

# Biodiversity of Myxomycetes from the Monte Desert of Argentina

by

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## Abstract

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A biodiversity survey for myxomycetes was carried out in the Monte Desert (Argentina) and surrounding areas in November 2006 and late February and March 2007. Specimens were collected in seven different provinces (Catamarca, Jujuy, La Rioja, Salta, San Juan, San Luis and Tucumán), between 23° and 33° S latitude, and a total of 105 localities were sampled. Cacti and succulent plants were the most common type of substrate investigated, but shrubs and herbs characteristic of this biome were also included in the survey. Almost six hundred specimens of myxomycetes from 72 different species in 22 genera were collected either in the field, or from moist chamber cultures prepared with samples of plant material obtained from the same collecting sites. The results include 1 species new to science, *Macbrideola andina* three more species recently described based on material from this survey, 5 species cited for the first time for the Neotropics, 11 new records for South America and 38 new records for Argentina. Taxonomic comments on rare or unusual species are included and illustrated with photographs by LM and SEM. Data are presented on the development of some species and microenvironmental factors are discussed. An analysis of the biodiversity of myxomycetes in this area, and a comparison with other desert areas, are included.

**Keywords:** Amoebozoa, arid environments, Neotropics, Protista, SEM, slime mould, taxonomy.

## Introduction

The myxomycetes are a group of holotrophic eukaryotic organisms of worldwide distribution that for many years have been regarded as related to fungi, but are now included, together with several groups of

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Con el objetivo de estudiar la biodiversidad de Myxomycetes en el Desierto de Monte (Argentina) y áreas circundantes, se realizó un muestreo en los meses de noviembre de 2006 y febrero y marzo de 2007. Se recolectaron especímenes en un total de 105 localidades pertenecientes a siete provincias (Catamarca, Jujuy, La Rioja, Salta, San Juan, San Luis y Tucumán), situadas entre los paralelos 23° y 33° de latitud sur. Los cactus y plantas suculentas fueron los tipos de sustratos más estudiados, pero también se analizaron arbustos y plantas herbáceas características de este bioma. Casi 600 especímenes de mixomicetes pertenecientes a 72 especies y 22 géneros fueron recolectados en el campo o se obtuvieron en el laboratorio, por cultivo en cámara húmeda, a partir de plantas procedentes de las mismas localidades. Los resultados incluyen una nueva especie, *Macbrideola andina*, otras tres recientemente descritas y basadas en material de este estudio, 5 especies que se citan por primera vez para el Neotrópico, 11 nuevos registros para América del Sur y 38 nuevos registros para Argentina. Se añaden comentarios taxonómicos e ilustraciones fotográficas, tanto con microscopía óptica como electrónica, de aquellas especies raras o poco comunes. Se discuten nuevos datos sobre el desarrollo de algunas especies y cómo influyen determinados factores microambientales. También se incluye un análisis de la biodiversidad de mixomicetes en esta zona árida y se compara con la obtenida en otros desiertos de América.

**Palabras clave:** Amoebozoa, hongos mucilaginosos plasmoidiales, MEB, Neotrópico, Protista, taxonomía, zonas áridas.

free-living amoebae, and the social amoebae (dictyoselids), in a protists-like group called the Amoebozoa (Adl & al., 2005; Baldauf, 2008). They live in almost all terrestrial ecosystems and are particularly abundant in temperate and tropical forests (Ing, 1994; Rojas & Stephenson, 2008; Kosheleva & al., 2008), but

many species are also known to be present in warm dryland ecosystems (Evenson, 1961; Blackwell & Gilbertson, 1980; Novozhilov & al., 2003; Lado & al., 2007a; Estrada-Torres & al., 2009; Ndiritu & al., 2009). Most of the literature describes studies of deserts from North America, and has indicated that a special myxobiota, adapted to arid conditions, and much more numerous and varied than previously imagined, may develop in these environments (Lado & al., 1999; Estrada-Torres & al., 2009). To see if the patterns of distribution continue into South America, and to further investigate the relationships that exist between myxomycetes and the plants that live in these drylands, an intensive study was undertaken of a selected arid area of the Monte Desert. From a biogeographical point of view, the Monte Desert, with an area of about 467,000 km<sup>2</sup>, forms part of the ecoregion of Neotropical deserts (Roig & al., 2009). The Monte Desert, a subtropical to warm temperate desert and semidesert, is located entirely in Argentina. It extends approximately from 23° to 42° South latitude along the eastern border of the Andes, from close to Bolivia curving down to the Atlantic coast at Península Valdés. There are very few published studies of myxomycetes from this region of Argentina. Spegazzini (1899) and Fries (1903) reported on the first data from this area, and Digilio (1946, 1950), and Deschamps (1972, 1976) compiled catalogues including some data from Catamarca, Jujuy, Salta and Tucumán, but few of these were from the Monte Desert. This information forms part of the catalogue of the country published by Crespo & Lugo (2003). In addition, a biodiversity inventory of myxomycetes, from the Chilean Atacama desert, that runs parallel to the northern part of the Monte Desert, on the other side (West) of the Andes, was completed by Lado & al. (2007a).

## Study area

The area studied included the northern and central parts of the Monte Desert in Northwest Argentina, and the bordering transition zones of prepuna and puna in the provinces of Jujuy, Salta, Catamarca, Tucumán, La Rioja, San Juan and San Luis (Fig. 1). The elevation gradient was from 500 m to 4500 m, from the valleys and endorheic basins to the pre-Andean and Andean mountains. The soils of the Monte Desert are very poor, sandy or rocky, with very little humus. The climate of the area is semiarid to arid, with a mean annual rainfall between 50 and 450 mm, being among the most arid areas of Argentina, and the mean annual temperature is between 10 and 18 °C. The area is in the rain shadow of the Andes, and rapid evaporation, increased even more by windy condi-

tions in the South, also contributes to the aridity of the region (Abraham & al., 2009). The vegetation of the Monte (Figs. 2-9) is composed of shrub steppes dominated by *Larrea* spp., spiny shrubs such as *Chiquiraga* spp., and including several tree species of *Prosopis* (Roig & al., 2009). In addition, several kinds of cacti of the genera *Denmoza*, *Maibueniopsis*, *Cereus*, *Echinopsis*, *Opuntia*, *Tephrocactus* and *Trichocereus* are present in the area or among the bordering vegetation types at higher altitudes, where the grasslands of the puna (species of *Festuca*, *Poa* and *Stipa*) also formed part of the present study. In the basins extensive salt flats form, due to the constant evaporation caused by intense solar radiation and the lack of precipitation, and in those areas typical halophytic vegetation is found.

## Material and methods

Sampling was carried out in 105 localities (Table 1) in two expeditions during November to December 2006 and February to March 2007 to coincide with the austral Spring and the end of the summer of the same phenological year. At each locality, the microhabitats in which myxomycetes are known or suspected to occur were examined carefully. All localities were geo-referenced with a portable GPS unit (Magellan eXplorist 600 5.1, Datum WGS84). Samples were collected in the field and substrate samples were also removed for moist chamber culture. Methods used for collecting myxomycetes in the field and substrates for laboratory culture can be found in Stephenson (1989), Rossman & al. (1998). The field work was done by the three authors and approximately one hour was spent in each collecting locality.

Moist chamber cultures were prepared using sterile disposable plastic Petri dishes (9 cm diameter), in the manner described by Wrigley de Basanta & al. (2009). The pH of each culture was determined with a portable pH meter after 24 hours, and then excess water in each dish was poured off. Cultures were maintained at room temperature (21-25 °C) in diffuse daylight and examined at regular intervals with a dissecting microscope for a period of three months. As the myxomycetes matured, the portion of the substrate upon which they occurred was removed from the moist chamber culture, allowed to dry slowly in a closed empty petri dish and then glued in a small cardboard box. All sporophores of a given species that developed in the same culture, were considered to represent a single record.

All specimens are deposited in the MA-Fungi herbarium (sub Lado) with duplicates in TLXM herbarium (sub aet), or in the private collection of Wrigley

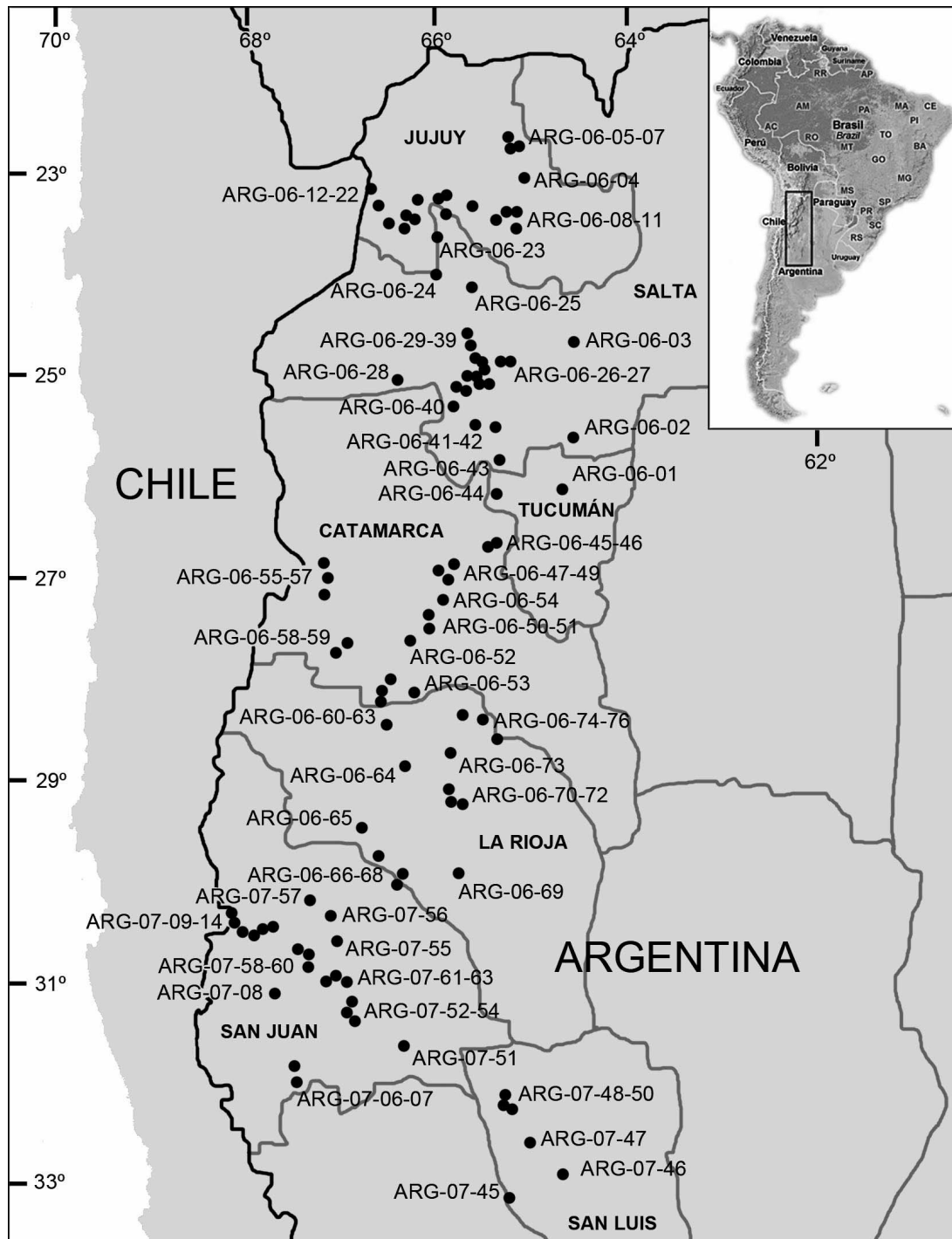


Fig. 1. Map of Argentina showing the collecting localities (numbers).

de Basanta (dwb). Differential interference contrast (DIC) microscopy was used to obtain descriptive data. The light photomicrographs were made using a Nikon AZ100 microscope and combining sequential images. Specimens were examined and photographed at 10-15 kV, with a Hitachi S-3000N scanning electron microscope (SEM), in the Real Jardín Botánico,

CSIC. For all SEM-photographs the critical point dried material technique was employed. Colour notations in parenthesis are from the ISCC-NBS Color Name Charts Illustrated with Centroid Colors (Anonymous, 1976).

Taxonomic diversity was examined using the mean number of species per genus (S/G), which has been





**Figs. 2-9.** Some characteristic plants of the Monte Desert and surrounding areas: **2**, desert scrub with *Larrea* spp. (jarillas). **3**, *Trichocereus* sp. and the rosette-leaved plant *Puya* sp. **4**, cardonal of *Trichocereus pasacana* and *Opuntia* sp. **5**, *Prosopis* sp. **6**, Xerophyllous scrubland with "retamo" (*Bulnesia retama*) at El Leoncito National Park. **7**, *Mahiueniopsis* sp. **8**, Grassland near to the saltflats in the Andes. **9**, Grassland of the puna (species of *Festuca*, *Poa* and/or *Stipa*).



**Table 1.** List of collecting localities.

	Locality	Coordinates, elevation	Vegetation	Date
ARG-06-01	Tucumán: Trancas, Vipos, on route RN-9, km 1331	26°31'23" S 65°18'18" W, 751 m ± 7 m	Spiny scrubland with <i>Acacia</i> sp. and <i>Opuntia quimilo</i>	18 Nov. 2006
ARG-06-02	Salta: Candelaria, Rosario de la Frontera, on route RN-9, km 1393	26°01'24" S 65°07'53" W, 965 m ± 9 m	Spiny scrubland with <i>Echinopsis atacamensis</i> and <i>Cereus uruguayensis</i>	18 Nov. 2006
ARG-06-03	Salta: General Güemes, Virgilio Tedín, on route RN-9, Km 1515	25°04'42" S 65°00'12" W, 818 m ± 8 m	Spiny scrubland with <i>Echinopsis atacamensis</i> , <i>Cereus uruguayensis</i> and <i>Trichocereus thelegonus</i>	18 Nov. 2006
ARG-06-04	Jujuy: Tumbaya, North of Volcán, on route RN-9, Cieneguillas	23°40'47" S 65°26'50" W, 2346 m ± 8 m	Desert scrub with <i>Echinopsis atacamensis</i> and <i>Opuntia sulphurea</i>	19 Nov. 2006
ARG-06-05	Jujuy: Humahuaca, 20 km North of Humahuaca, on route RN-9, 6 km from Hornaditas, by Sapaua stream	23°02'03" S 65°22'50" W, 3419 m ± 7 m	Pre-puna with leguminous plants, Compositae and <i>Oreocereus trollii</i>	19 Nov. 2006
ARG-06-06	Jujuy, Humahuaca, 12 km North of Humahuaca, on route RN-9	23°06'28" S 65°22'26" W, 3218 m ± 6 m	Pre-puna with <i>Echinopsis atacamensis</i> , <i>Opuntia sulphurea</i> and leguminous trees	19 Nov. 2006
ARG-06-07	Jujuy, Humahuaca, 16 km South of Humahuaca, on route RN-9, Chucalesna	23°21'33" S 65°20'42" W, 2780 m ± 11 m	Desert scrub with <i>Echinopsis atacamensis</i> , <i>Opuntia sulphurea</i> and leguminous trees	19 Nov. 2006
ARG-06-08	Jujuy, Tumbaya, Volcán, Huajra	23°52'12" S 65°27'50" W, 2112 m ± 8 m	Desert scrub with <i>Tephrocactus</i> and <i>Puya</i> sp.	20 Nov. 2006
ARG-06-08bis	Jujuy, Tumbaya, Purmamarca, La Ciénaga, on route RN-52	23°41'58" S 65°32'53" W, 2678 m ± 8 m	Desert scrub with <i>Echinopsis atacamensis</i> , and <i>Opuntia</i> sp.	20 Nov. 2006
ARG-06-09	Jujuy, Tumbaya, Purmamarca, on route RN-52, 12 Km West of Purmamarca, Paso de Lipán	23°40'08" S 65°34'33" W, 2972 m ± 6 m	Xerophyllous scrubland with <i>Puya</i> sp.	20 Nov. 2006
ARG-06-10	Jujuy, Tumbaya, Abra de Potrerillos pass, on route RN-52, El Quemado	23°41'39, 65°38'58" W, 4149 m ± 9 m	Andean puna with <i>Stipa</i> sp.	20 Nov. 2006
ARG-06-11	Jujuy, Tumbaya, Abra de Potrerillos pass, on route RN-52, East of Saladillas	23°42'22" S 65°40'20" W, 4147 m ± 7 m	Andean puna with <i>Stipa</i> sp. and cacti	20 Nov. 2006
ARG-06-12	Jujuy, Tumbaya, on route RN-52, Salinas Grandes	23°35'10" S 65°53'58" W, 3425 m ± 8 m	Andean puna with Gramineae	20 Nov. 2006
ARG-06-13	Salta, La Poma, Salinas Grandes, Cerro Negro, on route RN-52, km 43	23°25'28" S 66°10'38" W, 3513 m ± 6 m	Salt flat with leguminous tree	20 Nov. 2006
ARG-06-14	Jujuy, Susques, Angosto del Taire, on route RN-52	23°25'05" S 66°29'54" W, 4001 m ± 8 m	Andean puna with <i>Stipa atacamensis</i>	21 Nov. 2006
ARG-06-15	Jujuy, Susques, Paso de lama, customs office, on route RN-52	23°14'14" S 67°01'45" W, 4102 m ± 4 m	Andean puna with <i>Stipa</i> sp. and salt flats	21 Nov. 2006

**Table 1.** List of collecting localities. (Continuation).

	<b>Locality</b>	<b>Coordinates, elevation</b>	<b>Vegetation</b>	<b>Date</b>
ARG-06-16	Jujuy, Susques, Paso de Jama, Salar de Jama, on route RN-52	23°15'15" S 67°00'27" W, 4100 m ± 7 m	Andean puna with <i>Stipa</i> sp. and salt flats	21 Nov. 2006
ARG-06-17	Jujuy, Susques, southern end of the Salar de Jama, on route RN-52	23°24'38" S 66°57'08" W, 4117 m ± 8 m	Andean puna with <i>Stipa</i> sp. and salt flats	21 Nov. 2006
ARG-06-18	Jujuy, Susques, Archibarca, 68 Km Southwest of Susques, on route RN-52	23°37'19" S 66°51'18" W, 4043 m ± 8 m	High elevation wetland with <i>Stipa</i> sp.	21 Nov. 2006
ARG-06-19	Jujuy, Susques, Salar de Olaroz, 43.6 km Southwest of Susques, on route RN-52	23°33'29" S 66°39'36" W, 3931 m ± 5 m	High elevation wetland with <i>Stipa</i> sp.	21 Nov. 2006
ARG-06-20	Jujuy, Susques, 9 km East of Susques, on route RN-52	23°26'39" S 66°19'00" W, 3760 ± 9 m	Borders of a stream with <i>Cortaderia</i> sp. and bushes	21 Nov. 2006
ARG-06-21	Jujuy, Susques, 20 km East of Susques, on route RN-52, Quebrada Malpaso	23°25'51" S 66°16'01" W, 3723 ± 7 m	Scrubland with <i>Cumulopuntia</i> sp.	22 Nov. 2006
ARG-06-22	Salta, La Poma, Río Negro, on route RP-75 to Cobres, km 24	23°36'43" S 66°13'55" W, 3442 m ± 5 m	Andean puna with <i>Prosopis</i> sp., bushes and grasses	22 Nov. 2006
ARG-06-23	Salta, Los Andes, San Antonio de los Cobres, La Polvorilla viaduct, mine Concordia	24°12'21" S 66°24'05" W, 4160 m ± 6 m	Spiny scrubland with <i>Cumulopuntia</i> sp. and Compositae	22 Nov. 2006
ARG-06-24	Salta, La Poma, San Antonio de los Cobres, Abra Blanca, 129 km Northwest of Salta, on route RN-52	24°19'30" S 66°07'02" W, 4001 m ± 7 m	Andean puna with <i>Cumulopuntia</i> sp. and grasses	22 Nov. 2006
ARG-06-25	Salta, Rosario de Lerma, Tastil, 119 km Northwest of Salta, on route RN-51, La Encrucijada	24°21'06" S 66°04'18" W, 3559 m ± 5 m	Desert scrub with <i>Echinopsis atacamensis</i>	22 Nov. 2006
ARG-06-26	Salta, San Carlos, San Fernando de Escoipe, cemetery, on route RP-33, km 33	25°09'54" S 65°44'07" W, 1900 m ± 8 m	Spiny scrubland with <i>Puya</i> sp., leguminous plants and <i>Cereus uruguayensis</i>	23 Nov. 2006
ARG-06-27	Salta, Cachi, San Martín, Cuesta del Obispo, on route RP-33, km 50	25°10'27" S 65°49'31" W, 2744 m ± 13 m	Dry gully with bushes (Compositae, Solanaceae and <i>Sambucus</i> sp.) and grasses	23 Nov. 2006
ARG-06-28	Salta, Cachi, Los Cardones National Park, Tin Tin straight	25°12'08" S 66°58'27" W, 2911 m ± 5 m	Desert scrub with <i>Echinopsis atacamensis</i> and bushes	23 Nov. 2006
ARG-06-29	Salta, Cachi, on route RN-40 from Payogasta to La Poma, km 4513	25°02'32" S 66°05'28" W, 2490 m ± 6 m	Cultivated area with <i>Prosopis</i> sp.	24 Nov. 2006
ARG-06-30	Salta, Cachi, on route RN-40 from Payogasta to La Poma, km 4539, Pueblo Viejo, 2 km North of Rodeo	24°50'58" S 66°09'12" W, 2703 m ± 6 m	Spiny scrubland with <i>Echinopsis atacamensis</i> and cacti	24 Nov. 2006



**Table 1.** List of collecting localities. (Continuation).

	Locality	Coordinates, elevation	Vegetation	Date
ARG-06-31	Salta, Cachi, Buena Vista, Potrero river, on route RN-40, km 4519	25°00'13"S 66°06'03"W, 2504 m ± 6 m	Scrubland along a dry stream	24 Nov. 2006
ARG-06-32	Salta, Cachi, Los Cardones National Park, Tin Tin straight, 2 km up an unmarked path	25°10'13"S 66°00'11"W, 2907 m ± 6 m	Desert scrub with <i>Echinopsis atacamensis</i> and bushes	24 Nov. 2006
ARG-06-33	Salta, Cachi, Los Cardones National Park, Tin Tin straight, up a path to a copse	25°11'22"S 65°59'29"W, 2880 m ± 7 m	Desert scrub with <i>Echinopsis atacamensis</i> and leguminous plants	24 Nov. 2006
ARG-06-34	Salta, Cachi, Los Cardones National Park, on route RP-42, km 17	25°12'47"S 66°01'06"W, 2805 m ± 5 m	Desert scrub with <i>Echinopsis atacamensis</i> , <i>Cortaderia</i> sp. and Asteraceae	24 Nov. 2006
ARG-06-35	Salta, Cachi, Los Cardones National Park, on route RP-42, km 5	25°15'06"S 66°06'30"W, 2660 m ± 8 m	Desert scrub with <i>Echinopsis atacamensis</i>	24 Nov. 2006
ARG-06-36	Salta, Cachi, El Algarrobal	25°05'22"S 66°04'57"W, 2684 m ± 9 m	Desert scrub with <i>Echinopsis atacamensis</i> and a copse of <i>Prosopis alba</i> and <i>Prosopis nigra</i>	24 Nov. 2006
ARG-06-37	Salta, Molinos, on route RN-40, km 4472	25°18'49"S 66°14'50"W, 2135 m ± 6 m	Spiny scrubland with <i>Opuntia sulphurea</i>	25 Nov. 2006
ARG-06-38	Salta, Molinos, Seclantás, on route RN-40, km 4467	25°21'47"S 66°16'52"W, 2238 m ± 6 m	Spiny scrubland with <i>Puya</i> sp.	25 Nov. 2006
ARG-06-39	Salta, Molinos, Molinos river, on route RN-40, km 4458	25°25'56"S 66°17'11"W, 2059 m ± 10 m	<i>Prosopis</i> sp. woodland	25 Nov. 2006
ARG-06-40	Salta, Molinos, Angostura, on route RN-40, km 4445	25°29'29"S 66°14'10"W, 1986 m ± 7 m	Spiny scrubland with <i>Gymnocycium</i> sp., <i>Austrocyllindropuntia</i> sp. and <i>Denmoza</i> sp.	25 Nov. 2006
ARG-06-41	Salta, San Carlos, Corte la Flecha, on route RN-40, km 4406	25°42'29"S 66°07'17"W, 1951 m ± 8 m	Spiny scrubland	25 Nov. 2006
ARG-06-42	Salta, San Carlos, Los Sauces, on route RN-40, km 4380	25°47'06"S 65°58'04"W, 1861 m ± 13 m	Cultivated land with <i>Prosopis</i> sp.	25 Nov. 2006
ARG-06-43	Salta, Cafayate, on route RN-40, km 4332	26°08'40"S 65°57'30"W, 1640 m ± 9 m	Desert scrub with <i>Puya</i> sp. in a rocky area	25 Nov. 2006
ARG-06-44	Tucumán, Tafi del Valle, Quilmes, Quilmes archaeological ruins	26°28'06"S 66°01'56"W, 1849 m ± 6 m	Desert scrub with <i>Trichocereus</i> sp., <i>Echinopsis</i> sp. and leguminous plants	26 Nov. 2006
ARG-06-45	Catamarca, Santa María, Punta de Balasto, on route RN-40, km 4219	26°56'46"S 66°07'51"W, 2132 m ± 6 m	Spiny scrubland on sand with <i>Prosopis</i> sp.	26 Nov. 2006
ARG-06-46	Catamarca, Santa María, Guanaco Yacu, on route RN-40, km 4206	27°00'09"S 66°14'00"W, 2188 m ± 8 m	Spiny scrubland on sand dunes with grasses and succulent-leaved bushes	26 Nov. 2006
ARG-06-47	Catamarca, Santa María, Guanaco Yacu, on route RN-40, km 4203	26°59'56"S 66°15'13"W, 2191 m ± 7 m	Spiny scrubland on sand dunes with grasses and succulent-leaved bushes	26 Nov. 2006

**Table 1.** List of collecting localities. (Continuation).

	<b>Locality</b>	<b>Coordinates, elevation</b>	<b>Vegetation</b>	<b>Date</b>
ARG-06-48	Catamarca, Santa María, Sierra del Hombre Muerto, on route RN-40, km 4167	27°05'14"S 66°37'01"W, 2305 m ± 5 m	Scrubland with Asteraceae	26 Nov. 2006
ARG-06-49	Catamarca, Belén, Hualfin, Los Nacimientos, on route RN-40, km 4151	27°10'02"S 66°44'14"W, 2049 m ± 7 m	Source of a spring with herbaceous plants and grasses ( <i>Cortaderia</i> sp.)	26 Nov. 2006
ARG-06-50	Catamarca, Belén, on route RN-40 from Belén to Hualfin, 4 km South of Hualfin	27°36'55"S 67°01'06"W, 1305 m ± 6 m	Desert scrub with <i>Puya</i> sp., and cacti ( <i>Trichocereus</i> sp.)	27 Nov. 2006
ARG-06-51	Catamarca, Belén, 7 km North of Belén, on route RN-40, Reserva Natural Morro de los Cóndores	27°34'13"S 67°00'10"W, 1308 m ± 16 m	Desert scrub with <i>Puya</i> sp., and grasses	27 Nov. 2006
ARG-06-52	Catamarca, Belén, Londres, up a track 5 km West from route RP-3 to Tinogasta, La Aguada	27°45'09"S 67°12'26"W, 1328 m ± 6 m	Thorn forest with Leguminosae ( <i>Brea</i> sp.)	27 Nov. 2006
ARG-06-53	Catamarca, Tinogasta, Andaluca, on route RN-60, km 1277	28°18'37"S 67°17'36"W, 1035 m ± 9 m	Spiny scrubland on sand dunes with Leguminosae and opuntoid cacti	27 Nov. 2006
ARG-06-54	Catamarca, Belén, Hualfin, Los Nacimientos, on route RN-40, km 4143	27°12'36"S 66°47'20"W, 1938 m ± 7 m	Spiny scrubland with <i>Gymnocalycium</i> sp., <i>Prosopis</i> sp. and <i>Cercidium</i> sp.	26 Nov. 2006
ARG-06-55	Catamarca, Tinogasta, Fiambalá, on route RN-60, 59 km Southeast of San Francisco pass, Las Losas	27°12'28"S 68°06'25"W, 3764 m ± 7 m	Pre-puna with <i>Cumulopuntia</i> sp.	28 Nov. 2006
ARG-06-56	Catamarca, Tinogasta, Fiambalá, on route RN-60, 34 km East of San Francisco pass, Las Peladas	26°55'33"S 68°04'49"W, 4141 m ± 5 m	Andean puna	28 Nov. 2006
ARG-06-57	Catamarca, Tinogasta, Fiambalá, on route RN-60, 35 km East of San Francisco pass, Las Peladas	27°01'45"S 68°04'00"W, 3928 m ± 8 m	Andean puna with <i>Stipa</i> sp.	28 Nov. 2006
ARG-06-58	Catamarca, Tinogasta, Fiambalá, Valle de Chaschuil, on route RN-60 to San Francisco pass, 50 km West of Fiambalá	27°47'09"S 68°04'55"W, 3085 m ± 10 m	Scrub with halophytes, bushes, <i>Parodia</i> sp. and <i>Cumulopuntia</i> sp.	28 Nov. 2006
ARG-06-59	Catamarca, Tinogasta, Fiambalá, Valle de Chaschuil, on route RN-60 to San Francisco pass, Cañón de Angosturas	27°42'16"S 67°56'47"W, 2644 m ± 11 m	Rocky outcrop with <i>Opuntia</i> sp., <i>Parodia</i> sp. and <i>Cumulopuntia</i> sp.	28 Nov. 2006
ARG-06-60	Catamarca, Tinogasta, on route RN-60, km 1317, 10 km South of La Puntilla	28°06'13"S 67°30'52"W, 1184 m ± 8 m	Desert scrub with <i>Puya</i> sp.	29 Nov. 2006
ARG-06-61	Catamarca, Tinogasta, Costa de Reyes, on route RP-3	28°16'18"S 67°38'51"W, 1437 m ± 7 m	Desert scrub with rosette-leaved succulent plants ( <i>Puya</i> sp.), <i>Opuntia</i> sp. and <i>Prosopis</i> sp.	29 Nov. 2006



**Table 1.** List of collecting localities. (Continuation).

Locality	Coordinates, elevation	Vegetation	Date
ARG-06-62 Catamarca, Tinogasta, Costa de Reyes, 34 km South of Tinogasta, on route RP-3	28°23'12"S 67°39'44"W, 1647 m ± 5 m	Spiny scrubland with <i>Trichocereus</i> sp. and other cacti	29 Nov. 2006
ARG-06-63 La Rioja, Vinchina, Campanas, on route RP-11, km 51	28°36'32"S 67°38'25"W, 1777 m ± 10 m	Spiny scrubland	29 Nov. 2006
ARG-06-64 La Rioja, Vinchina, Famatina, El Potrillo, on route RN-78, km 3	28°59'00"S 67°30'51"W, 1390 m ± 7 m	Desert scrub with <i>Puya</i> sp., <i>Gymnocalycium</i> sp. and cultivated area with leguminous plants and lianas	29 Nov. 2006
ARG-06-65 La Rioja, General F. Varela, Villa Unión, Pagancillo, on route RP-26, km 174	29°34'00"S 68°05'17"W, 1162 m ± 8 m	Cultivated area with <i>Prosopis alba</i> and <i>Brea</i> sp.	30 Nov. 2006
ARG-06-66 La Rioja, General F. Varela, Villa Unión, Talampaya National Park, on route RP-26, km 143	29°49'03"S 67°59'06"W, 1229 m ± 9 m	Sand dunes	30 Nov. 2006
ARG-06-67 La Rioja, Independencia, Talampaya National Park, on route RP-26, km 99	30°07'42"S 67°44'19"W, 1378 m ± 8 m	Desert scrub with <i>Puya</i> sp., <i>Tunilla</i> sp. and <i>Trichocereus</i> sp.	30 Nov. 2006
ARG-06-68 San Juan, Valle Fértil, Ischigualasto Provincial Park, on route RP-510 to the Park, km 104	30°10'44"S 67°48'56"W, 1374 m ± 12 m	Desert scrub with <i>Puya</i> sp., <i>Opuntia</i> sp. and <i>Trichocereus</i> sp.	30 Nov. 2006
ARG-06-69 San Juan, Valle Fértil, El Agua de Arriba, on route RP-510, km 21	30°07'54"S 67°03'27"W, 599 m ± 7 m	Desert scrubland	30 Nov. 2006
5ARG-06-70 La Rioja, Capital, La Rioja, Los Padercitos, on route RN-75, km 6	29°24'20"S 66°56'35"W, 681 m ± 9 m	Spiny scrubland with <i>Stetsonia coryne</i>	1 Dec. 2006
ARG-06-71 La Rioja, Sanagasta, Dique Los Sauces, on route RN-75, km 15	29°22'41"S 66°58'58"W, 858 m ± 8 m	Desert scrub with rosette-leaved succulent plants of <i>Puya</i> sp.	1 Dec. 2006
ARG-06-72 La Rioja, Sanagasta, 3 km West of Sanagasta, on route RN-75	29°20'27"S 67°00'25"W, 914 m ± 10 m	Desert scrub with <i>Prosopis</i> sp. and <i>Puya</i> sp.	1 Dec. 2006
ARG-06-73 La Rioja, Castro Barros, Pinchas, on route RN-75	28°55'46"S 66°57'32"W, 1370 m ± 9 m	Disturbed zone with lianas	1 Dec. 2006
ARG-06-74 La Rioja, Arauco, Aimogasta, 2 km South of Aimogasta, on route RN-75	28°34'37"S 66°49'10"W, 906 m ± 5 m	Disturbed zone with palm trees	1 Dec. 2006
ARG-06-75 La Rioja, Arauco, Aimogasta, Villa Mazán, on route RN-60	28°39'02"S 66°33'05"W, 950 m ± 10 m	Desert scrubland with <i>Opuntia</i> sp. and <i>Trichocereus</i> sp.	1 Dec. 2006
ARG-06-76 Catamarca, Capayán, 7 km West of Chumbicha, on route RN-60	28°51'42"S 66°23'58"W, 582 m ± 8 m	Dry forest with <i>Opuntia quimilo</i>	1 Dec. 2006

**Table 1.** List of collecting localities. (Continuation).

	<b>Locality</b>	<b>Coordinates, elevation</b>	<b>Vegetation</b>	<b>Date</b>
ARG-07-06	San Juan, Calingasta, Barreal, El Leoncito National Park, 50 km South of Barreal, on route RP-412	31°53'20"S 69°25'08"W, 1892 ± 7 m	Xerophyllous scrubland	24 Feb. 2007
ARG-07-07	San Juan, Calingasta, Barreal, El Leoncito National Park, 25 km South of Barreal, on route RP-412	31°51'23"S 69°26'03"W, 1867 ± 9 m	Xerophyllous scrubland	24 Feb. 2007
ARG-07-08	San Juan, Calingasta, Villa Nueva, on route RP-412 towards Tocola and Iglesia	31°02'49"S 69°27'50"W, 1668 ± 5 m	Xerophyllous scrubland	24 Feb. 2007
ARG-07-09	San Juan, Iglesia, Rodeo, on route RN-150, km 380, Paso del Agua Negra, Quebrada Sarmiento	30°13'36"S 69°48'26"W, 4615 ± 9 m	Andean puna	26 Feb. 2007
ARG-07-10	San Juan, Iglesia, Rodeo, on route RN-150, km 370, Los Corrales	30°13'30"S 69°47'33"W, 4305 ± 10 m	Andean puna	26 Feb. 2007
ARG-07-11	San Juan, Iglesia, Rodeo, on route RN-150, km 366	30°16'04"S 69°47'43"W, 4100 ± 10 m	Andean puna	26 Feb. 2007
ARG-07-12	San Juan, Iglesia, Rodeo, on route RN-150, km 350.5, Ojo de Agua, 17 km West of Arrequeñtín	30°21'24"S 69°42'04"W, 3710 ± 10 m	Xerophyllous scrubland	26 Feb. 2007
ARG-07-13	San Juan, Iglesia, Rodeo, on route RN-150, km 326	30°23'12"S 69°31'11"W, 2730 ± 8 m	Xerophyllous scrubland	26 Feb. 2007
ARG-07-14	San Juan, Iglesia, Rodeo, on route RN-150, km 313	30°22'05"S 69°23'38"W, 2387 ± 5 m	Xerophyllous scrubland	26 Feb. 2007
ARG-07-45	San Luis, La Capital, on route RN-7, km 858, Alto Pencoso	33°25'07"S 67°04'38"W, 512 ± 6 m	Spiny scrubland with <i>Prosopis</i> sp.	6 Mar. 2007
ARG-07-46	San Luis, La Capital, San Luis, on route RN-147, km 818, San Jerónimo	33°14'14"S 66°23'45"W, 663 ± 6 m	Spiny scrubland	7 Mar. 2007
ARG-07-47	San Luis, Belgrano, San Antonio, on route RN-147, km 868	33°14'14"S 66°23'45"W, 663 ± 6 m	Spiny scrubland with <i>Larrea</i> spp. and <i>Prosopis flexuosa</i>	7 Mar. 2007
ARG-07-48	San Luis, Belgrano, Hualtarán, Sierra de las Quijadas National Park, viewpoint	32°29'47"S 67°00'22"W, 805 ± 9 m	Spiny scrubland with <i>Echinopsis</i> sp.	7 Mar. 2007
ARG-07-49	San Luis, Belgrano, Hualtarán, Sierra de las Quijadas National Park, 2 km East of the viewpoint	32°29'49"S 66°59'44"W, 780 ± 10 m	Spiny scrubland with <i>Echinopsis</i> sp.	7 Mar. 2007
ARG-07-50	San Luis, Belgrano, Hualtarán, Sierra de las Quijadas National Park, 3 km East of the viewpoint	32°29'35"S 66°59'23"W, 777 ± 7 m	Spiny scrubland with <i>Echinopsis</i> sp.	7 Mar. 2007



**Table 1.** List of collecting localities. (Continuation).

	Locality	Coordinates, elevation	Vegetation	Date
ARG-07-51	San Juan, Caucete, Vallecito, Difunta Correa, Valle Fértil Natural Park, Sierra Pie de Palo, on route RN-141, km 185	31°45'02" S 68°01'56" W, 748 ± 5 m	Spiny scrubland with <i>Tephrocactus</i> sp.	7 Mar. 2007
ARG-07-52	San Juan, Albardón, on route RN-40, km 3483	31°23'07" S 68°35'41" W, 830 ± 10 m	Spiny scrubland with <i>Tephrocactus</i> sp., <i>Opuntia</i> sp. and <i>Puya</i> sp.	8 Mar. 2007
ARG-07-53	San Juan, Ullum, Matagusanos, on route RN-40, km 3491	31°19'14" S 68°36'23" W, 1040 ± 10 m	Spiny scrubland with <i>Echinopsis</i> sp., <i>Opuntia</i> sp. and <i>Tephrocactus</i> sp.	8 Mar. 2007
ARG-07-54	San Juan, Jáchal, Niquivil, on route RN-40, km 3525, 20 km North of Talacasto	31°02'36" S 68°38'09" W, 990 ± 8 m	Spiny scrubland	8 Mar. 2007
ARG-07-55	San Juan, Jáchal, Niquivil, on route RN-40, km 3572, Tucunuco	30°37'23" S 68°38'21" W, 909 ± 9 m	Spiny scrubland	8 Mar. 2007
ARG-07-56	San Juan, Jáchal, San Roque, on route RN-40, km 3619	30°21'03" S 68°38'07" W, 1054 ± 5 m	Desert scrub with rosette-leaved succulent plants of <i>Puya</i> sp.	8 Mar. 2007
ARG-07-57	San Juan, Jáchal, San José de Jáchal, Dique Pachimoco, on route RN-150, km 243	30°11'52" S 68°49'23" W, 1240 ± 7 m	Spiny scrubland	8 Mar. 2007
ARG-07-58	San Juan, Ullum, on route RP-436, 79 km Northwest of the crossroads with route RN-40 and 3 km from the turn to Tocota	30°38'47" S 69°03'56" W, 2445 ± 8 m	Spiny scrubland	9 Mar. 2007
ARG-07-59	San Juan, Ullum, on route RP-436, 72 km Northwest of the crossroads with route RN-40 and 1 km from the turn to La Invernada	30°41'41" S 69°01'19" W, 2105 ± 10 m	Spiny scrubland with <i>Tephrocactus</i> sp.	9 Mar. 2007
ARG-07-60	San Juan, Ullum, on route RP-436, 66 km Northwest of the crossroads with route RN-40, Minas de Guallán	30°42'41" S 68°58'22" W, 1900 ± 6 m	Spiny scrubland with <i>Tunilla corrugata</i>	9 Mar. 2007
ARG-07-61	San Juan, Ullum, La Ciénaga, on route RP-436, 50 km Northwest of the crossroads with route RN-40	30°50'58" S 68°57'01" W, 1660 ± 10 m	Spiny scrubland with <i>Eriosyce</i> sp.	9 Mar. 2007
ARG-07-62	San Juan, Ullum, Quebrada de Las Burras, on route RP-436, 18 km Northwest of the crossroads with route RN-40	31°00'46" S 68°45'58" W, 1370 ± 10 m	Desert scrub with rosette-leaved succulent plants of <i>Puya</i> sp.	9 Mar. 2007
ARG-07-63	San Juan, Ullum, Termas de Talacasto, on route RP-436, 16.2 km Northwest of from the crossroads with route RN-40	31°01'41" S 68°45'44" W, 1333 ± 6 m	Desert scrub with rosette-leaved succulent plants of <i>Puya</i> sp.	9 Mar. 2007

used in other studies of myxomycetes (Stephenson & al., 1993). To examine community similarity, the Sørensen coefficient of community (CC) index was used, which considers the presence or absence of species in the study areas compared using the formula  $CC = 2z / (x + y)$ , where  $z$  = the number of species in common to both communities, and where  $x$  and  $y$  equal the number of species in communities A and B, respectively. The completeness of the sampling effort was evaluated using the ACE and CHAO1 abundance indices (Colwell & Coddington, 1994; Colwell & al., 2004). Each collecting site was used as the unit of collecting effort, using the total number of species found with the programme EstimateS v 7.5.2 (<http://viceroy.eeb.uconn.edu/estimates>).

## Results

This survey produced a total of 594 collections of myxomycetes, including 372 that had developed under natural conditions in the field, as well as 222 collections obtained from 127 moist chamber cultures. The collections represent 72 different species from 22 genera of myxomycetes. The following list of species includes one species new to science, three species recently described based on material from this survey, 5 more are new records for the Neotropics and a further 11 species previously unknown from South America. The survey has added a total of 38 species to the catalogue of Argentina.

### Annotated list of species

In the list that follows, all the myxomycetes observed are arranged alphabetically by genus and species. Information is provided on the source of each record, first the locality from which the specimen itself or the sample of dead plant material used to prepare the moist chamber culture was collected (Table 1), followed by the substrate upon which it was collected or cultured, and the collection number. A collection obtained from a moist chamber culture is indicated by [mc] followed by the pH of the culture in which the specimen appeared. Additional comments are included for records of particular interest. Nomenclature follows Lado (2005-2010). The abbreviation 'cf.' in the name of a taxon indicates that the specimen representing the source of the record could not be identified with certainty. Unless otherwise indicated, the data on Neotropical distribution of myxomycete species is from Lado & Wrigley de Basanta (2008).

#### *Arcyria afroalpina* Rammeloo. (Figs. 10-21).

ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80230, 80231; on dead leaf base of *Puya* sp. (mc, pH 7), dwb 2831; (mc pH 7.1), dwb

2854. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80232; on dead leaf bases of *Puya* sp. (mc, pH 6.8), dwb 2979. ARG-06-60: On dead leaf bases of *Puya* sp. (mc, pH 6.9), dwb 2853. ARG-06-61: On dead leaf bases of *Puya* sp. (mc, pH 7.4), dwb 2973. ARG-06-67: On dead leaf bases of *Puya* sp. (mc, pH 7.2), dwb 2844; (mc, pH 6.8), dwb 2866; (mc, pH 6.9), dwb 3152. ARG-06-68: On dead leaf bases of *Puya* sp. (mc, pH 7.1), dwb 2849. ARG-07-62: On dead leaf bases of *Puya* sp. (mc, pH 6.7), dwb 2924.

These collections have globose to subglobose sporocarps, 225-500 µm in diameter and 875-1050 µm in total height (Figs. 10-11). The stipe is long and thin (45-67-70 µm wide) and filled with spore-like cysts 8-(12.1)-15.5 µm diameter, the peridium is partially evanescent, and the remaining flattened calyculus is slightly narrower than the diameter of the sporotheca and finely warted on the inner surface by LM and SEM (Figs. 12-13). The capillitium is tubular, slightly elastic, firmly attached to the calyculus (Fig. 11), the tubules are 2.5-(3.5)-4.5 µm in diameter, lightly ornamented with warts by LM, the warts fused to form small crests by SEM (Figs. 14, 15, 17, 18). The spores are yellowish by LM, 7.3-(8.3)-9.2 µm diameter, finely warted with groups of more prominent warts readily visible by SEM (Figs. 16, 19-21). In general the specimens agree with the original description of *A. afroalpina* by Rammeloo (1981a, 1981b) except for the size of the spores, which are 9-11 µm diameter for that species. Rammeloo however comments on the presence of collections (Rammeloo 4061 and Z109) with smaller spores, which he called *A. aff. afroalpina* but he describes the colour as grey, not yellowish like *A. afroalpina* and our specimens.

In South America only previously reported from Ecuador. New for Argentina.

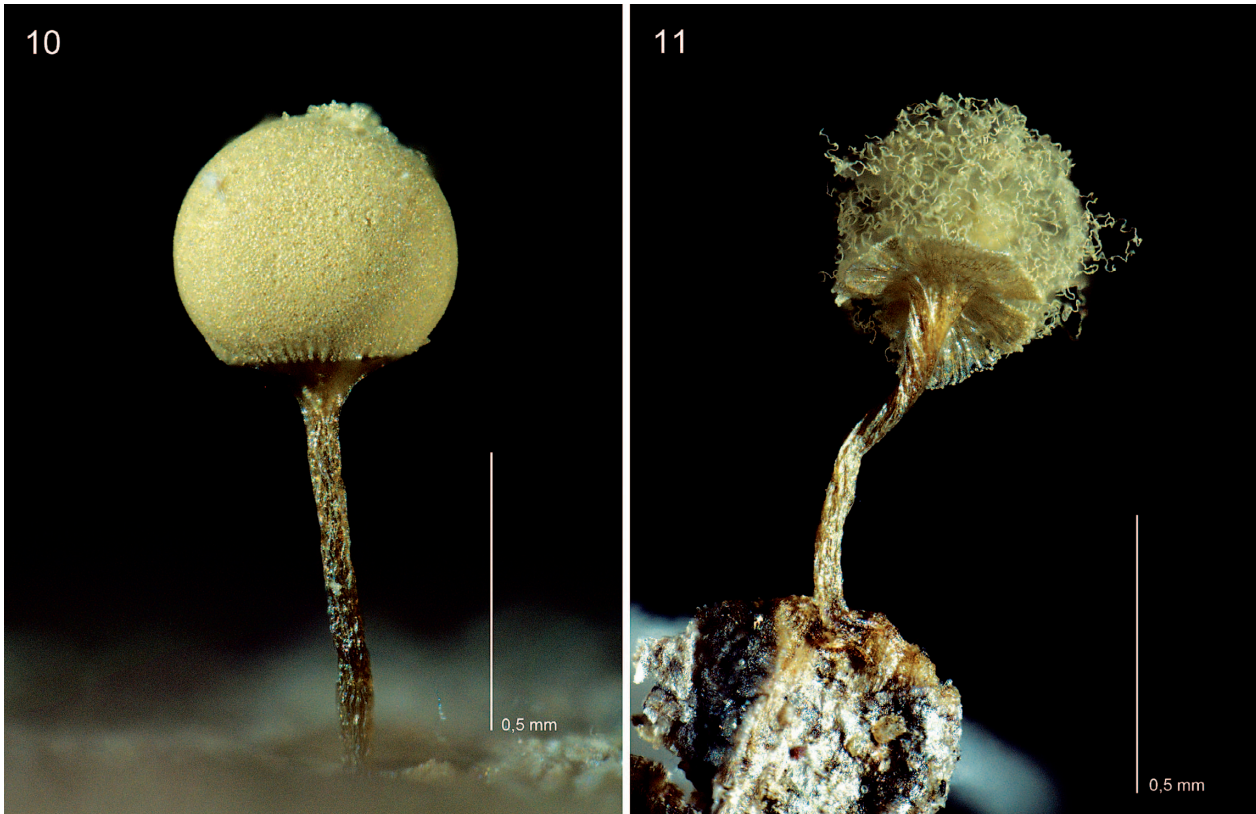
#### *Arcyria cinerea* (Bull.) Pers.

ARG-06-22: On twigs, MA-Fungi 80406. ARG-06-38: On dead leaf bases of *Puya* sp. (mc, pH 7), dwb 2859. ARG-06-43: On dead leaf bases of *Puya* sp. (mc), dwb 2806. ARG-06-51: On dead leaf bases of *Puya* sp. (mc, pH 6.9), dwb 2868. ARG-06-61: On *Puya* sp. leaves, MA-Fungi 80233, 80234, 80235. ARG-06-64: On bark of dead liana (mc, pH 7), dwb 2990; (mc, pH 7.1), dwb 3003. ARG-06-73: On dead liana, (mc, pH 7), dwb 2977. ARG-06-76: On *Opuntia quimilo* bark, (mc, pH 7.4), dwb 2995. ARG-07-48: On dead leaf bases of *Puya* sp. (mc, pH 6.6), dwb 2907.

#### *Arcyria denudata* (L.) Wettst. (Figs. 22-27).

ARG-06-46: On dead leaves of *Cortaderia* sp., MA-Fungi 80236, 80237, 80238, 80239, 80240, 80241. ARG-06-47: On dead leaves of *Cortaderia* sp., MA-Fungi 80404, 80405.

The material has small sub-cylindrical sporocarps with the capillitium firmly attached to the calyculus (Fig. 22). The calyculus is plicate with a warted-reticulate ornamentation; the capillitium ornamented with rings, half rings and a reticulum (Figs. 23-25); spores



**Figs. 10-11.** Sporocarps of *Arcyria afroalpina* [dwb 2853]: **10**, before spore dispersal. **11**, after spore dispersal. The capillitial threads firmly attached to the calyculus and barely expanding.

globose, 7-8  $\mu\text{m}$  diameter, warted with groups of larger warts (Figs. 26, 27).

***Arcyria insignis* Kalchbr. & Cooke**

ARG-06-22: On twigs, MA-Fungi 80242.

The collection confirms the presence of this species in Argentina (Wrigley de Basanta & al., 2010b).

***Arcyria minuta* Buchet**

ARG-06-52: On wood, MA-Fungi 80243.

***Badhamia affinis* Rostaf.**

ARG-06-42: On bark of living *Prosopis* sp., MA-Fungi 80149, 80244. ARG-07-45: On *Prosopis flexuosa* bark (mc, pH 5.8), dwb 2901.

The field collections were plasmodiocarpic mixed with a few short-stalked sporocarps. The collections all had a delicate capillitium in the form of columns arising from the base of the sporotheca, and spores with a pale band as mentioned by Martin & Alexopoulos (1969).

***Badhamia foliicola* Lister**

ARG-06-40: On decayed *Denmoza rhodocantha*, MA-Fungi 80245.

***Badhamia macrocarpa* (Ces.) Rostaf.**

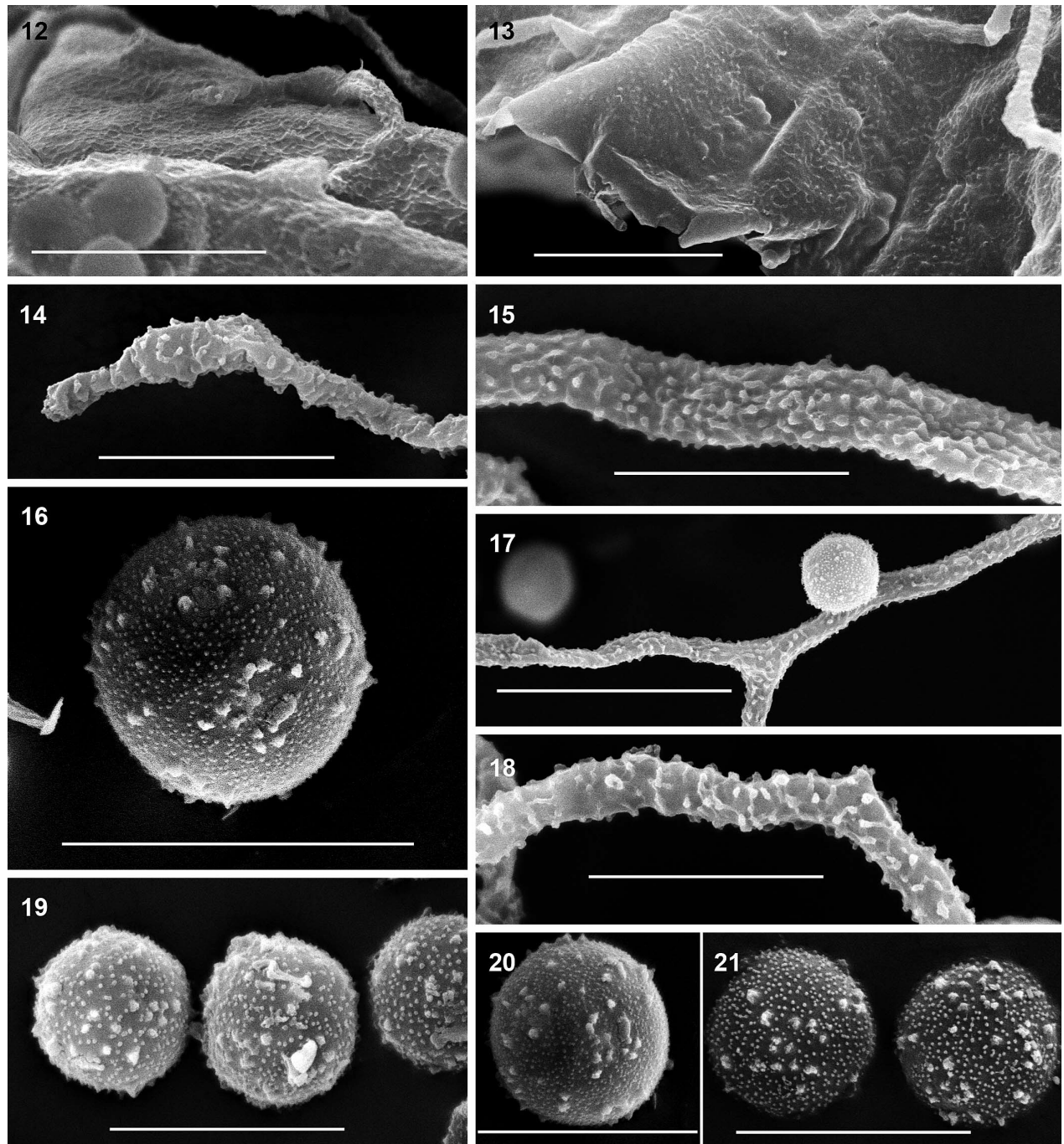
ARG-06-04: On *Opuntia sulphurea* cladodes, MA-Fungi 80246. ARG-06-08bis: On *Opuntia* sp. cladodes, MA-Fungi 80247. ARG-06-27: On twigs, MA-Fungi 80248. ARG-06-52: On wood, MA-Fungi 80249. ARG-06-62: On *Opuntia sulphurea*, MA-Fungi 80250. ARG-06-63: On wood, MA-Fungi 80251. ARG-06-64: On dried legume fruit, MA-Fungi 80252.

Two collections (MA-Fungi 80247, 80248) had physaroid capillitium, but they keyed out to *B. macrocarpa*. A physaroid capillitium is also mentioned by Martin & Alexopoulos (1969).

***Badhamia melanospora* Speg.**

ARG-06-01: On *Opuntia quimilo* cladodes, MA-Fungi 80071, 80072, 80073, 80074, 80075, 80076, 80077, 80078, 80079, 80080. ARG-06-03: On *Opuntia* sp. cladodes, MA-Fungi 80081, 80082. ARG-06-04: On decayed *Echinopsis atacamensis*, MA-Fungi 80083; on decayed *Gymnocalycium* sp., MA-Fungi 80084, 80085; on decayed *Puya* sp. leaves, MA-Fungi 80089; on decayed *Pyrrhocactus* sp., MA-Fungi 80086, 80087; on *Opuntia sulphurea* cladodes, MA-Fungi 80088; on cactus litter on agar, dwb 2815. ARG-06-05: On decayed *Orocereus trolli*, MA-Fungi 80090; (mc, pH 7.4), dwb 2813. ARG-06-06: On *Opuntia* sp. cladodes, MA-Fungi 80091, 80092, 80093, 80094, 80095, 80096, 80097, 80099, 80100. ARG-06-07: On decayed *Echinopsis atacamensis*, MA-Fungi 80101, 80102, 80103, 80104, 80105, 80106, 80107, 80108, 80109, 80110; on decayed legume tree wood, MA-Fungi 80113; on deca-



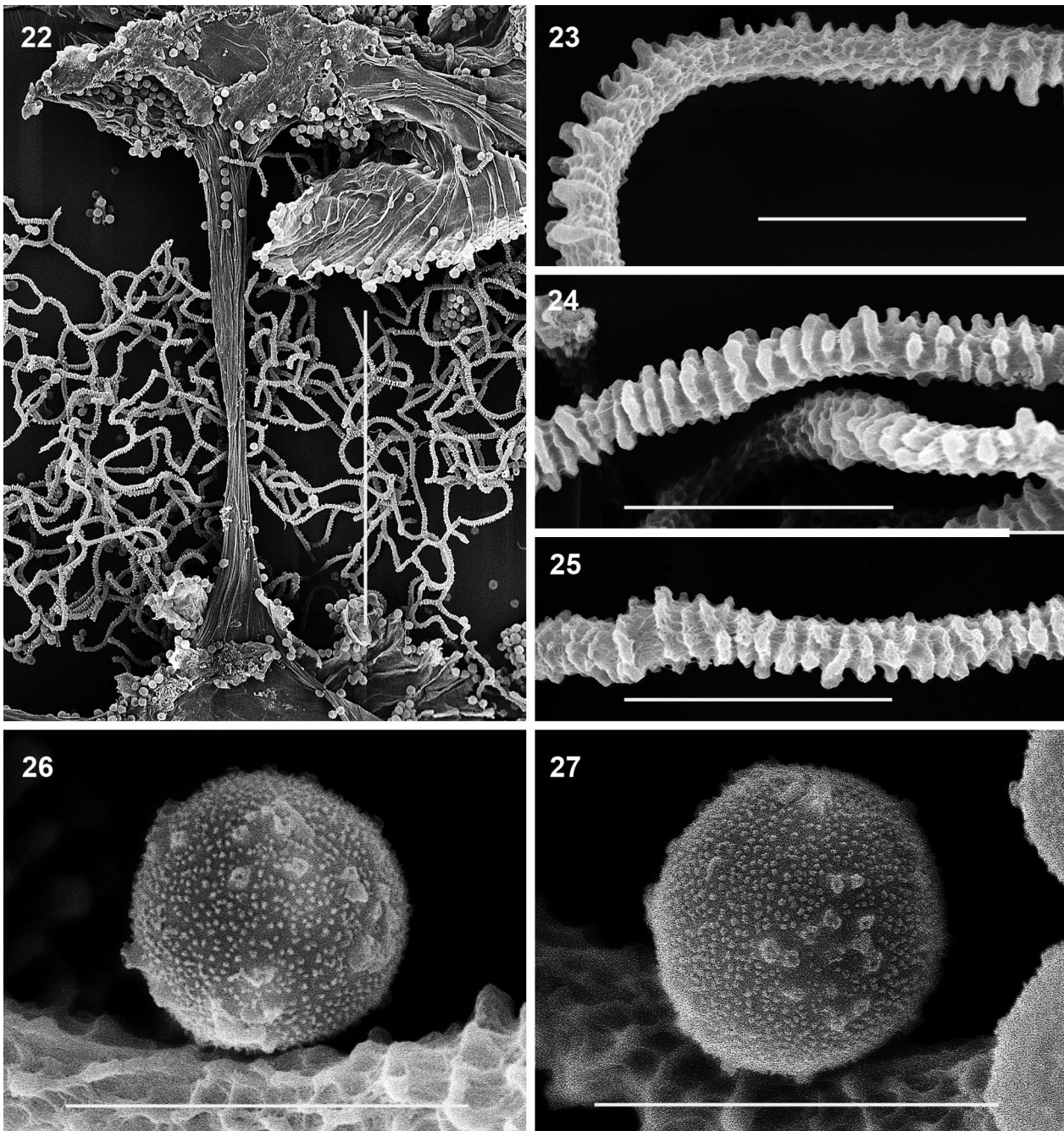


**Figs. 12-21.** *Arcyria afroalpina* by SEM: **12, 13**, detail of the lightly ornamented inner surface of the calyculus. **14, 15, 17, 18**, Capillitial threads. **16, 19-21**, Spores. [12, 13, 15, 17, 18, 20, 21: dwb 2866. 14, 16, 19: MA-Fungi 80232]. Bar: 12, 13, 17 = 20  $\mu$ m; 14-16, 18-21 = 10  $\mu$ m.

yed *Pyrrhocactus* sp., MA-Fungi 80114, 80115, 80116, 80117; on decayed *Thillandsia* sp. leaves, MA-Fungi 80111, 80112. ARG-06-08: On decayed *Tephrocactus* sp., MA-Fungi 80118; on dead leaf bases of *Puya* sp. (mc, pH 7.3), dwb 2949. ARG-06-08bis: On decayed *Echinopsis atacamensis*, MA-Fungi 80119, 80121; on *Opuntia* sp. cladodes, MA-Fungi 80120. ARG-06-21: On *Cumulopuntia boliviana* bark (mc, pH 7.5), dwb 2810; (mc, pH 8.1), dwb 2827; (mc, pH 8.1), dwb 2812. ARG-06-24: On decayed *Acanthocalycium* sp., MA-Fungi 80122. ARG-06-25: On decayed *Echinopsis atacamensis*,

MA-Fungi 80123, 80124, 80125. ARG-06-26: On decayed *Cereus uruguayensis*, MA-Fungi 80129; on decayed *Austrocylindropuntia* sp., MA-Fungi 80130; on *Opuntia sulphurea* cladodes, MA-Fungi 80126, 80127, 80128. ARG-06-28: On decayed *Echinopsis atacamensis*, MA-Fungi 80131, 80132. ARG-06-30: On decayed *Echinopsis atacamensis*, MA-Fungi 80133; on *Opuntia sulphurea* cladodes, MA-Fungi 80134; on *Denmoza rhodocantha* epidermis (mc, pH 7.6), dwb 3052; (mc, pH 7.8), dwb 3081, dwb 3082. ARG-06-32: On decayed *Echinopsis atacamensis*, MA-Fungi 80136; on





**Figs. 22-27.** *Arcyria denudata* by SEM [MA-Fungi 80405]: **22**, stalk and remains of the calyculus and capillitial threads. **23-25**, capillitial threads. **26, 27**, spores. Bar: 22 = 300  $\mu$ m; 23-25 = 20  $\mu$ m; 26, 27 = 10  $\mu$ m.

*Opuntia sulphurea* cladodes, MA-Fungi 80135. ARG-06-34: On decayed *Echinopsis atacamensis*, MA-Fungi 80137, 80138. ARG-06-35: On decayed *Echinopsis atacamensis*, MA-Fungi 80139; on twigs, MA-Fungi 80140. ARG-06-37: On decayed *Echinopsis atacamensis*, MA-Fungi 80141; on *Opuntia sulphurea* cladodes, MA-Fungi 80142. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80143, 80144. ARG-06-40: On decayed *Austrocylindropuntia* sp., MA-Fungi 80145, 80148; on decayed *Denmoza rhodocantha*, MA-Fungi 80146, 80147. ARG-06-42: On *Prosopis* sp. bark, (mc, pH 5.1), dwb 3074, dwb 3073. ARG-06-43: On *Opuntia sulphurea* cladodes, MA-Fungi 80150. ARG-06-44: On decayed *Trichocereus thelego-*

*mus*, MA-Fungi 80151; on *Opuntia sulphurea* cladodes, MA-Fungi 80152. ARG-06-45: On decayed *Trichocereus* sp., MA-Fungi 80153; on *Opuntia sulphurea* cladodes, MA-Fungi 80154. ARG-06-46: On *Opuntia* sp. cladodes, MA-Fungi 80155. ARG-06-50: On decayed *Trichocereus* sp., MA-Fungi 80157, 80158, MA-Fungi 80159. ARG-06-52: On *Opuntia* sp. cladodes, MA-Fungi 80160. ARG-06-54: On decayed *Gymnocalycium* sp., MA-Fungi 80156. ARG-06-58: On decayed *Parodia* sp., MA-Fungi 80161. ARG-06-59: On decayed *Parodia* sp., MA-Fungi 80162. ARG-06-62: On decayed *Trichocereus* sp., MA-Fungi 80163, 80166, 80167; on *Opuntia sulphurea* cladodes, MA-Fungi 80164, 80165; on *Trichocereus*

sp. cortex, (mc, pH 7.4), dwb 2984. ARG-06-63: On decayed *Tribochocereus* sp., MA-Fungi 80169, 80170; on *Opuntia sulphurea* cladodes, MA-Fungi 80168. ARG-06-64: On decayed *Gymnocalycium* sp., MA-Fungi 80171. ARG-06-68: On *Opuntia sulphurea* cladodes, MA-Fungi 80172. ARG-06-75: On *Tephrocactus* sp. remains, MA-Fungi 80173. ARG-06-76: On *Opuntia quimilo* cladodes, MA-Fungi 80174, 80175; on *Opuntia quimilo* bark, (mc, pH 7.8), dwb 2998. ARG-07-08: On decayed *Tephrocactus aoracanthus*, MA-Fungi 80176, 80177; on decayed *Tephrocactus aoracanthus*, (mc, pH 7.7), aet 11925; (mc, pH 8.3), aet 11923; (mc, pH 8.5), aet 11921, aet 11924; (mc, pH 7.4), dwb 2899; (mc, pH 7.3), dwb 2926; (mc, pH 7.2), dwb 2934. ARG-07-11: On twigs, (mc, pH 7.8), aet 11937; on succulent stem of Compositae, (mc, pH 8.0), aet 11942; (mc, pH 8.2), aet 11947. ARG-07-12: On decayed cladodes of *Cumolopuntia boliviana*, (mc, pH 8.1), aet 11931; on twigs (mc, pH 5.7), aet 11950. ARG-07-13: On decayed *Denmoza rhodacantha*, MA-Fungi 80178; on *Opuntia* sp. internal tissue (mc, pH 9.2), aet 11949, aet 11920, aet 11930; (mc, pH 9.0), aet 11919, aet 11926. ARG-07-47: On decayed *Echinopsis candicans*, MA-Fungi 80181; on *Opuntia sulphurea* cladodes, MA-Fungi 80179, 80180, 80182; (mc, pH 8.4), aet 12012, aet 12013. ARG-07-48: On decayed *Echinopsis candicans*, MA-Fungi 80183. ARG-07-50: On decayed *Echinopsis candicans*, MA-Fungi 80184; on decayed *Tephrocactus articulatus*, (mc, pH 8.2), aet 12025. ARG-07-51: On decayed *Tephrocactus articulatus*, (mc, pH 8.2), aet 12024, aet 12033. ARG-07-52: On decayed *Echinopsis strigosa* (mc, pH 9.0), aet 12029; on decayed *Tephrocactus* sp., MA-Fungi 80185, 80186, 80187. ARG-07-53: On decayed *Echinopsis* sp., MA-Fungi 80188. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80189. ARG-07-59: On decayed *Erioseyce* sp., MA-Fungi 80192, 80193; on decayed *Tephrocactus articulatus*, MA-Fungi 80190; on *Opuntia sulphurea* cladodes, MA-Fungi 80191. ARG-07-60: On decayed *Tunilla corrugata*, MA-Fungi 80194. ARG-07-61: On decayed *Erioseyce* sp., MA-Fungi 80195.

### **Calomyxa metallica** (Berk.) Nieuwl.

ARG-06-71: On *Puya* sp. leaves, MA-Fungi 80253.

### **Comatricha laxa** Rostaf.

ARG-06-39: On *Prosopis* sp. bark (mc, pH 5.5), dwb 2819.

### **Comatricha pulchelloides** Nann.-Bremek.

ARG-06-38: On dead leaf base of *Puya* sp. (mc, pH 7), dwb 2867.

The sporocarps in this large (>40 sporocarps) moist chamber collection are typical of this species, except for the shorter stalks measuring 1/5 to 1/3 of the total height rather than 1/3 to 1/2 as in the description by Nannenga-Bremekamp (1985), and the spores are 9-11  $\mu\text{m}$  diameter, rather than 8-9  $\mu\text{m}$ . A similar species, *C. longipila* Nann.-Bremek. has shorter stalks, but smaller spores (6-7  $\mu\text{m}$  diameter) and swollen tips of some free ends of the capillitium, a character not present in our specimens. This is the first time this species has been recorded in the Neotropics.

### **Comatricha tenerrima** Nann.-Bremek.

ARG-06-64: On bark of dead liana (mc, pH 7.1), dwb 2986; (mc, pH 7), dwb 2988.

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

ARG-06-20: On *Cortaderia* sp., MA-Fungi 80254, 80255, 80256. ARG-06-24: On grasses, MA-Fungi 80257. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80258, 80259, 80260, 80261. ARG-06-51: On *Puya* sp. leaves, MA-Fungi 80262, 80263, 80264. ARG-06-52: On wood, MA-Fungi 80265. ARG-06-61: On *Puya* sp. leaves, MA-Fungi 80266, 80267, 80268, 80269. ARG-06-67: On *Puya* sp. leaves, MA-Fungi 80270. ARG-06-68: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2841. ARG-06-71: On dead leaf base of *Puya* sp. (mc, pH 6.8), dwb 2975. ARG-07-63: On dead leaf base of *Puya* sp. (mc, pH 6.4), dwb 2895.

Some of the specimens (MA-Fungi 80254, 80255, 80256, 80257, dwb 2841, dwb 2975, dwb 2895) were the variety *scyphoides* (Cooke & Balf. f.) G. Lister, differentiated by the more globose sporotheca and slightly larger spores.

### **Cribraria lepida** Meyl. (Figs. 28-31).

ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80271; on dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2886; (fc) dwb 2896. ARG-06-61: On dead leaf base of *Puya* sp. (mc, pH 7.4), dwb 3015. ARG-07-63: On *Puya* sp. leaves, MA-Fungi 80272.

This purple *Cribraria*, is similar in colour to *C. violacea* but with longer stalks, up to 8 times the diameter of the sporotheca. The specimens have a shallow calyculus occupying approximately one third of the diameter of the sporotheca (Fig. 28), finely dotted with calcic granules (Fig. 28), the upper margin scalloped giving rise at the points to a fine net with few thickened pulvinate nodes. The spores are pale violet, 6-7.5  $\mu\text{m}$  diameter and have a smooth but pitted appearance in transmitted light with Nomarski optics, but are in fact densely and minutely warted by SEM (Figs. 29-31). The plasmodium was described as probably white by Meylan (1927) but he may have seen later stages of the morphogenesis. Pale purple protoplasmodia were observed during the development of these specimens in moist chamber culture, giving rise to a pale stalk with the white ball of the forming sporotheca on top, dotted with purple as the nodes form, also mentioned by Meylan, then all turning completely purple and exuding water droplets with the maturation of the spores. These suppose new records of the species for South America. It has been cited from dry areas of Mexico (Estrada-Torres & al., 2009).

### **Cribraria violacea** Rex

ARG-06-27: On twigs, MA-Fungi 80273.

### **Dianema corticatum** Lister

ARG-06-27: On twigs, MA-Fungi 80274.

In this collection the specimens were predominate-



ly sporocarpic to short plasmodiocarps, and the sparse capillitium has branched slender threads, often twisted spirally at the ends and with a roughened surface, and typical clustered spores but with 5-15 spores per cluster, not 2-6 as stated in Martin and Alexopolous (1969). This is the first record for South America. In the Neotropics it has been reported from Mexico.

**Dictydiaethalium plumbeum** (Schumach.) Rostaf.

ARG-06-27: On twigs, MA-Fungi 80275.

**Diderma cf. crustaceum** Peck

ARG-06-50: On dead leaf bases of *Puya* sp. (mc, pH 6.8), dwb 3023.

The specimens in this collection are macroscopically similar to *D. crustaceum*, with white sessile sporocarps, which are closely gregarious to heaped, and distorted in shape by mutual pressure. They differ from *D. crustaceum* in having a brown and membranous hypothallus, not white and limy as in that species. Our specimen also differs from *D. crustaceum* in the spores, which are subglobose, 13-16  $\mu\text{m}$  diameter, densely and minutely warted, with a pattern of tiny white lines where there are fewer warts, the spores appearing almost angular with Nomarski optics because of the lines, whereas in *D. crustaceum* the spores are dark and spiny, mostly 12-14  $\mu\text{m}$  diameter. In the Neotropics, this species has been reported from Mexico.

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**Diderma cf. deplanatum** Fr.

ARG-06-51: On leaves of *Puya* sp., MA-Fungi 80276.

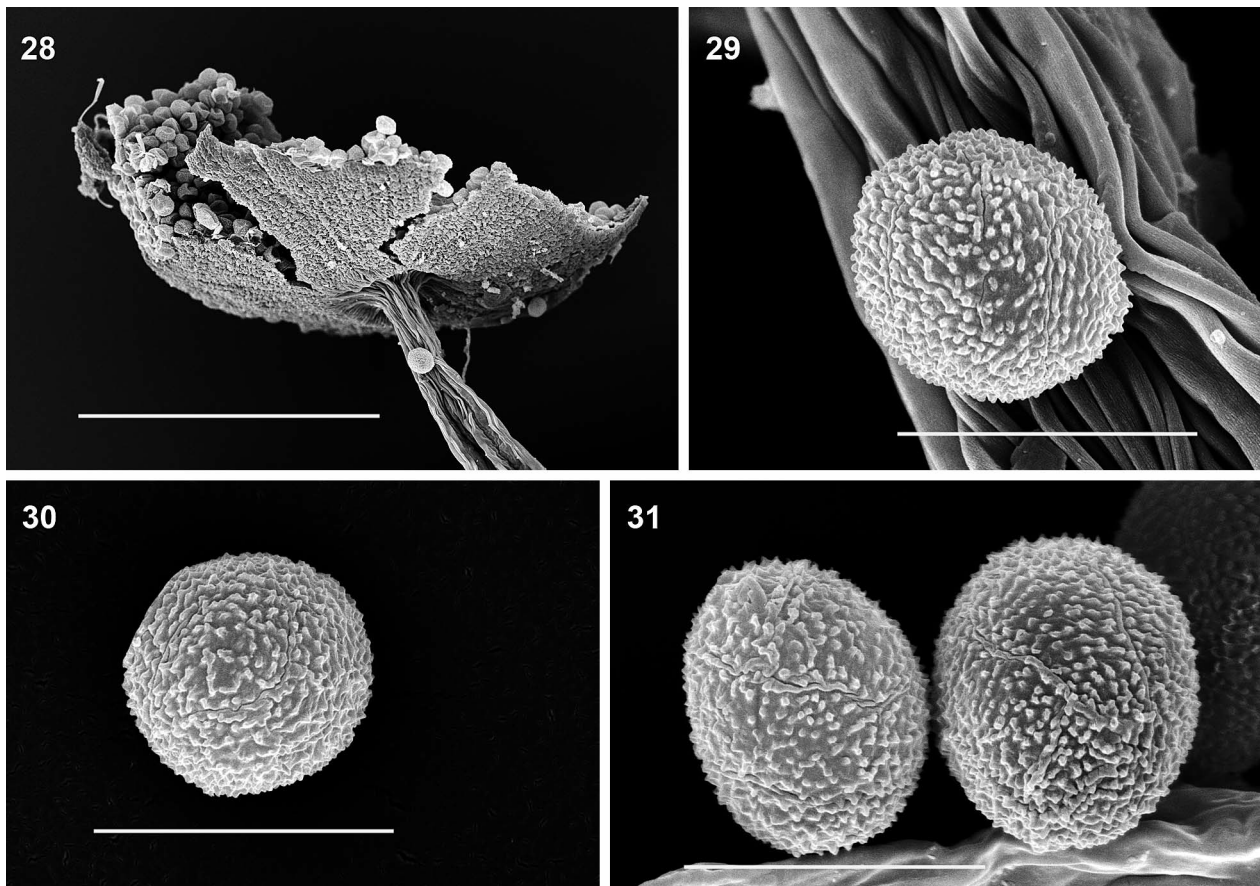
The weathered material in this collection did not permit a definite identification.

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

ARG-06-27: On twigs, MA-Fungi 80277, 80278, 80279, 80280.

**Didymium anellus** Morgan

ARG-06-03: On decayed *Echinopsis atacamensis* cf., MA-Fungi 80281. ARG-06-38: On dead leaf base of *Puya* sp. (mc, pH 7.1), dwb 2855; (mc, pH 7.1), dwb 2870; (mc, pH 7), dwb 2856.



**Figs. 28-31.** *Cribraria lepida* by SEM [dwb 2886]: **28**, remains of the peridium forming a shallow calyculus. **29-31**, spores. Bar: 28 = 100  $\mu\text{m}$ ; 29-31 = 10  $\mu\text{m}$ .

The field collection differs from the typical *D. anellus* in having spores without groups of warts.

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

ARG-06-76: On litter, MA-Fungi 80098; on wood, MA-Fungi 80282, MA-Fungi 80283.

**Didymium dubium** Rostaf.

ARG-06-03: On decayed *Echinopsis* sp., MA-Fungi 80284. ARG-06-64: On the wood of a leguminous tree, MA-Fungi 80285.

**Didymium infundibuliforme** D.Wrigley, Lado & Estrada

ARG-06-08: On dead leaf bases of *Puya* sp., dwb 2942. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 78321, 80286; on dead leaf bases of *Puya* sp. (mc, pH 6.8), dwb 3019. ARG-06-51: On dead leaf base of *Puya* sp. (mc, pH 6.8), dwb 2829, dwb 2834. ARG-06-60: On dead leaf base of *Puya* sp. (mc, pH 7.1), dwb 2851. ARG-06-61: On *Puya* sp. leaves, MA-Fungi 78322, 78323, 78320. ARG-06-67: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2825; (mc, pH 7.2), dwb 2843; (mc, pH 6.8), dwb 2845; (mc, pH 6.9), dwb 3154. ARG-07-50: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2918. ARG-07-52: On dead leaf base of *Puya* sp. (mc, pH 7.1), dwb 2927. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 78324, 78325. ARG-07-63: On dead leaf base of *Puya* sp. (mc, pH 6.4), dwb 2894.

These collections with the exception of MA-Fungi 80286, dwb 2918 and dwb 3154, were included in the original description of the species by Wrigley de Basanta & al. (2009).

**Didymium cf. listeri** Masseur

ARG-07-11: On decayed wood, (mc, pH 7.0), aet 11956.

This collection has many sessile, pulvinate sporocarps to short effuse plasmodiocarps, with irregular dehiscence. The peridium is double, the outer layer like an egg-shell, formed of closely packed crystals. The inner layer is membranous, iridescent and hyaline by LM. The capillitium is rigid, formed by hyaline tubules arising from the rudimentary columella. The spores are globose, 10-11.5 µm diameter, faintly warted and with a paler area. This species is macroscopically similar to *D. quitense* (see below) but has smaller, paler globose spores, and a hyaline capillitium. It differs from the original description in the pale area of the spores and the paler capillitium. If confirmed this would be the first record of the species for Argentina. In the Neotropics it has been found in Mexico and Ecuador.

**Didymium mexicanum** G. Moreno, Lizárraga & Illana

ARG-06-07: On decayed *Echinopsis atacamensis*, MA-Fungi 80287.

This is the first record of this species for South America. In the Neotropics it has been found in Mexico.

**Didymium obducens** P. Karst.

ARG-06-08: On dead leaf bases of *Puya* sp. (mc, pH 7.3), dwb 2940.

Our specimen fits the description of this species by Härkönen (1979: 3-5) exactly. It is the first record for the Neotropics.

**Didymium quitense** (Pat.) Torrend. (Figs. 32-36).

ARG-06-27: On twigs, MA-Fungi 80288.

This collection has white sporocarps to short plasmodiocarps, with a double peridium, the outer layer like an egg-shell, formed of tiny closely packed crystals (Fig. 32), the inner layer membranous and iridescent. The dehiscence is irregular, leaving a flat base attached to the substrate. The capillitium is short and rigid, brown with pale ends, of uniform diameter and with cross connections forming a loose net, with a granular surface by SEM (Fig. 34). The spores are dark purplish brown and polyhedral with the angles slightly lighter in colour, 13-15 µm diameter, covered with warts united to form a sub-reticulum by LM, much more clearly seen by SEM. In the SEM micrographs (Figs. 33, 35, 36) the ornamentation can be seen to be a dense network of irregular muri. This rare species was described by Patouillard & Lagerheim (1895) as *Chondrioderma quitense* Pat. from Quito (Ecuador), on leaves. This is the first time the species has been recorded from Argentina.

**Didymium squamulosum** (Alb. & Schwein.) Fr.

ARG-06-27: On twigs, MA-Fungi 80289, 80290. ARG-06-64: On legume dried fruits, MA-Fungi 80291, 80292; on legume tree wood, MA-Fungi 80293, 80294, 80295; on *Puya* sp. leaves, MA-Fungi 80296. ARG-06-70: On decayed *Stetsonia coryne*, MA-Fungi 80297, 80298; on legume tree wood, MA-Fungi 80299. ARG-06-76: On *Prosopis* sp. litter, MA-Fungi 80300; on *Opuntia quimi-lo* bark (mc, pH 6.9), dwb 2993.

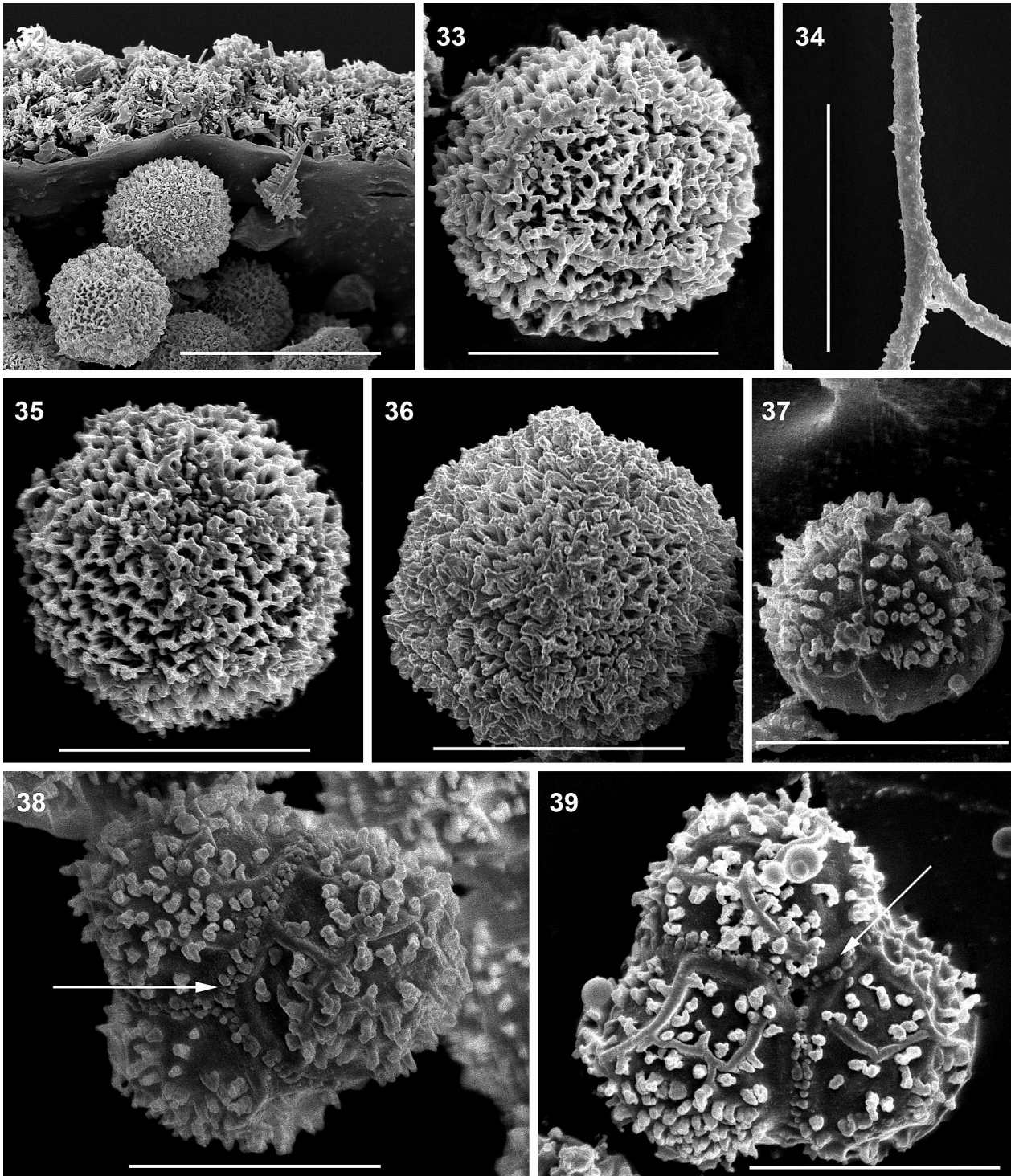
Some of the collections had sub-sessile sporocarps, and the stipes of some stipitate sporocarps were less robust. Some also did not have an obvious white hypothallus.

**Didymium vaccinum** (Durieu & Mont.) Buchet

ARG-06-24: On *Cumulopuntia boliviana* epidermis (mc, pH 8), dwb 3076; (mc, pH 7.5), dwb 3077. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80301, 80302, 80303, 80304; on dead leaf base of *Puya* sp. (mc, pH 7), dwb 2832. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80305, 80306, 80307, 80308; on dead leaf bases of *Puya* sp. (mc, pH 7.1), dwb 2978. ARG-06-57: On *Stipa atacamensis*, MA-Fungi 80309. ARG-06-60: On *Puya* sp. leaves, MA-Fungi 80310. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80311, 80312, 80313. ARG-06-64: On bark of dead liana (mc, pH 7), dwb 3020. ARG-06-67: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 3153.

These represent the first records of this species for Argentina.





**Figs. 32-36.** *Didymium quitense* by SEM [MA-Fungi 80288]: **32**, detail of the peridium with the outer layer formed of tiny closely packed crystals. **33, 35, 36**, spores with a dense network of irregular muri. **34**, fragment of a capillitial thread. **Figs. 37-39.** *Physarum synsporom* by SEM [MA-Fungi 80377]: **37**, spore with irregular ornamentation. **38, 39**, cluster of spores, arrows show the contact points between the spores. Bar: 32, 34 = 20  $\mu\text{m}$ ; 33, 35-39 = 10  $\mu\text{m}$ .

***Didymium wildpretii*** Mosquera, Estrada, Beltrán-Tej., D. Wrigley & Lado

ARG-06-03: On *Opuntia* sp. cladodes, MA-Fungi 80208.

ARG-06-76: On *Opuntia quimilo* bark (mc, pH 7.4), dwb 2994; (mc, pH 7.8), dwb 2996; (mc, pH 6.9), dwb 3005.

These are the first records for South America of this



species. It was recently described from material from arid areas of Mexico and from the Canary Islands, Spain (Lado & al., 2007b).

**Echinostelium arboreum** H.W. Keller & T.E. Brooks.  
(Fig. 40).

ARG-06-08: On dead leaf bases of *Puya* sp. (mc, pH 7.3), dwb 2937; (mc, pH 6.9), dwb 2939. ARG-06-30: On *Denmoza rhodocantha* epidermis (mc, pH 7.5), dwb 3078. ARG-07-08: On *Tephrocactus aoracanthus* remains (mc, pH 8.3), aet 11918.

Described from Mexico this species is characterized by pale yellow sporocarps with a persistent shiny peridium (Fig. 40), which dehisces at the base of the sporotheca leaving a distinct wide collar. The columella is stout and it has dichotomously branched capillitial threads. This is the first record of the species from Argentina.

**Echinostelium colliculosum** K.D. Whitney & H.W. Keller

ARG-06-08: On dead leaf bases of *Puya* sp. (mc, pH 6.9), dwb 2938. ARG-06-20: On bark and twigs of unidentified shrub (mc, pH 4.4), dwb 2786; (mc, pH 4.5), dwb 2801. ARG-06-30: On *Denmoza rhodocantha* epidermis, (mc, pH 7.5), dwb 3042; (mc, pH 7.8), dwb 3043. ARG-06-36: On *Prosopis* sp. bark (mc, pH 6.1), dwb 2787. ARG-06-39: On *Prosopis* sp. bark (mc, pH 6.1), dwb 3039; (mc, pH 6), dwb 3040. ARG-06-51: On dead leaf bases of

*Puya* sp. (mc, pH 6.9), dwb 2823; (mc, pH 6.8), dwb 2824. ARG-06-52: On *Brea* sp. bark (mc, pH 6.4), dwb 2963. ARG-07-08: On *Tephrocactus aoracanthus* remains (mc, pH 7.3), dwb 2887; (mc, pH 8.5), aet 11913; (mc, pH 8.3), aet 11915. ARG-07-50: On *Opuntia sulphurea* remains (mc, pH 8.8), aet 12010; on *Tephrocactus articulatus* remains (mc, pH 8.4), aet 12009.

This species was reported from arid areas of Mexico (Estrada-Torres & al., 2009) from cacti and tree bark. The authors commented on the small size and the slightly different spore-like body and spore shape. These collections appear to be the same ecotype, and also measure from 60-130  $\mu\text{m}$  in total height with a sporotheca of 20-29  $\mu\text{m}$  diameter. Whitney (1980), in the original description, gives the measurements as 70-150  $\mu\text{m}$ , and 30-50  $\mu\text{m}$  respectively. It was reported for the first time from Argentina from Santa Cruz (Wrigley de Basanta & al., 2010b).

**Echinostelium minutum** de Bary

ARG-06-38: On dead leaf bases of *Puya* sp. (mc, pH 7), dwb 2863. ARG-06-42: On *Prosopis* sp. bark (mc, pH 5.6), dwb 3045.

**Hemitrichia minor** G. Lister

ARG-06-01: On *Opuntia quimilo* cladodes, MA-Fungi 80196, 80197.



**Fig. 40.** *Echinostelium arboreum* [dwb 2937]: Two sporocarps showing the persistent shiny peridium.

**Licea belmontiana** Nann.-Bremek.

ARG-07-63: On *Puya* sp. leaves, MA-Fungi 80314. ARG-07-48: Dead leaf base of *Puya* sp. (mc, pH 6.6), dwb 2916.

These are the first records of this species in South America. In the Neotropics it has been cited from Mexico.

**Licea denudescens** H.W. Keller & T.E. Brooks

ARG-07-45: On *Prosopis flexuosa* bark (mc, pH 6), dwb 2902, dwb 2905.

In South America the species has been recorded from Brazil, but these represent the first records for Argentina.

**Licea eremophila** D. Wrigley, Lado & Estrada

ARG-06-60: On *Puya* sp. leaves, MA-Fungi 79159; on dead leaf bases of *Puya* sp. (mc, pH 7.1), dwb 2837; (mc, pH 6.9), dwb 2888. ARG-06-61: On dead leaf bases of *Puya* sp. (mc, pH 7.4), dwb 2982. ARG-06-62: On *Trichocereus* sp. cortex (mc, pH 7.4), dwb 3002. ARG-06-67: On *Puya* sp. leaves, MA-Fungi 79160, 79161; on dead leaf bases of *Puya* sp. (mc, pH 6.9), dwb 2826, dwb 3151; (mc, pH 7.2), dwb 2885. ARG-07-62: On dead leaf bases of *Puya* sp. (mc, pH 6.7), dwb 2920.

These collections were included in the paper describing this as a new species (Wrigley de Basanta & al., 2010a).

**Licea pygmaea** (Meyl.) Ing. (Figs. 41-48).

ARG-06-06: On bark of living *Prosopis* sp. (mc, pH 6.2), dwb 3035. ARG-06-10: On *Stipa atacamensis* (mc, pH 7.1), dwb 2874; (mc, pH 7), dwb 2875. ARG-06-14: On *Stipa atacamensis* (mc, pH 6.5), dwb 3006. ARG-06-22: On *Stipa* sp. (mc, pH 5.5), dwb 3026; (mc, pH 4.8), dwb 3037. ARG-06-24: On *Stipa atacamensis* (mc, pH 5.5), dwb 2999.

These specimens belong to the subgenus *Licea*, according to the revision of the genus by Nannenga-Bremekamp (1965), dehiscent by platelets (Figs. 41, 42). They have baculate spore ornamentation by SEM (Figs. 46-48) and teeth-like protuberances on the edge of the platelets (Figs. 43-45). The double peridium is slightly warty on edge of the inner surface at high magnification by SEM (Figs. 43, 44), otherwise smooth. These are the first records of this species in South America. In the Neotropics it has been cited from Mexico.

**Licea sambucina** D.W. Mitch.

ARG-06-06: On bark of living *Prosopis* sp. (mc, pH 6.2), dwb 3036, 3026a.

The characteristic hyaline tubercles on the platelet edges of the transparent peridium permit the identification of this tiny species, described by Mitchell & McHugh (2000), from the British Isles and USA.

The species is cited here for the first time for the Neotropics.

**Licea scyphoides** T.E. Brooks & H.W. Keller. (Figs. 49-53).

ARG-06-02: On bark of living *Echinopsis atacamensis* (mc, pH 6.5), dwb 2778.

The circumscissile equatorial dehiscence leaving a basal calyculus (Figs. 49, 50), the clearly ornamented inner peridial surface (Fig. 51) and the very closely punctate spores (Figs. 52, 53) are characteristics of this species. Reported previously from Ecuador and Peru in South America, and on the bark of another living cactus, *Opuntia* sp. from Mexico (Wrigley de Basanta & Lado, 2005) but these are the first records from Argentina.

**Licea succulenticola** Mosquera, Lado, Estrada & Beltrán-Tej.

ARG-06-50: On dead leaf bases of *Puya* sp. (mc, pH 6.8), dwb 3008. ARG-06-60: On dead leaf bases of *Puya* sp. (mc, pH 7.1), dwb 2871. ARG-07-50: On internal tissue of *Opuntia sulphurea* (mc, pH 8.8), aet 12021. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80343; on dead leaf bases of *Puya* sp. (mc, pH 6.9), dwb 2921.

These represent the first records of the species for Argentina. It was recently described from material from arid areas of Mexico, from the Canary Islands, Spain and from USA (Mosquera & al., 2003). In South America it is also known from Chile and Ecuador.

**Lycogala epidendrum** (L.) Fr.

ARG-06-27: On wood, MA-Fungi 80315.

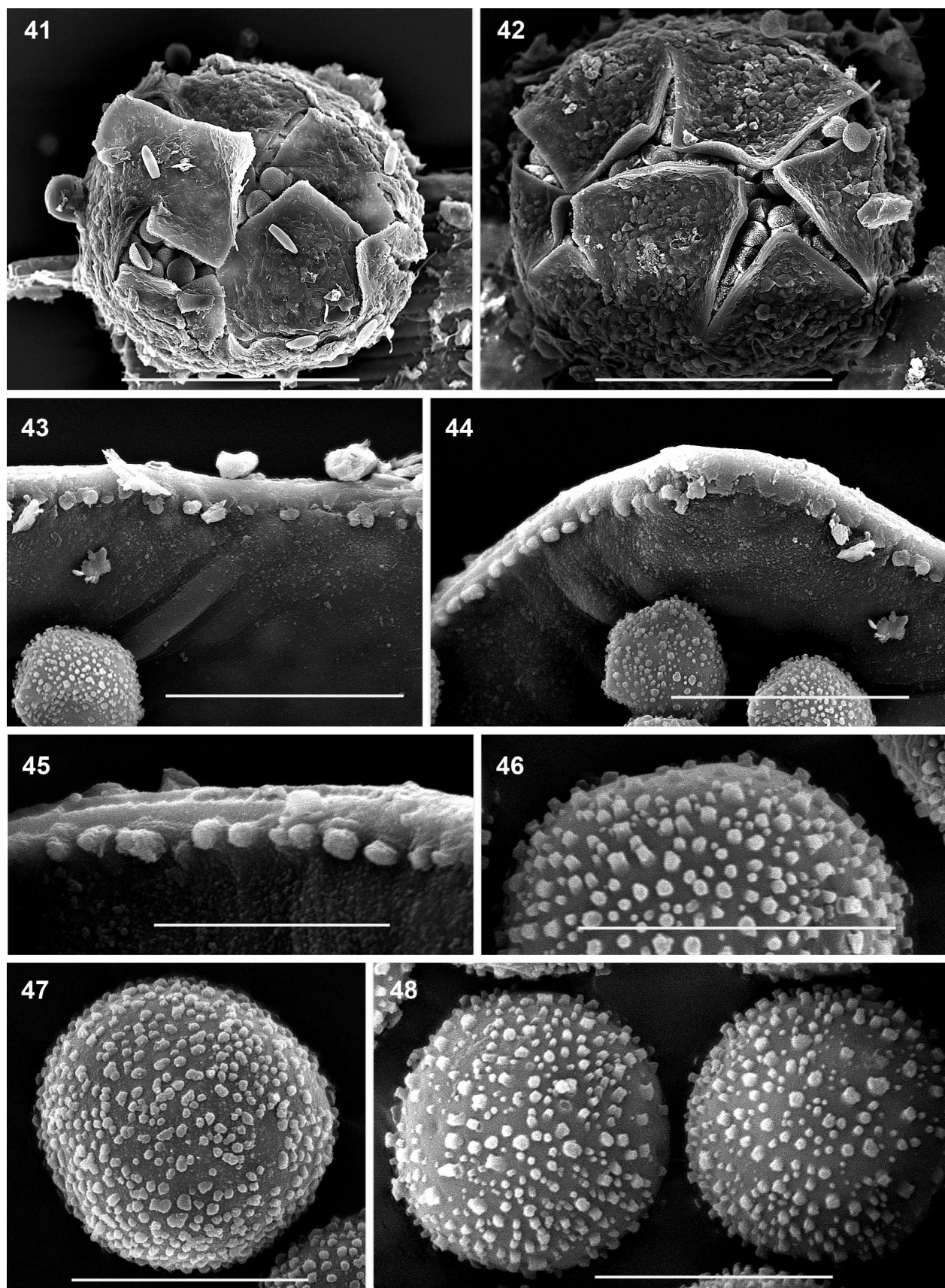
**Macbrideola andina** D. Wrigley, Lado & Estrada, **sp. nov.** (Figs. 54-58).

*Holotype*: Argentina. Salta, Molinos, Molinos river, route RN-40, km 4458, 25°25'56"S 66°17'11"W, 2059 m ± 10m, on bark of living *Prosopis* sp. collected 25-XI-2006, A. Estrada-Torres, C. Lado & D. Wrigley de Basanta, dwb 3048 (MA-Fungi 79883).

*Species Macbrideola oblonga* Pando & Lado *proxima*, sed ab ea densis capillitium atque uniforme diámetros, cum acuminis spinosis, sporothecae sine torquis basalis, sporis densis spinulis ornatis primo icto discernibilis.

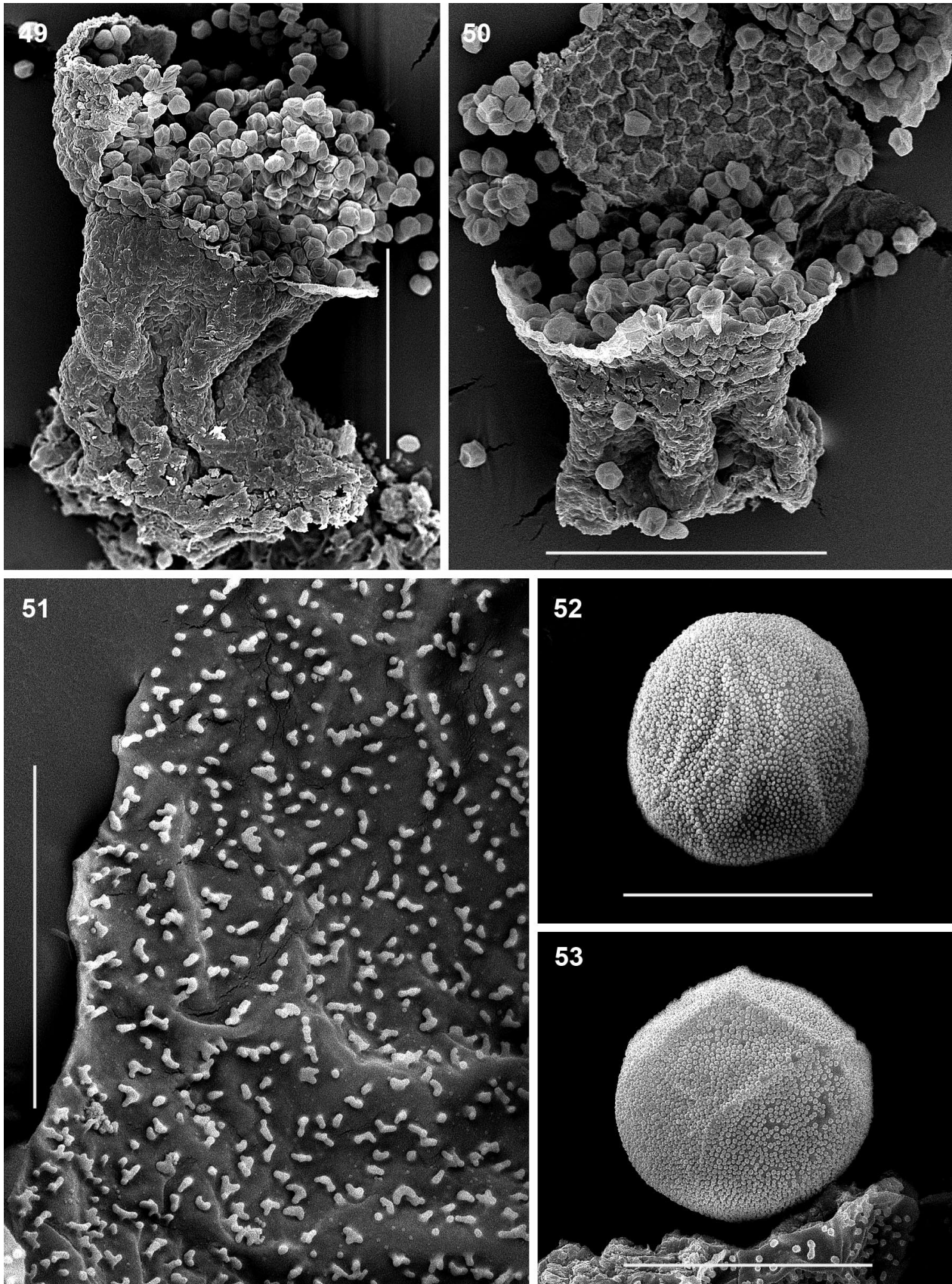
Sporocarps scattered or in small groups, stipitate, 0.4-0.9 mm in total height. Sporotheca 0.25-0.6 mm in height by 0.2-0.4 mm wide, ellipsoidal (Figs. 54, 57), rarely subglobose, greyish brown (61. gy. Br-62. d. gy.





**Figs. 41-48.** *Licea pygmaea* by SEM: **41, 42**, sporocarp showing the dehiscence by plates. **43-45**, edge of the peridial platelets showing teeth-like protuberances. **46-48**, spores. [41, 47: dwb 3037. **42-46, 48**: dwb 2999]. Bar: 41, 42 = 100  $\mu$ m; 43, 44 = 20  $\mu$ m; 45-48 = 10  $\mu$ m.





**Figs. 49-53.** *Licea scyphoides* by SEM [dwb 2778]: **49, 50**, dehiscent sporocarps. **51**, detail of the ornamentation of the inner peridial surface. **52, 53**, spores with a dense ornamentation of minute warts. Bar: 49, 50 = 100  $\mu$ m; 51-53 = 10  $\mu$ m.



Br). Hypothallus membranous, translucent, concolourous with the base of the stalk. Stalk 0.1-0.3 mm in length, hollow, tubular, widening into the hypothallus, brownish black (65. br Black), with a paler area, orange-yellow to yellowish brown (72. d. OY-75. deep y Br) at the base. Peridium membranous, completely evanescent. Columella brownish black (65. br Black), almost reaching the apex of the sporotheca. Capillitium greyish brown (61. gy. Br-62. d. gy. Br), arising from all parts of the columella, dichotomously branched, forming a dense internal net, the threads of uniform diameter, not tapering towards the periphery, making frequent anastomoses with numerous free ends appearing as spines at the periphery, at the base of the sporotheca these anastomoses making an irregular surface net (Figs. 55, 58). Spores greyish brown (61. gy. Br-62. d. gy. Br) in mass, lighter by transmitted light (63. l. br Gy), globose, 9-11  $\mu\text{m}$  diam., warty by LM, with closely, evenly distributed spinules by SEM (Fig. 56). Plasmodium not observed.

*Etymology:* The epithet *andina* refers to the geographical area where the species was found.

*Habitat:* Bark of living *Prosopis* sp.

*Known distribution:* Salta and Jujuy, Argentina.

#### *Other specimens examined*

ARG-06-06: On bark of living *Prosopis* sp. (mc, pH 6.0), dwb 3055. ARG-06-36: On bark of living *Prosopis* sp. (mc, pH 6.1), dwb 2795. ARG-06-39: On bark of living *Prosopis* sp. (mc, pH 6), dwb 3041; (mc, pH 6.1), dwb 3065. *Macbrideola oblonga* Pando & Lado. Spain: Soria, Calatañazor, Dehesa de Carrillo, 1050 m, 30TWM1417, on bark of *Juniperus thurifera* (mc), MA-Fungi 16008 (Holotype).

The distinctive characters of this new species are its ellipsoid sporotheca (Fig. 54), a short tubular stalk, a columella gradually tapering upwards to the apex, a dense, robust, capillitium with threads of uniform diameter, and no collar (Figs. 54, 55, 57, 58). This species also has a distinctive ornamentation of the spores by SEM (Fig. 56). The overall habit is most similar to *Macbrideola oblonga* from which the new species differs in its denser capillitium, with spiny free ends (Figs. 55, 58), and its cylindrical stalk (Figs. 54, 57). In *M. oblonga* the capillitium was described as "... hardly or not anastomosing inside ... free ends blunt slightly swollen or club-shaped" (Pando & Lado, 1988) and in *M. oblonga* has 4-6 meshes per radius of the sporotheca, whereas in *M. andina* there are 10-12 meshes in a much denser net. The stalk in *M. oblonga* is conical (Pando & Lado, 1988: fig. 2). The new species also differs in its total lack of a collar (transparent red-brown in *M. oblonga*) and the ornamentation of the spores by SEM. This ornamentation, in *M. oblonga*, is of small rounded warts, not spinules,

and they are less uniformly distributed than in *M. andina*. Another species that lacks a collar and has anastomoses on the periphery of the capillitium is *Macbrideola dubia* Nann.-Bremek. & Y. Yamam. (Nannenga-Bremekamp & Yamamoto, 1990), but in this species the columella only reaches around the middle of the sporotheca, not almost to the apex as in our species, the lax capillitium attenuates towards the periphery, and it has a netted fibrous stalk base, absent in the new species. *Macbrideola dubia* also has an extensive hypothallus common to groups of sporocarps, and darker spores. The shape of *M. andina* is somewhat similar to *M. ovoidea* Nann.-Bremek. & Y. Yamam. (Nannenga-Bremekamp & Yamamoto, 1983) but in this species the capillitium does not anastomose, which easily distinguishes it from the new species. *Macbrideola ovoidea* also has smaller spores, 7-8.5  $\mu\text{m}$  diameter vs. 9-11  $\mu\text{m}$  diameter in *M. andina*, and the spiny ornamentation by SEM has stellate apices (Moreno & al., 2006: figs. 29, 30), absent in *M. andina*. Another species with a dense capillitium is *Macbrideola lamprodermoides* G. Moreno, Lizárraga, & Illana (Moreno & al., 2006) but it can be easily distinguished from *M. andina* by its persistent silvery peridium, evanescent in the latter, and the presence of a collar, absent in *M. andina*. *Macbrideola herrerae* Lizárraga, G. Moreno & Illana (Lizárraga & al., 2006) has a well-developed capillitium but it does not anastomose at the periphery and is made of rigid and parallel threads with free dichotomously branched ends, totally different from the dense and robust net of the capillitium of *M. andina*. *Macbrideola reticulospora* Hooff & Nann.-Bremek. is distinguished by its reticulate spores.

The specimens developed on the bark of living *Prosopis* sp. at over 2000 m elevation at a slightly acidic pH, in two different provinces (Jujuy and Salta) of the North of Argentina. The development time in moist chamber was 4-71 days, probably dependent on whether the species was in the form of sclerotia, microcysts or spores, when the substrate was wetted.

#### *Macbrideola scintillans* H.C. Gilbert

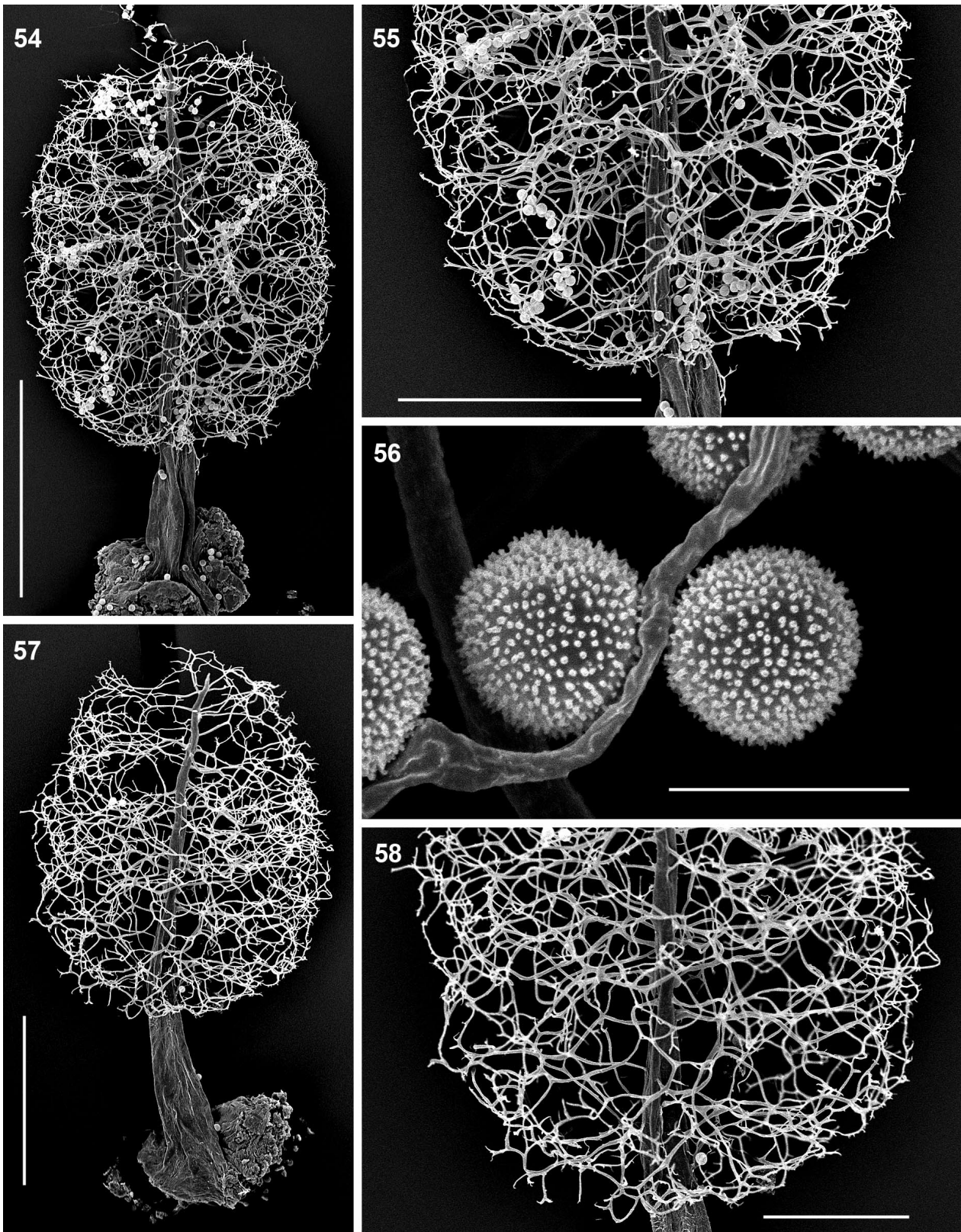
ARG-06-73: On dead liana (mc, pH 7), dwb 2966.

This represents the first record of the species for South America.

#### *Perichaena calongei* Lado, D. Wrigley & Estrada

ARG-06-08: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2957. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 78678, 78679, 78680, 78681; on dead leaf base of *Puya* sp. (mc, pH 7), dwb 2833; (mc, pH 7.1), dwb 2865; (mc, pH 7), dwb 2857. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 78682, 78683, 78684. ARG-06-51: On *Puya* sp. leaves, MA-Fungi 78685, 78686, 78687, 78688. ARG-06-60: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2838; (mc, pH





**Figs. 54-58.** *Macbrideola andina* by SEM [dwb 3048]: **54, 57**, sporocarps. **55**, detail of the base of the sporotheca with the capillitium attached along the length of the columella. **56**, spores. **58**, detail of the base of another sporotheca showing anastomoses and spiny free ends. Bar: 54 = 300  $\mu\text{m}$ ; 55, 57, 58 = 100  $\mu\text{m}$ ; 56 = 10  $\mu\text{m}$ .



7.1), dwb 2852. ARG-06-61: On *Puya* sp. leaves, MA-Fungi 78689; on dead leaf base of *Puya* sp. (mc, pH 7.4), dwb 3009. ARG-06-67: On *Puya* sp. leaves, MA-Fungi 78690. ARG-06-68: On dead leaf base of *Puya* sp. (mc, pH 7.1), dwb 2850; (mc pH 6.9), dwb 2873. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 78691, 78692, 78693. ARG-07-63: On *Puya* sp. leaves, MA-Fungi 78694.

These collections were included in the paper describing this as a new species (Lado & al., 2009).

### **Perichaena depressa** Lib.

ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80316, 80317, 80318, 80319, 80320. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80321. ARG-06-51: On *Puya* sp. leaves, MA-Fungi 80322. ARG-06-60: On *Puya* sp. leaves, MA-Fungi 80323. ARG-06-70: On decayed *Stetsonia coryne*, MA-Fungi 80324. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80325, 80326.

### **Perichaena quadrata** T. Macbr.

ARG-06-06: On bark of living *Prosopis* sp., (mc, pH 6), dwb 3058. ARG-06-08: On dead leaf base of *Puya* sp. (mc, pH 7.2), dwb 2955; (mc, pH 6.9), dwb 2956. ARG-06-27: On twigs, MA-Fungi 80327. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80328; on dead leaf base of *Puya* sp. (mc, pH 7.1), dwb 2864; (mc, pH 7), dwb 2858, dwb 2860. ARG-06-39: On *Prosopis* sp. bark (mc, pH 5.5), dwb 3094. ARG-06-42: On dead leaf base of *Puya* sp. (mc, pH 7.2), dwb 3091. ARG-06-61: On dead leaf base of *Puya* sp. (mc, pH 7.4), dwb 2981. ARG-06-64: On bark of dead liana (mc, pH 7), dwb 3021, (mc, pH 7.1), dwb 3010.

These represent the first records of the species for South America. In the Neotropics, it has been reported from Mexico.

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

ARG-06-05: On *Oreocereus trollii* remains (mc, pH 6.8), dwb 2811. ARG-06-07: On decayed *Echinopsis atacamensis*, MA-Fungi 80329, 80330, 80331, 80332; on decayed legume tree wood, MA-Fungi 80333. ARG-06-24: On decayed *Acanthocalycium* sp., MA-Fungi 80334. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80335. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80336, 80337, 80338. ARG-06-51: On *Puya* sp. leaves, MA-Fungi 80339, 80340. ARG-06-52: On *Brea* sp. bark (mc, pH 6.5), dwb 3013. ARG-06-62: On decayed *Trichocereus* sp., MA-Fungi 80341; on *Trichocereus* sp. cortex (mc, pH 7.4), dwb 2985; (mc, pH 7.2), dwb 3017. ARG-06-63: On decayed *Trichocereus* sp., MA-Fungi 80342. ARG-06-71: On dead leaf bases of *Puya* sp. (mc, pH 6.8), dwb 2983. ARG-07-08: On *Tephrocactus aoracanthus* remains (mc, pH 8.3), aet 11960; (mc, pH 8.5), aet 11924b. ARG-07-47: On *Opuntia sulphurea* remains (mc, pH 8.2), aet 12030; (mc, pH 8.4), aet 12031. ARG-07-50: On *Tephrocactus articulatus* (mc, pH 8.2), aet 12026; (mc, pH 8.4), aet 12027. ARG-07-51: On *Tephrocactus articulatus* (mc, pH 8.2), aet 12035.

### **Physarum cf. auripigmentum** G.W. Martin

ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80407.

The specimen is close to *P. auripigmentum* but the spores are slightly larger [10-12  $\mu\text{m}$  diameter vs. (8)9-10(11)  $\mu\text{m}$  diameter] and have a paler area at one pole. This would represent the first record of the species

for the Neotropics, if confirmed. The species was described by Martin (1948), from the mountains of California.

### **Physarum bitectum** G. Lister

ARG-06-06: On bark of *Prosopis* sp. (mc, pH 5.9), dwb 3038. ARG-06-27: On twigs, MA-Fungi 80344, 80345, 80346, 80347, 80348. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80349, 80350, 80351, MA-Fungi 80352. ARG-06-39: On bark of *Prosopis* sp. (mc, pH 5.5), dwb 3071. ARG-06-42: On bark of *Prosopis* sp. (mc, pH 5.8), dwb 3068.

These collections are new records of the species for Argentina.

### **Physarum compressum** Alb. & Schwein.

ARG-06-01: On *Opuntia quimilo* cladodes, MA-Fungi 80198, 80199, 80200. ARG-06-03: On decayed *Echinopsis* sp., MA-Fungi 80203, 80204, 80205; on *Opuntia* sp. cladodes, MA-Fungi 80201, 80202, 80206. ARG-06-08: Isolated on agar from remains of a bromeliad, dwb 2814. ARG-06-38: On dead leaf base of *Puya* sp. (mc, pH 7), dwb 2861. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80207. ARG-06-76: On *Opuntia quimilo* bark (mc, pH 6.9), dwb 2992; (mc, pH 7.8), dwb 2997.

### **Physarum decipiens** M.A. Curtis

ARG-06-39: On bark of living *Prosopis* sp. (mc, pH 6), dwb 3070; (mc, pH 5.5), dwb 3072.

These collections are new records of the species for Argentina.

### **Physarum didermoides** (Pers.) Rostaf.

ARG-06-03: On decayed *Echinopsis* sp., MA-Fungi 80353; on *Opuntia* sp. cladodes, MA-Fungi 80401.

### **Physarum hongkongense** Chao H. Chung

ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80354.

The laterally compressed, pale yellow, sessile plasmodiocarps with a double peridium, which separates at dehiscence, are typical of *Physarum hongkongense*. However the spores in our collection are larger (10.5-12  $\mu\text{m}$  diameter vs. 7.5-9  $\mu\text{m}$  diameter). This species can be distinguished from *P. bogoriense* primarily on the basis of the yellow colour of the plasmodiocarps (Chung & Tzean, 1998), but the authors have found the two species occurring together on a single leaf. We have also seen the same in material from Brazil (unpublished data). *Physarum hongkongense*, apart from its colour, differs in the apical fissure of dehiscence, which is by irregular fracture into fragments in *P. bogoriense*. As has been stated before (Wrigley de Bascanta & al., 2008), these species may be conspecific. This collection represents the first record of the species for South America. In the Neotropics, it has been reported from Mexico.



**Physarum leucophaeum** Fr.

ARG-06-27: On twigs, MA-Fungi 80355.

**Physarum licheniforme** (Schwein.) Lado

ARG-06-16: On *Stipa atacamensis*, MA-Fungi 80356, 80402, 80357; (mc, pH 7), dwb 2794; (mc, pH 7.1), dwb 2800. ARG-06-20: On *Cortaderia* sp., MA-Fungi 80358. ARG-06-24: On grasses, MA-Fungi 80359. ARG-06-50: On dead leaf bases of *Puya* sp. (mc, pH 6.8), dwb 2980. ARG-07-12: On twigs, MA-Fungi 80360.

These collections represent the first records of the species for South America. In the Neotropics, it has been reported from Mexico and Cuba.

**Physarum megalosporum** T. Macbr.

ARG-06-63: On wood, MA-Fungi 80361. ARG-06-70: On wood of a leguminous plant, MA-Fungi 80362. ARG-06-76: On wood, MA-Fungi 80363.

These collections are the first records of this species for Argentina.

**Physarum notabile** T. Macbr.

ARG-06-02: On *Echinopsis atacamensis* remains (mc, pH 6.5), dwb 2802. ARG-06-61: On leaves of *Puya* sp., MA-Fungi 80364, 80365, 80366. ARG-06-62: On *Trichocereus* sp., MA-Fungi 80367. ARG-06-64: On a legume tree wood, MA-Fungi 80368, 80369, 80370. ARG-06-67: On dead leaf base of *Puya* sp. (mc, pH 6.5), dwb 2842; on leaves of *Puya* sp., MA-Fungi 80371. ARG-06-68: On dead leaf base of *Puya* sp. (mc, pH 6.8), dwb 2872. ARG-06-76: On wood, MA-Fungi 80372. ARG-07-12: On twigs of a Compositae, (mc, pH 5.8), aet 11944.

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

ARG-06-03: On decayed *Trichocereus thelegonus*, MA-Fungi 80209. ARG-06-38: On *Puya* sp. leaves, MA-Fungi 80210; on dead leaf base of *Puya* sp. (mc, pH 7), dwb 2830. ARG-06-42: On *Prosopis* sp. wood, MA-Fungi 80212, 80213; on twigs, MA-Fungi 80211; on *Prosopis* sp. bark (mc, pH 6.5), dwb 3075. ARG-06-43: On dead leaf base of *Puya* sp. (mc), dwb 2777. ARG-06-50: On *Puya* sp. leaves, MA-Fungi 80214, 80215, 80216; on dead leaf base of *Puya* sp. (mc, pH 6.8), dwb 2972. ARG-06-51: On *Puya* sp. leaves, MA-Fungi 80217, 80218, 80219; on dead leaf base of *Puya* sp. (mc, pH 6.8), dwb 2869. ARG-06-52: On *Brea* sp. bark (mc, pH 6.4), dwb 3011; (mc, pH 6.1), dwb 3012. ARG-06-60: On dead leaf base of *Puya* sp. (mc, pH 6.9), dwb 2835. ARG-06-61: On *Puya* sp. leaves, MA-Fungi 80220, 80221. ARG-06-64: On legume tree wood, MA-Fungi 80222; on *Puya* sp. leaves, MA-Fungi 80223; on bark of dead liana (mc, pH 7.1), dwb 2987; (mc, pH 7), dwb 2989. ARG-06-67: On *Puya* sp. leaves, MA-Fungi 80224. ARG-06-68: On dead leaf base of *Puya* sp. (mc, pH 6.8), dwb 2846; (mc, pH 6.9), dwb 2847; (mc, pH 7.1), dwb 2848. ARG-06-72: On *Puya* sp. leaves, MA-Fungi 80225. ARG-06-73: On dead liana (mc, pH 7), dwb 2991. ARG-07-48: On dead leaf base of *Puya* sp. (mc, pH 6.6), dwb 2906, dwb 2897. ARG-07-52: On *Puya* sp. leaves, MA-Fungi 80226. ARG-07-56: On *Puya* sp. leaves, MA-Fungi 80227, 80228, 80229.

**Physarum serpula** Morgan

ARG-06-36: On bark of living *Prosopis* sp. (mc, pH 6.1), dwb

2796. ARG-07-45: On bark of living *Prosopis flexuosa* (mc, pH 6), dwb 2930, dwb 2910.

**Physarum spectabile** Nann.-Bremek., Lado & G. Moreno

ARG-06-03: On decayed *Echinopsis* sp., MA-Fungi 80373. ARG-06-07: On *Echinopsis atacamensis* internal tissue (mc, pH 8.9), dwb 2798; (mc, pH 8.6), dwb 2799; (mc, pH 9.1), dwb 2809. ARG-06-30: On decayed *Echinopsis atacamensis*, MA-Fungi 80374. ARG-06-35: On twigs, MA-Fungi 80375. ARG-06-62: On decayed *Trichocereus* sp., MA-Fungi 80376. ARG-06-70: On *Stetsonia coryne*, (mc, pH 7.4), dwb 3007. ARG-07-11: On succulent stem of Compositae, (mc, pH 8.0), aet 11946; on twigs of an unidentified shrub (mc, pH 7.8), aet 11953. ARG-07-12: On decayed *Cumulopuntia boliviana*, (mc, pH 8.1), aet 11959.

These collections represent the first records of the species for Argentina. In South America, it has been reported from Chile.

**Physarum synsporum** S.L. Stephenson & Nann.-Bremek. (Figs. 37-39).

ARG-06-27: On twigs, MA-Fungi 80377.

This collection has sessile, elongated plasmodiocarps, with translucent, smooth, membranous peridium, with scanty lime granules on the surface. The capillitium is typically physaroid, with large, white, amorphous lime nodes connected by hyaline threads. The spores are in tight clusters of 2-4 slightly ovoid spores (Figs. 38, 39), 11-12.5 × 8-9 μm, spinulose on the outer surface, almost smooth on the inner surface (Fig. 37). By SEM, some clusters of spores show a double line of warts along the points of spore to spore contact (Figs. 38, 39). This is one of the few species of *Physarum* with clustered spores.

These collections represent the first record of the species for the Neotropics. Described from West Virginia, USA by Stephenson & Nannega-Bremekamp (1990).

**Stemonaria irregularis** (Rex) Nann.-Bremek., R. Sharma & Y. Yamam.

ARG-07-45: On *Prosopis flexuosa* bark (mc, pH 6), dwb 2909, dwb 2903.

These collections are very similar to the description of *Stemonaria irregularis* (Nannega-Bremekamp & al., 1984), except for the size of the spores, which are larger (10-12.5 μm diameter) in our specimens than the size range given for that species (7.5-9.5 μm diameter).

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

ARG-06-62: On decayed *Trichocereus* sp., MA-Fungi 80378.

This collection represents the first record of the species for Argentina.

**Stemonitopsis gracilis** (G. Lister) Nann.-Bremek.

ARG-06-02: On *Echinopsis atacamensis* remains (mc, pH 6.5), dwb 2790.

This collection represents the first record of the species for Argentina.

**Trichia affinis** de Bary

ARG-06-10: On grasses, MA-Fungi 80379, 80380. ARG-06-46: On grasses, MA-Fungi 80381. ARG-06-47: On grasses, MA-Fungi 80382, 80383. ARG-06-49: On grasses, MA-Fungi 80384, 80403, 80385, 80386; on *Cortaderia* sp. (mc, pH 4.6), dwb 3000.

**Trichia agaves** (G. Moreno, Lizarraga & Illana) Mosquera, Lado, Estrada & Beltran-Tej.

ARG-06-50: On *Trichocereus* sp., MA-Fungi 80387.

This collection represents the first record of the species for South America. In the Neotropics, it has been reported from Mexico

**Trichia contorta** (Ditmar) Rostaf.

ARG-06-20: On *Cortaderia* sp., MA-Fungi 80388.

**Trichia scabra** Rostaf.

ARG-06-27: On twigs, MA-Fungi 80389, 80390, 80391, 80392, 80393, 80394, 80395.

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

ARG-06-14: On *Stipa atacamensis*, MA-Fungi 80396. ARG-06-22: On grasses, MA-Fungi 80397; on twigs, MA-Fungi 80398. ARG-06-24: On grasses, MA-Fungi 80399. ARG-06-27: On twigs, MA-Fungi 80400.

## Discussion

This biodiversity survey in the Monte Desert and surroundings has produced almost six hundred myxomycete collections from 105 localities. They represent 72 species from 22 genera, of which the genera *Dianema* and *Macbrideola* and 38 species, are new to Argentina, an increase of almost 22% to the country catalogue (Lado & Wrigley de Basanta, 2008; Wrigley de Basanta & al., 2010b). Among these 38 species, 11 are new for South America, 5 for the whole Neotropical region and 4 species are new to science, one described herein, *Macbrideola andina*, and three recently described based on material from this survey, *Didymium infundibuliforme* (Wrigley de Basanta & al., 2009), *Perichaena calongei* (Lado & al., 2009), and *Licea eremophila* (Wrigley de Basanta & al., 2010a). This brings the total number of myxomycete species

known from Argentina to 211, and from this desert area the results represent 8% of the number of species known worldwide (Lado, 2005-2010), a notable number for such a dry environment. Among the interesting species from the survey, apart from those newly described, are *Arcyria afroalpina*, *Comatricha pulchelloides*, *Didymium mexicanum*, *D. obducens*, *D. wildpretii*, *Licea sambucina*, *Physarum auripigmentum* and *Ph. synsorum*, either because they are exclusive to arid ecosystems or because they are rare species.

The results from the Monte Desert in these seven provinces show a high biodiversity of myxomycetes. Although for the whole survey, the species to genus ratio, a measure used to compare taxonomic diversity, with the lower numbers indicating greater diversity (Stephenson & al., 1993), is quite high (3.27), it is lower than the results (3.9) obtained in the dryland ecosystem in Mexico (Estrada-Torres & al., 2009) or (3.6) in Colorado, USA (Novozhilov & al., 2003), and comparable with other results (2.2-4.6) for temperate and tropical forests (Stephenson & al., 1993). When the results are separated by province it can be seen that some provinces have much higher taxonomic diversity than this (Table 2). The total number of species, now known from each province, indicates that Salta (57 species), Jujuy (47) and Tucumán (43) are currently the most species-rich. The table also shows the first data on myxomycetes from La Rioja, San Juan and San Luis, provinces previously unexplored for myxomycetes. In order to directly compare the results from each province, the total number of collections was adjusted to take into account the number of collecting sites that had identifiable collections of myxomycetes included in the annotated species list (positive site). Catamarca in this case had the greatest number of collections per positive collecting site, followed by Salta and Tucumán. The mean result was almost 8 species recovered from each locality, irrespective of the province.

The most abundant species (Table 3), by number of collections, were *Badhamia melanospora*, *Physarum pusillum*, *Perichaena calongei*, *P. vermicularis*, *Crategium leucocephalum*, *Didymium infundibuliforme*, *D. vaccinum* and *Echinostelium colliculosum*. Many of these are recognised as characteristic species of arid environments, and here more abundant than other species such as *Didymium squamulosum*, *Physarum bitectum* and *Arcyria cinerea* of broad distribution, usually among the common species in studies of other environments. The assemblage of abundant species coincides with that obtained in other studies of warm arid areas such as the Tehuacán-Cuicatlán valley in Mexico (Estrada-Torres & al., 2009), although there



**Table 2.** Summary data on the Myxomycetes in different Provinces of the survey area. Species a) from the literature-all vegetation types, b) this survey-arid vegetation.

Province	Localities Total (positive)	Collections	Collections per positive site	Species		Different species total	Genera	S/G ratio
				a	b			
Catamarca	19 (15)	151	10.07	6	33	37	13	2.85
Jujuy	18 (12)	87	7.25	27	21	47	24	1.96
La Rioja	11 (8)	62	7.75	0	20	20	10	2.00
Salta	25 (19)	166	8.74	10	48	57	23	2.48
San Juan	24 (18)	84	4.67	0	21	21	9	2.33
San Luis	6 (4)	28	7.00	0	12	12	8	1.50
Tucumán	2 (2)	17	8.50	41	3	43	18	2.34

are some differences probably due to different substrate species (Wrigley de Basanta & al., 2010a). Surprisingly, in spite of the intense work done over recent decades in the Neotropics (Lado & Wrigley de Basanta, 2008), almost 30% (27.8) of the species found in the Monte Desert are new records for South America and 12.5% are new records for the Neotropics, confirming the exclusive myxobiota of this dryland ecosystem. A relatively high number of species (*Didymium infundibuliforme*, *D. mexicanum*, *D. wildpretii*, *Licea eremophila*, *L. succulenticola*, *Macbrideola andina*, *Perichaena calongei*, *Physarum spectabile*, *Trichia agaves*) also belong to the succulenticolous species group. The most abundant species were also the most widespread, as can be seen (Table 3) from the number of localities from which they were recovered.

Of the total 72 species listed above, 25 were only found once which may indicate that these are the rarer species such as *Didymium obducens*, or that at the time of collecting there were not the ideal phenological conditions for some species or adequate substrate for others, such as *Lycogala epidendrum*, a typical lignicolous species.

The most common genera belonged to the order Physarales which made up almost 50% of the collections. This has been noted in other arid areas, for instance the Tehuacán valley in Mexico (Estrada-Torres & al., 2009), and Atacama desert in Chile (Lado & al., 2007a). In the Monte Desert however, the percentage of species of the genus *Physarum* was greater than that of *Didymium* species, unlike the results from both Mexico and Chile where the genus *Didymium* was predominant. In all three places, the species within the genera differed, except for the most common species, indicating precise microhabitat preferences, since the substrate species were also different. This was

particularly the case with the genus *Didymium* which had only 5 of the 30 species of the genus from Tehuacán in common. The species in the order Physarales made up only 32% of the total found in the Colorado plateau, USA (Novozhilov & al., 2003), but different woody vegetation was mainly sampled there. The sequence of orders was also basically the same in Mexico, and in a review of all Neotropical myxomycetes (Lado & Wrigley de Basanta, 2008), where results were compared to the percentage of known species from each order. The order Trichiales were slightly better represented in these results from Argentina, and in spite of the known number of species in the order being below that of the Liceales and Stemonitales, more species of Trichiales were found than of the other two orders.

The most productive substrates of this study were the more than twenty species of cacti, which produced 37% of all the specimens. The leafy substrates were the next most productive with 35% of the results. This substrate group includes mainly the leaf bases of the rosette-leaved succulent plant *Puya* sp. (Fig. 3), a particularly productive substrate both in the field and in moist chamber culture. The number of species however was greater in the latter group with 32 different species compared to 25 different species from cacti. Similar rosette-leaved succulent plants, but of other genera such as *Agave*, *Beaucarnea*, and *Hechtia*, were the most productive group of substrata in the Tehuacán valley in Mexico (Estrada-Torres & al., 2009). As has been noted previously (Wrigley de Basanta & al., 2010a) the rosettes form a water trap where any available moisture, even from condensation, in these extreme desert environments is channeled towards the base of the plant. The overlapping leaves prevent evaporation and, in the field, dead leaves

**Table 3.** Summary data on the most common Myxomycete species.

Species	Field collections	Moist chamber collections	Total collections	Percentage of Records	N° localities found
<i>Arcyria afroalpina</i>	3	10	13	2.20	7
<i>Arcyria cinerea</i>	4	8	12	2.02	9
<i>Badhamia melanospora</i>	123	36	159	26.72	50
<i>Craterium leucocephalum</i>	17	3	20	3.36	10
<i>Didymium infundibuliforme</i>	7	12	19	3.19	10
<i>Didymium squamulosum</i>	12	1	13	2.20	4
<i>Didymium vaccinum</i>	13	6	19	3.19	8
<i>Echinostelium colliculosum</i>	0	16	16	2.69	9
<i>Licea eremophila</i>	3	8	11	1.85	5
<i>Perichaena calongei</i>	17	9	26	4.37	10
<i>Perichaena depressa</i>	11	0	11	1.85	6
<i>Perichaena quadrata</i>	2	11	13	2.20	8
<i>Perichaena vermicularis</i>	14	12	26	4.37	14
<i>Physarum bitectum</i>	9	3	12	2.02	5
<i>Physarum compressum</i>	10	4	14	2.35	6
<i>Physarum notabile</i>	9	4	13	2.20	8
<i>Physarum pusillum</i>	17	12	29	4.87	17
<i>Physarum spectabile</i>	4	7	11	1.85	8
<i>Trichia affinis</i>	9	1	10	1.68	4
TOTAL (19 species)	284	162	446	75.18	–

around the base were often moist even in the middle of the day in mid summer. On bark, sixteen species were recovered, in spite of the paucity of woody substrates in these arid areas. The majority of bark was from species of the leguminous trees of the genus *Prosopis*, which was also a productive substrate in Mexican drylands (Estrada-Torres & al., 2009). In the grasslands of the puna and surrounding areas, in spite of the high elevation (above 3000 m), the high levels of solar radiation and extreme temperature differences day and night, the different species of grasses also produced a reasonable number of collections (almost 8%), and 12.5% of the species found in this survey.

In order to compare the results according to elevation and latitude of the sampling area, the results were expressed as collections and species of myxomycetes per locality, to correct for differences in sampling ef-

fort (Fig. 59). In the case of elevation there was a trend towards decreasing number of specimens with increasing elevation in the sampling range of 500 m to over 4000 m, as was found in other areas of Argentina (Wrigley de Basanta & al., 2010b). This was not the case for the number of species, as this remained more or less constant over the range. These values could only reflect the moment of sampling, which may represent a better time for myxomycetes at lower elevations and not at higher elevations, since sampling was done over the same period. The climatic conditions over this large gradient can vary considerably and affect the substrates for myxomycete development.

The range of latitudes in this survey was from South latitude 23° to 33°. However the results according to latitude, corrected for differences in collecting effort, were fairly uniform, without a significant trend. The



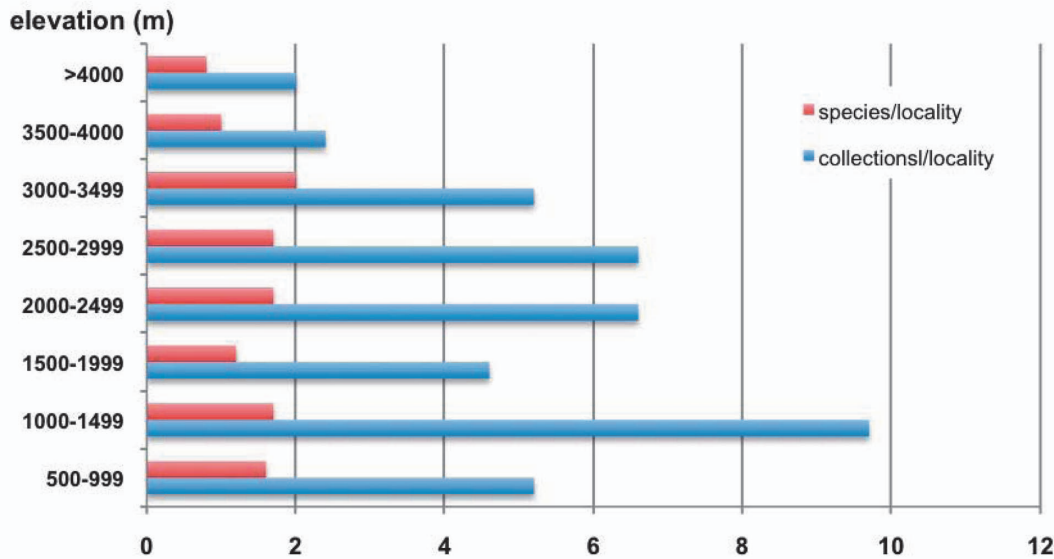


Fig. 59. Number of Myxomycetes from different elevations (positive sites only).

largest number of collections (16%), were made at latitude 28°S and the combined number of collections at the lower latitudes (23°-27°S), was much greater (60%) than the 24% at the higher latitudes (29°-33°S). This is consistent with data from other studies in Argentina (Wrigley de Basanta & al., 2010b).

The results include 28 species only found in the field, 19 species only produced in moist chamber culture and 25 species occurring in both field collections and from moist chamber culture. The 127 moist chamber cultures were 82% positive for myxomycete plasmodia or fruiting bodies. As in other studies (Estrada-Torres & al., 2009; Wrigley de Basanta & al., 2010b) some plasmodia only produced poor or malformed specimens, not included in the results, and in some cases only formed sclerotia that never fruited in the time span of the cultures. The productivity is high for moist chambers made with plants from such a dryland area, and higher than that of 250 moist chambers of cactus remains from dryland ecosystems of Mexico (Estrada-Torres & al., 2009), but lower than that for the whole study area of the Colorado Plateau (Novozhilov & al., 2003).

One of the important microenvironmental factors affecting the abundance and diversity of myxomycetes is the pH of the substrate, as has been indicated in other studies (Wrigley de Basanta, 2004; Wrigley de Basanta & al., 2008). The moist chamber cultures from this survey had a broad substrate pH range from 4.4-9.2, but the majority of myxomycete collections were harvested from substrates with a pH falling between 6 and 7.9 (Fig. 60), and the mean pH of all cultures was circumneutral at pH 7.03. All but one of the

cultures with a basic pH of 8.0 or above, were made with different cactus remains, and although some of the cultures made with epidermis of cacti had a pH nearer to 7, the mean of the cactus cultures was almost 8 (pH 7.95). The basic pH may favour the development of the lime-producing Physarales predominant in these results. The moist chamber cultures made with leaf bases of *Puya* sp., the next most productive of all the substrates after the cacti, had a mean pH of 6.95, again close to neutral as with other productive substrates (Wrigley de Basanta & al., 2008). *Badhamia melanospora* and *Echinostelium colliculosum* were the most tolerant species from the moist chamber cultu-

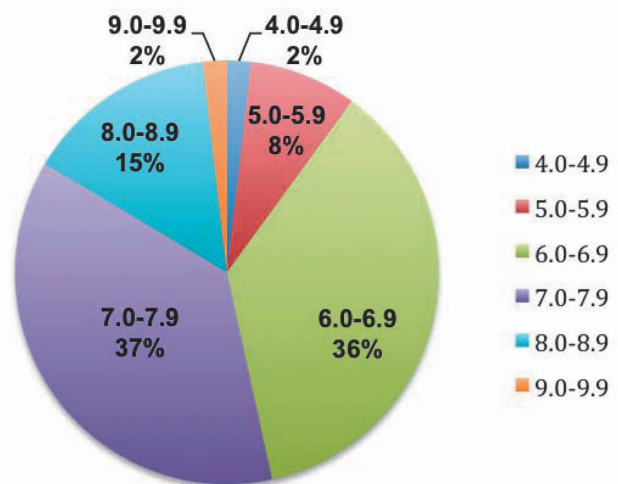


Fig. 60. Proportion of moist chamber collections at different substrate pH values.

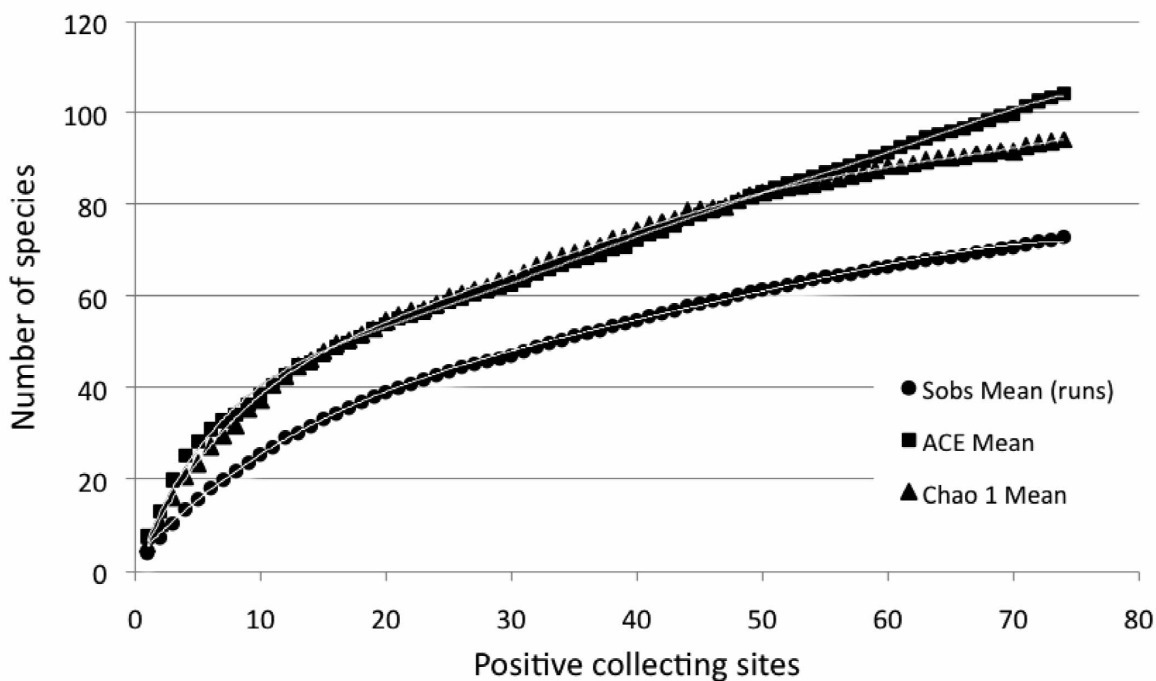
res, and were recovered from substrates with pH across the range. All the species of *Arcyria* were found on substrates with a circumneutral pH, as were *Licea eremophila* and *Perichaena calongei*, but *Physarum spectabile* was found only on basic substrates.

During this survey 73 taxa, 72 species and one variety (*Craterium leucocephalum* var. *scyphoides*) were obtained from various substrates. The number of species expected, if the sampling effort were exhaustive, according to the estimators ACE and CHAO1, are calculated at 104 and 94 respectively (Fig. 61). This means that the sampling effort of this survey was 70-78% complete. If the results of the field collections and collections recovered from moist chamber culture are assessed separately, the former recovered 69-72% of the expected species by each estimator and the moist chamber cultures 81-84% respectively. This suggests that the survey recovered a large proportion of the assemblage of myxomycetes to be expected in the Monte Desert. The results are surprisingly high when considering the fact that field sampling may not coincide with the best phenological moment for some species. In addition the substrates for moist chamber cultures may have spores, microcysts or sclerotia that have been exposed for too long to the harsh conditions of the desert, and are no longer viable.

To assess community similarities between this and

studies of other arid areas in the literature, the Sørensen coefficient of community (CC) index was used (Table 4). The myxomycete assemblage from the Tehuacán-Cuicatlán desert of Mexico was the most similar to the Monte Desert of Argentina (CC = 0.46). The relationships between the myxomycete assemblages of these areas could be due to similarities in their substrates. The floristic affinities between arid zones of North America and the Monte Desert were researched by Solbrig (1972) and Roig & al. (2009), who found that the genera *Larrea*, *Cercidium* and *Prosopis*, and members of the families Cactaceae, Agavaceae and Bromeliaceae, are the dominant plants shared in common between these areas. The microhabitats of the related plants in these taxa are similar, and so the community of myxomycetes developing in them overlaps, as pointed out by Wrigley de Basanta & al. (2010a) for the myxobiota of the genera *Hechtia* and *Puya*.

The apparently least similar assemblage (CC= 0.22) was from the Atacama Desert in Chile, on the other side of the Andes mountain chain. This is not surprising given the extreme arid environment, which limits the myxomycete species richness (Lado & al., 2008), and therefore produced a much smaller sample. However, despite the low number of common species (14) this number supposed almost 60% of the species found in that study of one of the driest places on earth.



**Fig. 61.** Curves of abundante (ACE and CHAO1 estimators) compared to these species accumulation curves (Sobs) of this Surrey. White lines indicate the polinomial best fit curve.



**Table 4.** Community similarity between myxobiota of arid areas using the coefficient of community index (CC). (Top right CC, number of species in common bottom left).

	Monte	Tehuacán-Cuicatlán	Atacama	Colorado Plateau
Monte desert, Argentina	–	0.46	0.29	0.35
Tehuacán-Cuicatlán Valley, Mexico (Estrada-Torres & al., 2009)	41	–	0.28	0.45
Atacama desert, Chile (Lado & al., 2007)	14	18	–	0.22
Colorado Plateau, USA (Novozhilov & al., 2003)	29	44	13	–

More recently, succulenticolous species *Didymium infundibuliforme* (Wrigley de Basanta & al., 2009) and *Licea eremophila* (Wrigley de Basanta & al., 2010a) were found associated with species of succulent plants on both sides of the Andes.

The Colorado Plateau species composition was between the other two. The uniformity of method has to be considered when comparing these studies. In all of them, the results are a combination of field results and those from moist chamber cultures. However the total number of collections in each study was different, as was the emphasis placed on fieldwork or cultures. In addition, in the Colorado Plateau study, the vegetation was very different from the other three areas since the research there centered on sagebrush and woodland communities, concentrating on woody substrates absent or very rare in the Monte Desert, and included herbivore dung, a substrate less common in the Monte.

The present study adds data to confirm some of the factors that appear to be critical for the development of myxomycetes. It is evident that the macroenvironmental factors such as temperature, rainfall, elevation and indirectly latitude, while influencing the growth of the substrate plants, do not show a direct influence on the species composition or abundance of the myxomycetes found in this area. On the other hand, the microenvironmental factors do seem to influence which myxomycetes develop and how abundantly they appear. The microhabitat in and on specific plants is a complex of many variable factors. The chemical composition of different plant species is different which influences the pH of the tissue, its capacity for water retention, and release of nutrients, which in turn determine the microbial flora living in or on and decomposing the plant, as suggested by Mosquera & al., (2003). The microbial biota, the food organisms for myxomycetes, probably alter the microhabitat in the course of decay and a succession of flora and other organisms, such as fly larvae, occurs (Fogleman & Foster,

1989; Foster & Fogleman, 1993). This complex of interacting abiotic and biotic factors within the microhabitat could explain the differences in myxobiota on different substrates and the apparent substrate specificity seen for example in *Licea eremophila*, that flourished in the Monte Desert on one type of rosette-leaved plant, *Puya* sp., and was absent from other similar plants, e.g. *Hechtia* sp., in Mexico (Wrigley de Basanta & al., 2010a). Other substrate, or substrate-group, specificity has been seen with *Didymium infundibuliforme* on *Puya* sp. (Wrigley de Basanta & al., 2009), *Didymium tehuacanense* on *Agave* sp., and *Didymium subreticulosporum*, *D. wildpretii* and *Badhamia melanospora* on cacti (Estrada-Torres & al., 2009). On the succulent plant species and cacti of the Monte Desert, several of the succulenticolous species of myxomycetes, *Didymium wildpretii*, *D. vaccinum*, *Licea succulenticola*, *Physarum spectabile*, *Trichia agaves*, found in other desert areas have re-appeared. There are many species that do not seem to have such a narrow specificity for substrate, and are found on a large variety of plants, as can be seen with *Arcyria cinerea*, *Didymium squamulosum*, *Perichaena vermicularis* or *Physarum pusillum*, obviously responding to a general number of conditions common to those microhabitats. It is interesting to note, as mentioned above, that where there were different plant species within similar habitats, studied in a similar manner, genus *Didymium* had only 17% of the species in common.

The myxomycetes found in the Monte Desert represent 8% of the number of species known worldwide, confirming an unexpected species richness of the area. Their colonization and ability to live in such arid environments demonstrate the importance of the resistant stages in their life cycle, where three different life stages, microcysts, sclerotia and spores, increase their ability to survive the extreme adverse environmental conditions of this dryland ecosystem. In the sampling for this survey, both in the field and in culturing by moist chamber, as mentioned above, sclerotia

were very common, attesting to their importance as resistant stages. Some of these sclerotia collected from the field were placed on agar and produced viable plasmodia. If the fact that myxomycetes require water, at least for their feeding stages as amoebae or plasmodia, a desert could be considered a totally hostile and impossible place for their development, but these results, showing an unexpectedly high biodiversity of myxomycetes, refute this assumption.

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