (Oeder) Onsberg
K.P. Dumont, BPI 833262 as *Arcyria nutans* (Bull.) Grev.; July 4, 1978; road to Medellin near Tenjo, NW of Bogotá; elevation approximately 2500 m; 4°37'N, 74°5'W; Department of Cundinamarca.

Comatricha laxa Rostaf.
K.P. Dumont, BPI 821467; January 11, 1976; road between Bogota and Villavincencio via Caqueza, SW of Bogotá; elevation approximately 2700 m; 4°30'N, 74°7'W; Department of Cundinamarca.

Comatricha pulchella (C. Bab.) Rostaf.
K.P. Dumont, BPI 822076; January 24, 1976; road to Antonio Nariño airport from Pasto, SW Colombia; elevation approximately 2400 m; 1°19'N, 77°16'W; Department of Nariño.

* *Comatricha tenerrima* (M.A. Curtis) G. Lister
N. Herrera, UARKM 36137, 36138 and 36142; March 16, 2008; University of Antioquia Campus, in a premontane moist forest; elevation 1460 m; 6°16'6'' N, 75°34'13'' W; Department of Antioquia.

* *Hemitrichia pardina* (Minakata) Ing
C. Rojas, UARKM 30453, 30463 and 30476; June 8, 2006; Santa Elena de Medellin, in a *Quercus humboldtii* dominated forest; elevation 2500 m; 6°13'7'' N, 75°30'24'' W; Department of Antioquia.

Hemitrichia spinifera M.L. Farr
K.P. Dumont, BPI 838725; August 21, 1976; road between Bucaramanga and Pamplona, NW Colombia; elevation approximately 2400 m; 7°30'N, 72°32'W; Department of Norte de Santander. This collection represents an isotype of what is apparently a rare species as well as an unreported record for the Neotropics according to Lado and Wrigley de Basanta (2008).

* *Licea minima* Fr.
C. Rojas, UARKM 30484, 30473, 30478, 30480 and 30481; June 11, 2006; San Sebastián de Palmitas, in a premontane mixed forest in early stage of succession; 2700 m; 6°23'46'' N, 75°40'18'' W; Department of Antioquia.

* *Licea pusilla* Schrad.
C. Rojas, UARKM 30479; June 11, 2006; San Sebastián de Palmitas, in a premontane mixed forest in early stage of succession; elevation 2700 m; 6°23'46'' N, 75°40'18'' W; Department of Antioquia.

Metatrichia floriformis (Schwein.) Nann.-Bremek.
K.P. Dumont, BPI 836500 as *Trichia floriformis* (Schwein.) G. Lister; January 17, 1976; road between Florencia and El Doncello, SE Colombia; elevation approximately 250 m; 1°21'N, 75°21'W; Department of Caquetá.

* *Physarum echinosporum* Lister
N. Herrera, UARKM 36157; April 9, 2008; Mompos, in a lowland tropical rainforest; elevation 18 m; 9°14'24.14'' N, 74°25'33.96'' W; Department of Bolivar.

* *Physarum notabile* T.Macbr.
C. Rojas, UARKM 30458; June 8, 2006; Santa Elena de Medellín, in a *Quercus humboldtii* dominated forest; elevation 2500 m; 6°13'7'' N, 75°30'24'' W; Department of Antioquia.

* *Stemonitis herbatica* Peck
N. Herrera, UARKM 36129 and 36130; November 20, 2007; University of Antioquia Campus, in a premontane moist forest; elevation 1460 m; 6°16'6" N, 75°34'13" W; Department of Antioquia.

Uribe-Melendez (1995) reported a species listed as *Didymium cancellatum* (Batsch) Macbr. According to Lado (2005-2012), such a nomenclatural combination has never existed. We consider it likely that the author misspelled the genus name and intended it to be *Dictydium cancellatum* (Batsch) T. Macbr., which is now considered a synonym of *Cribraria cancellata* (Batsch) Nann.-Bremek.

The additions to the myxomycete biota of Colombia presented herein are not surprising from a distributional perspective. Most of the species are known to occur widely throughout the Neotropical region (see Lado and Wrigley de Basanta 2008). However, for an underrepresented and highly understudied area of the world, the effort presented in this study represents an important contribution to the distribution and ecology of tropical myxomycetes. Such an effort is remarkable if it is considered that myxomycete research in Colombia has been practically absent during the last two decades.

Unfortunately, socio-political conflicts in forested areas of Colombia have affected human activities in this part of the world for almost 50 years already (Franco *et al.* 2006). Among these activities, biological research has suffered a major impact due its field-based approach. It is not surprising that a group such as the myxomycetes has been practically forgotten in this part of the world. For this reason, any effort to activate additional studies of the group in this country, even at the small scale presented in this investigation, would seem worthwhile.

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