Biodiversity of myxomycetes in subantarctic forests of Patagonia and Tierra del Fuego, Argentina

by

Diana Wrigley de Basanta1*, Carlos Lado1, Arturo Estrada-Torres2 and Steven L. Stephenson3

1Real Jardín Botánico, CSIC, Plaza de Murillo, 2. 28014 Madrid, Spain
2Centro de Investigación en Ciencias Biológicas, Universidad Autónoma de Tlaxcala, km 10.5 carretera Texmelucan-Tlaxcala, Ixtacuixtla, 90122, Tlaxcala, México
3Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701, U.S.A.

With 34 figures and 3 tables


Abstract: A biodiversity survey for myxomycetes was carried out in Patagonia and Tierra del Fuego (Argentina) in late January and early February 2005. Specimens were collected from six National Parks, located in five different provinces between 39° and 55°S latitude. *Nothofagus* forests represented the primary vegetation type investigated, but Valdivian temperate rainforests also were included in the survey, as were coniferous forests dominated by species of *Araucaria*, *Astrocedrus* and *Fitzroya*. More than four hundred (442) specimens of myxomycetes representing 67 different species in 23 genera were collected either in the field, or from moist chamber cultures prepared with samples of bark and litter obtained from the same collecting sites. The total species list generated from both the field and laboratory components of the survey includes six new records for South America and 13 new records for Argentina. Two species of the genus *Diderma*, *D. gracile* and *D. robustum*, described originally from Tierra del Fuego 35 years ago and not reported since, were among the more interesting collections. A third species of the genus, *D. antarcticum*, found only once since its description in 1887, was found for the third time in the world during the survey. These collections were compared to the type material deposited in La Plata, Argentina (LPS) and the first photographs of these species by LM and SEM are included. Ecological comments are made on how macroenvironmental factors as well as microhabitats, influence patterns of myxomycete distribution.

Keywords: *Diderma*, geographical distribution, National Parks, *Nothofagus*, SEM.

*Corresponding author; e-mail: dwb@eresmas.net

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Introduction

Argentina, one of the largest countries in the world, extends in the Southern Hemisphere from just above the Tropic of Capricorn to the archipelago of Tierra del Fuego and Antarctica and encompasses a great diversity of vegetation types that range from subtropical “yungas” to subantarctic and Magellanic forests. Patagonia was selected by the Centres of Plant Diversity project (WWF/IUCN) as a priority conservation site for vascular plants, since it is an area characterized by a rich and diverse flora that is threatened with desertification and by human activities such as overgrazing (Davis et al. 1997). The Patagonian Andean forests are dominated by trees of the genus *Nothofagus* (southern beech), of which there are ten species in South America between latitudes 56° to 33°S. Among the species found in Argentina are the evergreen *Nothofagus betuloides* and the deciduous *N. pumilio* at the southern wetter end of the west to east precipitation gradient, along with the evergreen *N. dombei* and the larger-leaf deciduous species *N. obliqua* in the more northerly warmer areas and *N. antarctica* towards the drier eastern areas (Gut 2008).

The diversity of myxomycetes in many areas of Argentina is unknown, since most of the existing records are from the central and north portion of the country. Results from previous work done in these southern provinces was published by Spegazzini (1887), Digilio (1946), Arambarri (1972, 1973, 1975), and Deschamps (1976). However, the catalogue of myxomycetes in the four provinces other than Tierra del Fuego, amounted to only nine species in total (Crespo & Lugo 2003).

During late January and early February 2005, a biodiversity survey for myxomycetes was carried out in Patagonia and Tierra del Fuego by a team of investigators from six different countries (Wrigley de Basanta & Stephenson 2005). The primary objective of this survey, which encompassed areas of the Patagonian Andes on the borders of Chile and Argentina along with the Argentinian portion of Tierra del Fuego, was to obtain data on myxomycete diversity. A secondary objective was to assess the biodiversity of protostelids and dictyostelids, two other groups of eumycetozoans. The majority of the collecting effort was directed towards relatively undisturbed forests in six National Parks. The purpose of this paper is to report the results obtained for myxomycetes from this survey.

Materials and methods

All localities visited were located within or in the immediate vicinity of six Southern National Parks (NP) in Patagonia and Tierra del Fuego (Fig. 1), where autochthonous subantarctic or andine-patagonian vegetation is best preserved. Sampling was carried out in January and February to coincide with the austral summer and thus the time of the year when fruiting bodies of myxomycetes might be expected to be most abundant. The six parks mentioned above are located along a south to north summer temperature gradient (Table 1) that extends from 39° and 55°S latitude and from 67° to 73°W longitude. The parks vary considerably with respect to both annual precipitation and overall area. In total, 50 different localities (Table 2) were subjected to at least some sampling. At each locality, the microhabitats in which myxomycetes are known or suspected to occur were examined carefully. All localities were referenced to geographic location through the use of the NAVSTAR Global Positioning System (GPS), with latitude and longitude determined by means of a portable GPS unit (model Garmin 12, Datum: SAM 69). Methods used for collecting myxomycetes in the
field and obtaining samples of dead plant material for subsequent laboratory culture were those described by Stephenson (1989), Rossman et al. (1998) and Schnittler et al. (2002).

Moist chamber cultures were prepared in the manner described by Stephenson & Stempen (1994), using disposable plastic Petri dishes (10 cm diameter) lined with filter paper. After a period of approximately 24 hours, the pH of each culture was determined with a portable pH meter, 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 up to three months in order to detect plasmodia and/or fruiting bodies of myxomycetes. The latter were noted and recorded each time a culture was checked. All fruiting bodies of a given species that developed in the same culture, were considered to represent a single record, whether they developed over a period of time or all at once. As soon as the fruiting bodies were judged to be mature, the portion of the substrate upon which the fruiting occurred was removed from the moist chamber culture, allowed to dry and then glued in a small paper box suitable for long-term storage. Differential

Fig. 1. Map showing location of sampling areas in Argentinian Patagonia and Tierra del Fuego.
interference microscopy was used to obtain descriptive data. Specimens were examined 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).

Results

The entire survey produced a total of 442 collections of myxomycetes. This included both material that had developed under natural conditions in the field as well as material obtained from 158 moist chamber cultures. These cultures were 37% positive for myxomycete fruiting bodies or plasmodia. The collections included 67 species and one variety representing 23 different genera.

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 (either a field collection [fc] or a collection obtained from a moist chamber [mc] culture), the pH of the culture in which the specimen appeared, the substrate upon which it was collected or cultured and the locality from which the specimen itself or the sample of dead plant material used to prepare the moist chamber culture was collected. Additional comments are included for records of particular interest or species that are new to Argentina. Nomenclature follows Lado (2001) and Hernández-Crespo & Lado (2005), with the conserved names of several genera (Lado et al. 2005), approved by the Committee for Fungi (Gams 2005) of the IAPT. 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. This usually indicates scanty or aberrant material. Unless otherwise indicated, collections reported herein are those of Carlos Lado (Lado), Steven L. Stephenson (SLS) or Diana Wrigley de Basanta (dwb). Vouchers have been deposited in several places, with those of Stephenson in the mycological herbarium of the University of Arkansas (UARKM), those of Lado in

<table>
<thead>
<tr>
<th>National Park</th>
<th>Province</th>
<th>Size (ha)</th>
<th>Elevation (m)</th>
<th>Mean summer temperature (°C)</th>
<th>Mean annual rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanín</td>
<td>Neuquén</td>
<td>412,000</td>
<td>660–1125</td>
<td>18</td>
<td>2000–3000</td>
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<tr>
<td>Nahuel Huapi</td>
<td>Río Negro and Neuquén</td>
<td>710,000</td>
<td>780–1578</td>
<td>18</td>
<td>500–3000</td>
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<tr>
<td>Lago Puelo</td>
<td>Chubut</td>
<td>27,675</td>
<td>228–231</td>
<td>17</td>
<td>1200</td>
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<tr>
<td>Los Alerces</td>
<td>Chubut</td>
<td>263,000</td>
<td>520–525</td>
<td>15</td>
<td>4000</td>
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<tr>
<td>Los Glaciares</td>
<td>Santa Cruz</td>
<td>724,000</td>
<td>195–786</td>
<td>13</td>
<td>100–2000</td>
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<tr>
<td>Tierra del Fuego</td>
<td>Tierra del Fuego</td>
<td>63,000</td>
<td>12–162</td>
<td>9</td>
<td>700</td>
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<td>Coordinates, elevation</td>
<td>Vegetation</td>
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<td>Loc. 1</td>
<td>Tierra del Fuego, Ushuaia, Tierra del Fuego NP, Bahia Lapataia 54°50'04&quot;S 68°33'45&quot;W, 12 ± 9 m</td>
<td><em>Nothofagus pumilio</em></td>
<td>22 Jan 2005</td>
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<tr>
<td>Loc. 2</td>
<td>Tierra del Fuego, Ushuaia, Tierra del Fuego NP, camping Lago Roca 54°49'49&quot;S 68°33'47&quot;W, 4 m</td>
<td><em>Nothofagus pumilio</em></td>
<td>22 Jan 2005</td>
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<tr>
<td>Loc. 3</td>
<td>Tierra del Fuego, Ushuaia, Tierra del Fuego NP, Lago Roca 54°49'29&quot;S 68°33'52&quot;W, 8 ± 12 m</td>
<td><em>Nothofagus pumilio</em></td>
<td>22 Jan 2005</td>
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<tr>
<td>Loc. 4</td>
<td>Tierra del Fuego, Ushuaia, Tierra del Fuego NP, Bahia Ensenada 54°50'30&quot;S 68°29'07&quot;W, 60 m</td>
<td><em>Nothofagus betuloides</em></td>
<td>22 Jan 2005</td>
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<tr>
<td>Loc. 5</td>
<td>Tierra del Fuego, Ushuaia, Lago Fagnano 54°35'57&quot;S 67°37'40&quot;W, 57 ± 14 m</td>
<td><em>Nothofagus betuloides</em></td>
<td>23 Jan 2005</td>
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<tr>
<td>Loc. 6</td>
<td>Tierra del Fuego, Ushuaia, Lago Escondido 54°39'04&quot;S 67°47'07&quot;W, 162 m</td>
<td><em>Nothofagus antarctica</em></td>
<td>23 Jan 2005</td>
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<tr>
<td>Loc. 7</td>
<td>Tierra del Fuego, Ushuaia, crossroads of RN-3 and RP-J to the Estancia Harberton 54°44'33&quot;S 67°49'30&quot;W, 130 ± 10 m</td>
<td><em>Sphagnum</em> spp. marsh with <em>Nothofagus</em> sp.</td>
<td>23 Jan 2005</td>
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<tr>
<td>Loc. 8</td>
<td>Tierra del Fuego, Ushuaia, road RP-J to the Estancia Harberton, km 30 54°50'09&quot;S 67°29'20&quot;W, 10 ± 10 m</td>
<td><em>Nothofagus betuloides</em></td>
<td>23 Jan 2005</td>
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<td>Loc. 9</td>
<td>Santa Cruz, Lago Argentino, El Calafate, Los Glaciares NP, Perito Moreno glacier 50°29'12&quot;S 73°02'26&quot;W, 200 ± 10 m</td>
<td><em>Nothofagus betuloides</em></td>
<td>25 Jan 2005</td>
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<td>Loc. 10</td>
<td>Santa Cruz, Lago Argentino, El Calafate, Los Glaciares NP, Península Magallanes 50°29'20&quot;S 72°56'41&quot;W, 230 ± 9 m</td>
<td><em>Nothofagus</em> spp.</td>
<td>25 Jan 2005</td>
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<tr>
<td>Loc. 11</td>
<td>Santa Cruz, Lago Argentino, El Calafate, Los Glaciares NP, bridge over Centinela river 50°21'13&quot;S 72°30'09&quot;W, 195 m</td>
<td><em>Steppe with Berberis buxifolia</em></td>
<td>25 Jan 2005</td>
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<tr>
<td>Loc. 12</td>
<td>Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Chorrillo del Salto 49°17'52&quot;S 72°54'18&quot;W, 420 ± 10 m</td>
<td><em>Nothofagus pumilio</em> and <em>N. antarctica</em> forest</td>
<td>26 Jan 2005</td>
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<tr>
<td>Loc. 13</td>
<td>Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Las Vueltas river 49°18'31&quot;S 72°53'56&quot;W, 418 ± 6 m</td>
<td><em>Nothofagus antarctica</em> forest</td>
<td>26 Jan 2005</td>
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<tr>
<td>Loc. 14</td>
<td>Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Lago Capri 49°18'17&quot;S 72°55'77&quot;W, 760 m</td>
<td><em>Nothofagus pumilio</em></td>
<td>27 Jan 2005</td>
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<td>Loc. 15</td>
<td>Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Lago Capri 49°18'08&quot;S 72°55'45&quot;W, 786 ± 8 m</td>
<td><em>Nothofagus pumilio</em></td>
<td>27 Jan 2005</td>
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<td>Loc. 16</td>
<td>Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Lago Capri 49°18'24&quot;S 72°55'11&quot;W, 761 m</td>
<td><em>Nothofagus pumilio</em> forest with <em>Escalonia virgata</em></td>
<td>27 Jan 2005</td>
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<td>Loc. 17</td>
<td>Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, path to Lago Capri 49°18'10&quot;S 72°55'28&quot;W, 770 ± 13 m</td>
<td><em>Nothofagus pumilio</em> forest with <em>Escalonia virgata</em></td>
<td>27 Jan 2005</td>
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<td>Locality</td>
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<td>Loc. 18 Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Lago Capri</td>
<td>49°18'64&quot;S 72°54'62&quot;W, 644 m</td>
<td><em>Nothofagus pumilio</em> forest with <em>Escalonia virgata</em></td>
<td>27 Jan 2005</td>
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<tr>
<td>Loc. 19 Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, path to Fitz Roy glacier</td>
<td>49°17'49&quot;S 72°56'14&quot;W, 730 ± 4 m</td>
<td><em>Nothofagus pumilio</em> forest with <em>Escalonia virgata</em></td>
<td>27 Jan 2005</td>
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<tr>
<td>Loc. 20 Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, Laguna Madre</td>
<td>49°17'22&quot;S 72°56'44&quot;W, 730 m</td>
<td><em>Nothofagus spp.</em> forest</td>
<td>27 Jan 2005</td>
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<tr>
<td>Loc. 21 Santa Cruz, Lago Argentino, El Chaltén, Los Glaciares NP, Mount Fitz Roy, crossroads at Laguna Madre</td>
<td>49°17'11&quot;S 72°57'08&quot;W, 738 ± 8 m</td>
<td><em>Nothofagus spp.</em> forest</td>
<td>27 Jan 2005</td>
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<tr>
<td>Loc. 22 Santa Cruz, Lago Argentino, El Chaltén, crossroads RP-23 with RN-40</td>
<td>49°42'32&quot;S 71°56'53&quot;W, 275 m</td>
<td>Steppes with <em>Berberis buxifolia</em></td>
<td>27 Jan 2005</td>
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<tr>
<td>Loc. 23 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, path to Cumbre Chalhuaco</td>
<td>41°15'49&quot;S 71°18'00&quot;W, 1560 ± 10 m</td>
<td><em>Nothofagus pumilio</em> forest</td>
<td>29 Jan 2005</td>
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<td>Loc. 24 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, path to Cumbre Chalhuaco</td>
<td>41°15'54&quot;S 71°18'00&quot;W, 1578 ± 10 m</td>
<td><em>Nothofagus pumilio</em> forest</td>
<td>29 Jan 2005</td>
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<td>Loc. 25 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, path to Cumbre Chalhuaco</td>
<td>41°15'05&quot;S 71°17'35&quot;W, 1520 ± 10 m</td>
<td><em>Nothofagus pumilio</em> forest</td>
<td>29 Jan 2005</td>
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<tr>
<td>Loc. 26 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, path to Cumbre Chalhuaco</td>
<td>41°15'43&quot;S 71°17'54&quot;W, 1532 ± 10 m</td>
<td><em>Nothofagus pumilio</em> forest</td>
<td>29 Jan 2005</td>
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<td>Loc. 27 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, path to Cumbre Chalhuaco</td>
<td>41°15'36&quot;S 71°17'30&quot;W, 1435 ± 10 m</td>
<td><em>Nothofagus pumilio</em> forest</td>
<td>29 Jan 2005</td>
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<td>Loc. 28 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, path to Cumbre Chalhuaco</td>
<td>41°15'40&quot;S 71°17'40&quot;W, 1464 ± 10 m</td>
<td><em>Nothofagus pumilio</em> forest</td>
<td>29 Jan 2005</td>
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<tr>
<td>Loc. 29 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Puerto Blest, path to Los Cantaros falls</td>
<td>41°01'24&quot;S 71°49'20&quot;W, 850 m</td>
<td>Valdivian forest with <em>N. dombeyi, Saxegothea conspicua</em> and <em>Chusquea culeou</em></td>
<td>30 Jan 2005</td>
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<tr>
<td>Loc. 30 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Puerto Blest, path to Los Cantaros falls</td>
<td>41°01'02&quot;S 71°49'22&quot;W, 780 ± 7 m</td>
<td>Valdivian forest with <em>N. dombeyi, Saxegothea conspicua</em> and <em>Chusquea culeou</em></td>
<td>30 Jan 2005</td>
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<tr>
<td>Loc. 31 Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Llao Llao Peninsula</td>
<td>41°03'17&quot;S 71°32'40&quot;W, 820 ± 10 m</td>
<td><em>Nothofagus dombeyi</em></td>
<td>31 Jan 2005</td>
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<td>Locality</td>
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<td>Vegetation</td>
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<td>Loc. 32</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Llao Llao Peninsula</td>
<td>41°03'22&quot;S 71°32'43&quot;W, 820 ± 10 m</td>
<td>Nothofagus dombeyi forest</td>
<td>31 Jan 2005</td>
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<td>Loc. 33</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Llao Llao Peninsula</td>
<td>41°03'13&quot;S 71°32'43&quot;W, 802 m</td>
<td>Nothofagus dombeyi forest</td>
<td>31 Jan 2005</td>
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<tr>
<td>Loc. 34</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Cerro Tronador, Ventisquero Negro</td>
<td>41°12'13&quot;S 71°49'22&quot;W, 985 ± 10 m</td>
<td>Nothofagus dombeyi forest</td>
<td>1 Feb 2005</td>
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<td>Loc. 35</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Cerro Tronador, Ventisquero Negro</td>
<td>41°12'27&quot;S 71°46'40&quot;W, 1534 m</td>
<td>Nothofagus dombeyi forest</td>
<td>1 Feb 2005</td>
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<td>Loc. 36</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Cerro Tronador, Pampa Linda</td>
<td>41°13'27&quot;S 71°46'25&quot;W, 865 m</td>
<td>Nothofagus dombeyi forest</td>
<td>1 Feb 2005</td>
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<tr>
<td>Loc. 37</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche, Nahuel Huapi NP, Cerro Tronador, Pampa Linda, path to Paso de las Nubes, Castaño Ovra river</td>
<td>41°12'27&quot;S 71°46'40&quot;W, 900 ± 8 m</td>
<td>Nothofagus dombeyi forest</td>
<td>1 Feb 2005</td>
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<td>Loc. 38</td>
<td>Neuquen, Los Lagos, La Angostura, Nahuel Huapi NP, Pichi Trafal</td>
<td>40°29'53&quot;S 71°35'11&quot;W, 845 ± 7 m</td>
<td>Araucaria araucana forest</td>
<td>2 Feb 2005</td>
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<td>Loc. 39</td>
<td>Neuquen, Huiliches, Junín de los Andes, Lanín NP, Lago Currúhué Grande</td>
<td>39°53'10&quot;S 71°25'13&quot;W, 1125 ± 9 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>3 Feb 2005</td>
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<td>Loc. 40</td>
<td>Neuquen, Huiliches, Junín de los Andes, Lanín NP, Termas de Lahuén-Có, Epulafquen</td>
<td>39°49'18&quot;S 71°38'26&quot;W, 1015 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>3 Feb 2005</td>
<td></td>
</tr>
<tr>
<td>Loc. 41</td>
<td>Neuquen, Huiliches, Junín de los Andes, Lanín NP, Termas de Lahuén-Có, Epulafquen</td>
<td>39°55'00&quot;S 71°17'52&quot;W, 1015 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>3 Feb 2005</td>
<td></td>
</tr>
<tr>
<td>Loc. 42</td>
<td>Neuquen, Huiliches, Junín de los Andes, Lanín NP, Termas de Lahuén-Có, Epulafquen</td>
<td>40°08'35&quot;S 71°17'52&quot;W, 1015 ± 8 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>3 Feb 2005</td>
<td></td>
</tr>
<tr>
<td>Loc. 43</td>
<td>Neuquen, La Car, San Martín de los Andes, Lanín NP, Puerto Hua Hum</td>
<td>40°07'09&quot;S 71°39'43&quot;W, 660 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>4 Feb 2005</td>
<td></td>
</tr>
<tr>
<td>Loc. 44</td>
<td>Neuquen, La Car, San Martín de los Andes, Lanín NP, Lago Nonthué</td>
<td>40°08'35&quot;S 71°37'21&quot;W, 685 ± 4 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>4 Feb 2005</td>
<td></td>
</tr>
<tr>
<td>Loc. 45</td>
<td>Río Negro, Bariloche, San Carlos de Bariloche Nahuel-Huapi NP, border of Lago Nahuel Huapi</td>
<td>41°03'04&quot;S 71°08'58&quot;W, 800 m</td>
<td>Valdivian forest with Saxegothea conspicua and Nothofagus sp.</td>
<td>5 Feb 2005</td>
<td></td>
</tr>
</tbody>
</table>
the herbarium of the Real Jardín Botánico of Madrid (MA-Fungi), and those of Wrigley de Basanta in the personal collection of this author. Duplicate material has been deposited in the herbaria of the University of Comahue, Argentina (BCRU), and the University of Tlaxcala (TLXM sub AET). Unless otherwise stated, comments on distribution of the species in South American are based on Lado & Wrigley de Basanta (2008). The species marked with an asterisk (*) are new records for Argentina.

Arcyria cinerea (Bull.) Pers.


COMMENTS: Arcyria cinerea, which is usually rather common in temperate forests of the Northern Hemisphere, was recorded only three times as field collections in the present study.

Arcyria denudata (L.) Wettst.


COMMENTS: This is another species that is usually rather common in temperate forests of the Northern Hemisphere but did not appear to display a comparable level of abundance in the subantarctic forests examined.

Arcyria ferruginea Saut.

Loc. 49: On Nothofagus dombeyi wood (fc), Lado 16644 (MA-Fungi 78719).


Loc. 5: On Nothofagus sp. wood (fc), Lado 16319 (MA-Fungi 78720). Loc. 7: On Nothofagus sp. wood (fc), Lado 16322 (MA-Fungi 78721). Loc. 12: On decaying wood SLS 19592 (fc), on mixed
Sporocarps gregarious, with short stalks to sessile, 0.6–1.2 mm total height, 1.2–3.5 mm when expanded. Sporotheca sub-globose to sub-cylindrical, 0.5–1.1 mm tall and 0.3–0.6 mm in diameter, and from 1–3.2 mm tall by 0.5–0.7 mm in diameter when expanded, from rosy yellow to orange yellow and brownish when faded. Hypothallus is common to a cluster, membranous and inconspicuous. Stalk cylindrical short, erect, 0.1–0.4 mm tall, longitudinally striate, brownish to pale orange or hyaline by transmitted light, filled at the base with spore-like cells (6–)8–19(–22) µm diam., subglobose, and hyaline. Peridium single, membranous, partially evanescent, remaining as a basal calyculus, almost flat, saucer-shaped, translucent, pale yellow to colourless by transmitted light, the inner surface ornamented with small spines sometimes interconnected in an incomplete reticulum, with bordered pits from 2–3.4 µm diam. towards the edge; dehiscence irregular, with fragments of the peridium sometimes remaining attached to the apex of the sporotheca, the edge of the calyculus or the expanded capillitium. Columella absent. Capillitium tubular, elastic, lax, from yellowish to colourless by transmitted light, tubes from 4.4–8.5 µm diam., flexuous, branched and anastomosing, entangled, with few attachments to the calyculus, and with swellings and bulbous free ends, 8.6–25.2 × 4–9.8 µm, ornamented with spines, cogs, half-rings and rings. Spores free from orange to yellow orange in mass, very pale yellow to colourless by transmitted light, subglobose, 6.3–8.4 µm diam., faintly warted (visible with oil immersion lens) with scattered groups of more prominent warts.

Comments: The description given above is based on the abundant material found by us in Argentina, over a range of localities that extend from Neuquen (40°S) to Tierra del Fuego (54°S). The most relevant characters are that the fruiting bodies have very short stalks or are almost sessile. The peridium is partially evanescent, remaining sometimes as fragments attached to the expanded capillitium, and at the base of the sporotheca as a shallow, flat calyculus. The calyculus is ornamented on its inner surface with spines and some bordered pits near the edge. The capillitium is lax and, on expansion, breaks free from the calyculus. The capillitial tubes, ornamented with spines, cogs, half-rings and rings, sometimes have swellings and bulbous free ends ornamented only with spines. This last character was noted and illustrated by Lister (1925) for A. incarnata, although it is not included in comments on the species by authors such as Martin & Alexopoulos (1969) and Nannenga-Bremekamp (1991). All of these characters are consistent with those given by Arambarri (1972) and Nannenga-Bremekamp & Schinner (1986) for A. fuegiana Aramb., a species described from Tierra del Fuego (Argentina). Arambarri (1972) considered her species to be very close to A. incarnata because of the size and ornamentation of the spores and the structure of the capillitium, but she separated A. fuegiana on the basis of the globose shape of the sporotheca before the capillitium expands, and the persistent peridium. In our Argentinian material of A. incarnata, younger sporocarps have sub-globose shapes mixed with sub-cylindrical ones, and in some mature sporocarps
peridium fragments were observed adhering to the calyculus. This suggests that the characters purported to define *A. fuegiana* as a distinct species, fall within the range of morphological variability expressed by *A. incarnata*, a widely distributed species. Unfortunately, the type material of *A. fuegiana* was not available for examination, so it was not possible to confirm whether it is conspecific with *A. incarnata*.

**Arcyria** *cf. insignis* Kalchbr. & Cooke
Loc. 18: On mixed litter (mc, pH 4.3), SLS 20528.

**Arcyria obvelata** (Oeder) Onsberg
Loc. 44: On *Nothofagus alpina* wood (fc), Lado 16537 (MA-Fungi 78729), Lado 16544 (MA-Fungi 78730); on *Nothofagus* sp. wood (fc), SLS 19648. Loc. 46: On wood (fc), Lado 16556 (MA-Fungi 78731), Lado 16563 (MA-Fungi 78732); on *Nothofagus* sp. wood (fc), SLS 19657, SLS 19663, SLS 19666.

**Arcyria pomiformis** (Leers) Rostaf.
Loc. 32: On *Nothofagus dombeyi* wood (fc), Lado 16477 (MA-Fungi 78733).

**Badhamia dubia** Nann.-Bremek.

**Comments:** The sessile, spherical, sporocarps are about 1 mm diam. and have spores in clusters with a cap of denser warts on the outside of each spore. Described from the Netherlands on bark, it was recently cited in South America, from the Atacama desert of Chile, by Lado et al. (2007) where it occurred on *Opuntia* sp. remains.

**Badhamia versicolor** Lister
Loc. 46: On wood (fc), Lado 16592 (MA-Fungi 78737).

**Calomyxa metallica** (Berk.) Nieuwl.
Loc. 31: On *Nothofagus dombeyi* wood (fc), Lado 16463 (MA-Fungi 78738).

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

**Comments:** Evidence from various studies (Olive 1975, Rojas et al. 2008) suggests that the genus *Ceratiomyxa* is more closely related to the protostelids and thus is not a true myxomycete. However, species of *Ceratiomyxa* are usually recorded in field surveys for myxomycetes. We use the conserved name for this species as proposed by Lado et al. (2005) and accepted by the IAPT (Gams 2005).

**Comatricha laxa** Rostaf.
Loc. 30: On wood (fc), Lado 16443(MA-Fungi 78743).
**Comatricha nigra** (Pers. ex J.F.Gmel.) J.Schröt.

**Cribraria aurantiaca** Schrad.
Loc. 47: On wood (fc), Lado 16597 (MA-Fungi 78758), Lado 16603 (MA-Fungi 78759).

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

*Cribraria microcarpa* Schrad.
Loc. 5: *Nothofagus* sp. wood (fc), SLS 19589.

COMMENTS: This species is known from several other South American countries and the Caribbean and widely distributed in Europe and North America (Martin & Alexopoulos 1969).

*Cribraria rufa* (Roth) Rostaf.

COMMENTS: This is the first record of *Cribraria rufa* for South America. The species was reported from Mexico by Rodríguez-Palma (1998), and is widely distributed throughout the United States and Europe (Martin & Alexopoulos 1969: 89).

**Diderma antarcticum** (Speg.) Sturgis
Figs 2–3, 7–10
Loc. 27: On *Nothofagus pumilio* bark and leaves (fc), Lado 16397 (MA-Fungi 78765); on *N. pumilio* wood (fc), Lado 16406 (MA-Fungi 78766).

COMMENTS: This species was described originally from Chile by Spegazzini in 1887, and the only other record appears to be from Tierra del Fuego (Arambarri 1973). Our material was compared to the type material (LPS 31371, leg. *Spegazzini*) from Punta Arenas, Chile. The prominent rugose columella (Figs 2–3), double peridium, with the tough cartilaginous outer layer that is patchy brown on the outside, packed with lime ganules inside (Fig. 8), the membranous inner layer (Fig. 7) and circumcissile dehiscence (Fig. 2), along with the characteristic spore ornamentation, leave no doubt as to the identity of our specimens. The capillitium is ornamented
with small spines, and the spores are minutely spinulose (Figs 9–10). These records extend the known distribution in Argentina of *Diderma antarcticum*, from latitude 54°S, further north to 41°S, to the Neuquén province.

### Diderma effusum (Schwein.) Morgan

Loc. 2: On *Nothofagus* sp. twigs (mc, pH 5.2), SLS 19825, SLS 20666.

### Diderma gracile Aramb.


Sporophores sporocarpic, gregarious, stalked, 1.3–2.3 mm high. Sporotheca from sub-globose to oblate, on a flattened base, dark red-brown, 0.6–0.8 mm high,
0.9–1.1 mm diam., marked with red-brown bands which arise from the base and break up into spots or flecks at the apex. Hypothallus membranous, yellowish, under individual sporocarps, or sometimes common to a group, with radial vein-like folds. Stalk cylindrical or with an expanded base, erect or curved, non-calcareous, translucent yellowish to reddish brown, by transmitted light, 0.9–1.5 mm in height, 0.2–0.25 mm wide at the apex, to 0.6 mm at the expanded base, deeply furrowed longitudinally. Peridium with three layers, outer layer cartilaginous, 8–13 µm thick, with dark red-brown bands of granular material on the outer surface intercalated with narrow areas appearing membranous and yellowish, the bands 15–30 µm wide arising from the base towards the apex, parallel sometimes merging or ramifying, breaking up into round or ellipsoid spots at the apex; middle layer white, calcareous, 20–25 µm wide, attached to the external layer; inner layer membranous hyaline except for the base.
Figs 11–16. *Diderma gracile* (MA-Fungi 78767) by SEM. Fig. 11. Cross-section of peridium. Fig. 12. Spore. Fig. 13. Capillitium of thin tubules. Figs 14–16. Detail of spore ornamentation formed by short crests in a sub-reticulum.
where it is yellowish, separate from the middle and outer layers, rarely adhering to part of the calcareous layer; dehiscence petaloid to irregular, the middle and outer layers remaining attached and forming 8 to 13 lobes (Fig. 4), the bands of the outer layer separating and showing the lighter zones between them; the inner layer separating and disintegrating quickly and so difficult to see, except at the base where it remains as a collar around the columella, whitened by the granular calcareous material from the middle layer. Columella pulvinate (Fig. 4), full of calcareous material, yellowish, 0.3–0.65 mm diam., 0.12–0.33 mm high, up to one third the height of the sporotheca, rough on the surface. Capillitium abundant, tubular, with very thin tubes 1–2 µm diam. (Fig. 13) violet-brown to hyaline at the tips straight, branching and anastomosed to form a lax net, with membranous expansions arising radially from the columella and attached to the outer peridial layer by conical expansions, which penetrate the calcareous layer, and ornamented with rounded granules. Spores dark brown in mass, sub-globose, free, violet brown by transmitted light, one pole slightly more pallid, (11.5–)13–14 µm diam., with short crests (Figs 12, 14–16) which sometimes branch to form a sub-reticulum.

Comments: This species is somewhat similar to *Diderma rufostriatum* Nann.-Bremek. & Lado but that species has sessile to short-stalked sporocarps and not clearly stipitate sporocarps as in *D. gracile*. In addition *D. rufostriatum* is paler in colour, with less distinct bands on the peridium, has a calcareous hypothallus, a capillitium without membranous expansions and uniformly warted, smaller spores (9–11 µm vs. 12–14 µm diam.). The comparison of this material with *Diderma rufostriatum* was based on the isotype (Lado 4758). The long stalks of *Diderma gracile* (Fig. 4) also differentiate it from *D. asteroides* (Lister & G.Lister), another sessile to short-stalked species. In addition, *D. asteroides* G.Lister has a uniform peridium without marked bands, a hyaline capillitium without membranous expansions and uniformly warted spores that measure 10.5–11 µm. The comparison of this material with *D. asteroides* was based on Lado 7137.

These represent the first known collections of this species since it was described by Arambarri (1973) from Tierra del Fuego, Argentina. Our material was compared to the type material (LPS 37124). An extended description and the first photographs by LM and SEM of this species are included herein. The collections cited above are from four states (Chubut, Río Negro, Santa Cruz, and Tierra del Fuego).

*Diderma niveum* (Rostaf.) T.Macbr.


Comment: Our collections of this species, which is considered a nivicolous species in other areas, were found in the woodlands at about 1500 m elevation, but during the austral summer and in the absence of snow.

*Didierma peyerimhoffii* (Maire & Pinoy) H.Neubert, Nowotny & K.Baumann

Figs 19–20

= *Diderma trevelyani* var. *nivale*

Loc. 9: On *Nothofagus* sp. wood (fc), Lado 16345 (MA-Fungi 78781).
COMMENTS: This is the first record of *Diderma peyerimhoffii* for South America. Described originally as *Diderma trevelyanii* var. *nivale* this species was renamed by Neubert et al. (2000) and its taxonomic status remains questionable. It was found among the nivicolous myxomycetes of Europe and its taxonomic position discussed in detail by Lado & Ronikier (2008). The clustered, spherical, sessile sporocarps have a very rugose outer peridium with a thick layer of lime attached to the inner surface. At dehiscence the two layers remain attached as the fragments separate (Figs 19–20).

*Diderma radiatum* (L.) Morgan

Loc. 50: On *Nothofagus* sp. wood (fc), SLS 19669.
Diderma robustum Aramb.                           Figs 17–18, 21–26

Loc. 27: On Nothofagus pumilio bark (fc), Lado 16403 (MA-Fungi 78782); on N. pumilio wood (fc), Lado 16411 (MA-Fungi 78783). Loc. 46: On wood (fc), Lado 16567 (MA-Fungi 78784), Lado 16572 (MA-Fungi 78785).

Comments: These represent the first collections of this species since it was described by Arambarrri (1973) from Tierra del Fuego, Argentina. Our collections are from two different states (Río Negro and Chubut) and extend the known distribution of Diderma robustum a considerable distance northward, from 54° to 41° South latitude. The most obvious distinguishing character of these stipitate, obovate, whitish sporocarps, is the large flattened columella (Figs 17–18), shaped like a spatula, which reaches the apex of the sporotheca. The spores are warted and 12–13 µm diam., with the warts forming an incomplete crested reticulum (Figs 23–26). The fragile double peridium has transverse folds and dehisces irregularly. The outer peridium is totally calcareous and the inner layer membranous (Fig. 21) and translucid.

Didymium difforme (Pers.) Gray

Loc. 45: Mixed aerial litter (mc, pH 5.5), SLS 19852.

Didymium minus (Lister) Morgan

Loc. 31: On Chusquea culeou leaves (fc), Lado 16461 (MA-Fungi 78786); on Nothofagus dombeyi wood (fc), Lado 16462 (MA-Fungi 78787). Loc. 46: On wood (fc), Lado 16576 (MA-Fungi 78788).

Didymium nigripes (Link) Fr.

Loc. 44: On Nothogafus alpina wood (fc), Lado 16534 (MA-Fungi 78789), Lado 16536 (MA-Fungi 78790).

*Echinostelium brooksi* K.D.Whitney

Loc. 39: On Araucaria araucana bark (mc, pH 5.1), dwb 2702.

Comments: This is the first record of the species for South America. Typical specimens possess the characteristic pigmented lenticular columella, which is 4–5 µm diam. and have a small peridial collar. This tiny species was cited from Mexico by Rodríguez-Palma et al. (2002). Its appearance on acidic bark is consistent with its appearance on acidified bark in Europe (Wrigley de Basanta 2004).

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

Loc. 22: On Berberis buxifolia bark (mc, pH 5.8), dwb 2691.

Comments: In South America it has otherwise been reported only from Brazil.

*Echinostelium minutum* de Bary

Loc. 2: On forest floor litter (mc, pH 4.6, 4.8), SLS 19801, SLS 19853. Loc. 5: On Nothofagus betuloides bark (mc, pH 5.0), dwb 2670. Loc. 30: On liana (mc, pH 6.2-6.3), dwb 2588, dwb 2600, dwb 2604; on Saxegothea conspicua (mc pH 5.1), dwb 2701.
COMMENTS: *Echinostelium minutum* has been reported from Brazil, Colombia, Ecuador and Peru in South America. It was reported from the South Polar Region by Stephenson et al. (2007).

**Figs 21–23. Diderma robustum** (MA-Fungi 78782) by SEM. Fig. 21. Inner surface of peridium. Fig. 22. Detail of capillitium. Fig. 23. Warted spore. Fig. 24. *Diderma robustum* (MA-Fungi 78784) detail of spore ornamentation by SEM. Fig. 25. *Diderma robustum* (MA-Fungi 78785) detail of spore ornamentation by SEM. Fig. 26. *Diderma robustum* (MA-Fungi 78784) detail of spore ornamentation by SEM.
**Fuligo septica** (L.) F.H.Wigg.


**Lamproderma arcyrioides** (Sommerf.) Rostaf.

Loc. 27: On *Nothofagus pumilio* wood (fc), Lado 16405 (MA-Fungi 78806).

* Lamproderma echinosporum * Meyl.

Loc. 27: On *Nothofagus pumilio* wood (fc), Lado 16395 (MA-Fungi 78807).

Comments: This is the first time this species has been recorded from South America. The ovoid sporothecae are on a rigid flattened stalk of about 1 mm in length. The persistent peridium is thin, dehiscing irregularly. The black columna reaches half to two thirds the diameter of the sporotheca, and at the apex gives rise to the capillitium, which forms a dense net with abundant free ends, that are hyaline at the tips. The capillitial threads are covered with many nodules. The spores are 13–16 µm diam. uniformly dusky brown and covered with irregularly distributed long spines (up to 1 µm long).

* Lamproderma maculatum * Kowalski

Loc. 27: On *Nothofagus pumilio* wood and bark (fc), Lado 16392 (MA-Fungi 78808), Lado 16393 (MA-Fungi 78809).

Comments: This is the first record of this species from South America. It is known from California and Washington in North America (Kowalski 1970). The globose to ovoid sporocarps are on a rigid cylindrical stalk less than 1 mm in length. The persistent peridium is thin, silvery-blackish, iridescent with colourful reflections, mottled with black depressed areas, especially at the base, the basal part of the peridium brown in transmitted light, the upper part hyaline with big brown dots. The purple-brown spores 12–15 µm diam. are uniformly spinulose with spines of less than 0.5 µm in length.

**Leocarpus fragilis** (Dicks.) Rostaf.


* Licea minima * Fr.

Loc. 29: On stem of *Chusquea culeou* (fc), Lado 16432a (MA-Fungi 78816). Loc. 32: On aerial litter of *Chusquea culeou* (mc, pH 5.3) dwb2699. Loc. 46: On wood (fc), Lado 16566 (MA-Fungi 78817), Lado 16594 (MA-Fungi 78818).
COMMENTS: This species is known in South America from Paraguay and Uruguay, and also widely distributed in North America and Europe (Martin & Alexopoulos 1969: 45).

*Lycogala epidendrum* (L.) Fr.


*Metatrichia floriformis* (Schwein.) Nann.-Bremek.


COMMENTS: This was one of the most abundant myxomycetes collected during the entire survey. It often occurred in large frunctions. Interestingly, *Metatrichia floriformis* also tends to be very abundant in the *Nothofagus* forests of New Zealand and Tasmania (Stephenson, personal observation).

**Oligonema flavidum** (Peck) Peck

Figs 27–30

Loc. 15: On *Nothofagus pumilio* wood (fc), Lado 16366 (MA-Fungi 78856), Lado 16367 (MA-Fungi 78857).

COMMENTS: This is the first record of this species from South America. The densely clustered bright yellow sporocarps sometimes form a layer thus approaching a pseudoaethalium. The scant, simple, tubular, capillitial threads have free blunt ends and no ornamentation (Figs 27–28). The free yellow spores are 12–16 µm in diam., and markedly reticulate (Figs 29–30).

*Perichaena chrysosperma* (Curr.) Lister

Loc. 22: On grass aerial litter (mc, pH 21), SLS 20480.
Perichaena depressa Lib.
Loc. 45: On mixed aerial litter (mc, pH 4.7), SLS 20612.

*Perichaena pedata* (Lister & G. List) G. List
Loc. 46: On forest floor litter (mc, pH 4.9), SLS 19813.

Comments: In South America, this species has only been found before in Ecuador.

Physarum album (Bull.) Chevall.
= Physarum nutans Pers.
Loc. 29: On Nothofagus sp. wood (fc), Lado 16426 (MA-Fungi 78858), Lado 16427 (MA-Fungi 78859), Lado 16428 (MA-Fungi 78860), Lado 16431 (MA-Fungi 78861); on dead bark (fc), SLS 19619, SLS 19622. Loc. 31: On Luma appiculata wood (fc), Lado 16464 (MA-Fungi 78862), Lado
Physarum cinereum (Batsch) Pers.  
Loc. 33: On mixed aerial litter (mc, pH 4.7), SLS 20527.

Physarum leucophaeum Fr.  
Loc. 9: On Nothofagus betuloides wood (fc), Lado 16330 (MA-Fungi 78870). Loc. 35: On N. dombeyi wood (fc), Lado 16499 (MA-Fungi 78871), Lado 16501 (MA-Fungi 78872).

*Rphysarum psittacinum* Ditmar  
Loc. 30: on wood of Chusquea culeou (fc), Lado 16442 (MA-Fungi 78873).

COMMENTS: This species is known in South America from Colombia, Venezuela and Chile.

Physarum vernum Sommerf.  
Loc. 27: On bark of Nothofagus pumilio (fc), Lado 16402 (MA-Fungi 78874).

Physarum viride (Bull.) Pers.  

*Reticularia jurana* Meyl.  

COMMENTS: The species has been previously reported in South America from Brazil.

Stemonitis axifera (Bull.) T.Macbride  

Stemonitis flavogenita E.Jahn  
Loc. 2: On bark of Nothofagus pumilio (mc, pH 4.5), dwb 2669. Loc. 29: On Nothofagus sp. wood (fc), Lado 16421 (MA-Fungi 78894).
Stemonitis fusca Roth


Stemonitis fusca var. nigrescens Rex.

Loc. 2: On *Nothofagus* sp. twigs (mc, pH 5.0–5.2), SLS 20479, SLS 19406, SLS 19824, SLS 19827, SLS 20487, SLS 20632. Loc. 7: On mixed litter (mc, pH 5.9), SLS 20530. Loc. 9: On forest floor litter (mc, pH 5.5), SLS 20529. Loc. 45: On mixed aerial litter (mc, pH 5.7), SLS 20761.

**COMMENTS:** This variety of the species is sometimes considered to represent a distinct species, *Stemonitis nigrescens*. However, Castillo et al. (1997) considered it to be synonymous with *S. fusca*.

Stemonitis lignicola Nann.-Bremerk.

Loc. 49: On *Nothofagus dombeyi* wood (fc), Lado 16637 (MA-Fungi 78901).

Stemonitis splendens Rostaf.

Loc. 46: On wood (fc), Lado 16591 (MA-Fungi 78902), SLS 19656, SLS 19658.

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

Loc. 31: On *Nothofagus dombeyi* wood (fc), Lado 16452 (MA-Fungi 78903), Lado 16453 (MA-Fungi 78904), Lado 16454 (MA-Fungi 78905), Lado 16467 (MA-Fungi 78906).

*Trichia affinis* de Bary


**COMMENTS:** In South America this species has been reported previously from Chile and Ecuador. It was one of the most common species collected during the survey. The intense orange-yellow, globose to subglobose sporothecae and fragmented-reticulate spores characterise this species (Lado & Pando 1997).
Trichia botrytis (J.F.Gmel.) Pers.


*Trichia contorta* (Ditmar) Rostaf.


COMMENTS: *Trichia contorta* is known from Brazil and Chile in South America.

Trichia decipiens (Pers.) T.Macbr.


Trichia favoginea (Batsch) Pers.


*Trichia flavicoma* (Lister) Ing


COMMENTS: These collections represent the first records of this species for South America. In Europe *T. flavicoma* is usually found on dead leaves of angiosperms or pine needles (Lado & Pando 1997, Ing 1999).
**Trichia lutescens** (Lister) Lister


**COMMENTS:** In South America it has been reported from Brazil and is relatively common in Europe and North America.

**Trichia persimilis** P.Karst.


**COMMENTS:** This species has been reported from Peru and Chile.

**Trichia varia** (Pers. ex J.M.Gmel.) Pers.


**Trichia verrucosa** Berk.


**Tubifera ferruginosa** (Batsch) J.F.Gmel.


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

Discussion

The survey yielded in total 442 collections of myxomycetes, including 404 specimens that had fruited in the field under natural conditions and 38 obtained from moist chamber cultures. These collections included 67 species and one variety in 23 different genera. The moist chamber cultures prepared with samples of dead plant material produced 16 of these species. Among the myxomycetes obtained are six species (Cribraria rufa, Diderma peyerimhoffii, Echinostelium brookii, Lamproderma echinosporum, L. maculatum and Oligonema flavidum) that are new for all of South America and 13 species that are new records for Argentina. Two species of the genus Diderma, D. gracile and D. robustum, which were described from Tierra del Fuego and not found since their original description, were among the more noteworthy collections from the survey. In addition, D. antarcticum, a third rare species of Diderma, found only once since its original description in 1887, was collected.

The most productive collecting locality visited during the survey was in Lago Puelo National Park (Table 3), where 26 different species of 15 genera were recorded in one day of fieldwork. This was probably due to the mild temperatures, abundant annual precipitation and the wide range of substrates potentially available to myxomycetes (Table 1). Lago Puelo is the smallest National Park in terms of total area, and is located at a lower elevation than the other National Parks sampled (200 m at the lake). This results in a relatively benign microclimate with more different tree species than the other parks and the presence of several elements of Valdivian forest. Among the trees present were wild hazel, a false walnut belonging to the Proteaceae, Lomatia hirsuta, elm, the mountain cypress Austrocedrus chilensis and other trans-Andean species that have distributions that extend eastwards from Chile. This increase in the diversity of substrates leading to an increase in myxomycete diversity was also noted in studies of litter and twigs by Stephenson (1989) and Stephenson et al. (2008), and also observed in our own recent fieldwork in Central Chile (Wrigley de Basanta et al. 2008a). Trichia was the most commonly collected genus, and seven different species in the genus were recorded in this National Park. Species in several other genera produced very large fruitings and prominent examples of this were Stemonitis fusca and Metatrichia floriformis. Of particular interest were the second known record in the world of Diderma robustum, not collected again since its original description in 1973 from Tierra del Fuego (Arambarri 1973), and now reported from Río Negro and Chubut considerably increasing its distribution. In addition, five collections of D. gracile were made here. This species was also described originally from Tierra del Fuego (Arambarri 1973) and found for the first time since then in this survey. Its distribution is extended by the collections, from Tierra del Fuego to Chubut Río Negro and Santa Cruz (54°–41° South latitude). Willkommlangea reticulata, a species distributed widely in tropical areas, particularly in the Neotropics (Farr 1976), was collected in Lago Puelo and in four of the other National Parks visited, and even in Tierra del Fuego at 54°S latitude, where subantarctic climatic conditions prevail. In addition, five of the species that are new records for Argentina were found in Lago Puelo National Park.

Los Alerces National Park, named after the endangered Patagonian cypress Fitzroya cupressoides that grows there, provided 47 collections and 16 species. There are few
trees of this species left in Argentina, and they occur in discontinuous patches of forest in this province and to the south of the neighboring province. Some of the trees in this monospecific genus are more than 2000 years old and up to 70 m tall. We obtained *Trichia affinis* on substrates provided by *F. cupressoides*, but most of our collections were associated with *Nothofagus dombeyi* and resulted from the intensive sampling effort carried out on one day in this park. The most common genus was *Trichia*, and the most common species was *Metatrichia floriformis*. The species *Arcyria ferruginea*, *Diderma radiatum* and *Stemonitis lignicola* were collected only from Alerces National Park. There was only a single previous record of a myxomycete from the Province of Chubut (*T. botrytis*, as reported by Crespo and Lugo [2003]), so all the 33 different species represented among the 119 collections from Lago Puelo and Los Alerces National Parks are new provincial records.

Substrate diversity was also high in parts of Nahuel Huapi National Park. Over a distance of only 60 km within this park, the vegetation changes from arid steppe land in the east through southern beech (*Nothofagus*) forest, with dwarf forms on hill-tops, to lush Valdivian temperate rainforest where annual rainfall is above 3000 mm. There are thickets of a bamboo-like grass (*Chusquea culeou*) upon which we found myxomycetes on the cane, leaves and aerial litter. The canes are mixed with *Podocarpus* spp., *Saxegothea* spp. and *Nothofagus dombeyi* and on the slopes to the mountain lakes, even lianas and epiphytes provided substrates for moist chamber culture. The myrtle *Luma apiculata*, with pretty, white flowers and an edible fruit used for medicinal purposes (Bisheimer 2003), formed patches of woodland in lowland places near the water. On the slopes, *Nothofagus* forest predominated, with *N. dombeyi* and *N. pumilio* particularly abundant. Both of these species provided field collections of myxomycetes. The longest period of time (5 days) was spent visiting different parts of this National Park as it is one of the largest parks and 17 collecting sites were visited. As a result, the total number of myxomycetes collected (167) was the highest, and 46 species were recorded, including representatives from 21 of the 23 genera represented in the whole survey. Seven species of *Trichia* were also found in this park. The most common species encountered as field collections were *Metatrichia floriformis* and *Trichia decipiens*, but four species of *Diderma*, including two more collections of *D. robustum*, were found. In addition, two collections of *D. antarcticum*, which was described originally from southern Chile by Spegazzini in 1887, and found only once since then in Tierra del Fuego (Arambarri 1973), and five

<table>
<thead>
<tr>
<th>National Park</th>
<th>Collecting sites</th>
<th>Days</th>
<th>Time (hrs)</th>
<th>Collections per site</th>
<th>Spp.</th>
<th>Genera</th>
<th>S/G ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanín</td>
<td>6</td>
<td>2</td>
<td>12</td>
<td>31</td>
<td>5.2</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Nahuel Huapi</td>
<td>17</td>
<td>5</td>
<td>30</td>
<td>167</td>
<td>9.8</td>
<td>46</td>
<td>21</td>
</tr>
<tr>
<td>Lago Puelo</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>72</td>
<td>36</td>
<td>26</td>
<td>15</td>
</tr>
<tr>
<td>Los Alerces</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>47</td>
<td>15.7</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Los Glaciares</td>
<td>14</td>
<td>2</td>
<td>12</td>
<td>60</td>
<td>4.3</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Tierra del Fuego</td>
<td>8</td>
<td>2</td>
<td>12</td>
<td>65</td>
<td>8.1</td>
<td>24</td>
<td>15</td>
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more of the collections of *D. gracile*, another species described from Tierra del Fuego (Arambarri 1973), were reported. Collections of two normally nivicolous species of *Lamproderma*, and *Diderma niveum*, were found in the woodlands at about 1,500 m elevation, close to the limit of the timber line, in spite of the fact that there had been no snow anywhere nearby for months. It is still not clear how many of the nivicolous species, found normally near melting snow, are obligate nivicoles or facultative nivicoles, with species in the latter group not necessarily requiring months of snow covering the substrate. Our specimens were freshly fruiting at the time of collection, which was mid austral summer, although they did develop where temperatures were low, and the substrates were very humid.

The northernmost of the National Parks visited was Lanín in Neuquén Province, where the deciduous species of southern beech, *Nothofagus nervosa* and *N. obliqua*, were the main substrates in these mixed forests, which yielded 18 species. The dioecious conifer *Araucaria araucana* was also sampled in one of the few patches of this species remaining on the Argentinian side of the Andes, and the first collection in South America of *Echinostelium brooksii* developed on the bark of this substrate. In two days collecting, ten genera were represented in the collections from Lanín, with *Trichia verrucosa* as the most common species.

The largest National Park visited was Los Glaciares. The park is characterized by high annual precipitation on mountain crags of the Andes but as little as 100 mm on parts of the dry steppe. The highest peak in the area is Mount Fitz Roy, with an elevation of 3375 m. *Nothofagus* forests with *N. antarctica*, *N. betuloides* and *N. pumilio* dominate the sub-antarctic vegetation on the slopes of the mountains. The mountains are bordered by arid Patagonian steppe where low precipitation and fierce winds permit only small low-growing shrubs and hardy grasses to survive. Sub-antarctic forests line the shore of Lake Argentino right up to the edge of the Perito Moreno Glacier, and these forests yielded many collections of myxomycetes even at less than 100 m from the face of the glacier. The cold temperatures limit decomposition, but fallen wood of *Nothofagus*, and understory woody shrubs such as *Fuchsia magellanica* and *Drimys winteri* provided good substrates. In two days, 57 myxomycete collections representing 17 genera were obtained. Again, the most common genus was *Trichia* (with three species) and the most common species found was *Trichia affinis*. Another collection of *Diderma gracile*, was recorded from the park, located in the province of Santa Cruz, as were the first South American records of *Diderma peyerimhoffii* (Figs 19–20) and *Oligonema flavidum* (Figs 27–30). *Leocarpus fragilis*, a widespread species, had been cited previously only once from Argentina, in Tierra del Fuego (Crespo & Lugo 2003), before our collections, which extend its distribution to Santa Cruz, Río Negro and Neuquén.

The cold temperatures and fierce winds in Tierra del Fuego National Park mean that even in an apparently lush woodland, with plenty of fallen wood and moisture, decomposition is very slow and the wood in these forests remains intact for long periods. The sphagnum bogs found here are also characterized by slow decomposition with low oxygen and acidic conditions and were tinted red with the carnivorous plant *Drosera* sp. Under these conditions, it was surprising to find as many myxomycetes as we did. In two days collecting we obtained 65 collections
representing 15 different genera. The most common genus was once again *Trichia*, and the most common species was *Stemonitis fusca*. However, one collection of *Diderma gracile* was also made here, which is in the same province as the type locality of Lago Yehuin (Arambarri 1973).

Altogether, *Metatrichia floriformis* (44 collections) *Trichia decipiens* and *Trichia verrucosa* (33 collections each) were the most common species. The former was also very common in New Zealand (Stephenson 2003), where *Nothofagus* forests are also present, and the latter was the most common species in the results reported from Macquarie Island (Stephenson et al. 2007), another subantarctic territory, suggesting a pattern in their distribution. In general, the genus *Trichia* was very well represented. *Arcyria cinerea*, normally one of the most cosmopolitan of all myxomycetes, and common in forests at comparable latitudes in the Northern Hemisphere, was collected only six times during the present study. Twenty-one of the 67 species we collected were represented by only a single collection, and just four species were recorded in all the parks surveyed. The predominant order was the Trichiales, as can be seen in the graph providing data on the relative proportion of the taxonomic orders (Fig. 31). This contrasts with the results obtained in most other regions of the world where comparable studies have been carried out. For example a review of the myxomycetes reported from the entire Neotropics, which includes all South America, Lado & Wrigley de Basanta (2008) indicated that this order is represented far less than the Physarales. When the number of known species in each order is taken into account (16% for the Trichiales versus 38% for the Physarales), the predominance of the former order in these results from Patagonia is particularly noteworthy. These results also contrast with those from arid areas of Chile or Mexico, where almost half of the species (Lado et al. 2007, Estrada-Torres et al. 2009) recorded were members of the Physarales. A predominance of the Physarales in high-latitude, cold-dominated ecosystems has been noted previously. For example, Stephenson et al. (2007) reported that 48% of the species of myxomycetes recorded from subantarctic Macquarie Island (54°30' South latitude, the same as Tierra del Fuego) belonged to

![Fig. 31. Summary of results to show the relative proportion of myxomycete orders.](image-url)
the Physarales. However, members of the Trichiales were next in abundance, making up 28% of all species. In high-elevation areas of the state of Alaska, members of the Trichiales were the most abundant, representing 40% of all species. In a recent study carried out in Nothofagus forests of Tasmania (41°09′ to 42°49′S), 58% of all collections of myxomycetes were those of species belonging to the Trichiales (Stephenson, unpublished data). Based on the data obtained for pH in the moist chamber culture component of the present study, most of the substrates available for myxomycetes in southern South America are relatively acidic, and it is possible that this represents a limiting factor for at least some members of the Physarales. In a study of dryland ecosystems in Mexico, the abundant presence of the order Physarales was linked to substrates with a basic pH (Estrada-Torres et al. 2009).

The mean number of species per genus (S/G) has been used to estimate taxonomic diversity (Stephenson et al. 1993), and was calculated for the assemblage of myxomycetes recorded in the present study. As has been pointed out, an assemblage in which the species are divided among many genera is intuitively more ‘diverse’ than one in which most species belong to only a few genera. Consequently, a low value for S/G implies a higher overall diversity than does a high value. The value 2.9 (67/23) we calculated for the whole survey was well within the range of values (generally 2.2 to 4.6) that have been reported for temperate and tropical forests (Stephenson et al. 1993). Many of the individual National Parks (Table 3) had lower values, usually below 2. As such, they fall within the range of values (1.4–2.1) that have been reported for both northern and southern high-latitude regions (Stephenson et al. 2007).
Eleven species (16% of the total) were recorded exclusively from moist chamber cultures, thus providing further evidence of the importance of including this method in biodiversity surveys. However, moist chamber cultures were much less productive than in most other surveys of which we are aware, and only 37% of 158 cultures were positive for myxomycete fruiting bodies or plasmodia. There was a marked tendency for plasmodia to form sclerotia, some of which never fruited in spite of several months of observation. The pH of the substrates may have been a contributing factor as the range of all cultures was 3.3 to 6.8, with a mean value of 5.3. This is somewhat more acidic than the optimum pH of other relatively more productive cultures (Wrigley de Basanta et al. 2008b). The six species of Nothofagus provided the substrate upon which fruiting occurred for a large percentage (more than 90%) of the field collections, but in moist chamber culture, leaf litter and bark from Nothofagus were very poor (24 bark cultures produced only two collections and 38 cultures prepared with leaf litter produced only six collections). Apart from the relatively low pH, Nothofagus bark and litter decay very slowly and the time frame of the cultures may not have allowed sufficient decomposition to provide ideal conditions for myxomycete development. The results obtained for Nothofagus in the present study were consistent with those obtained for other members of the same genus in both New Zealand and Tasmania (Stephenson, unpublished data).

In order to compare the results from the different latitudes and elevations at which collecting was carried out, data were compiled on the mean number of collections per collecting site (Figs 32–33), since the number of sites varied.

These data indicate that the lower latitudes (Fig. 32) and elevations (Fig. 33) were apparently more favourable for myxomycetes in this portion of South America. The greatest number of collections per collecting site was at latitude 42° and from 201–400 m elevation. Almost three quarters of the collections (72%) were made between 39° and 42° South latitude which represented only 56% of the sites visited, and 88% of the collections were at elevations up to 1000 m (78% of the collecting sites). It is also evident, as can be seen from the results of the most common species

![Figure 33. Summary of results by elevation of collecting site (m).](image-url)
Fig. 34. Latitude (°S) versus elevation (m) of collections of four common species.

(Fig. 34), that as the latitude increases the elevation at which the species is generally found decreases, although *Trichia affinis* was found at all latitudes below 100 m. This is similar to the latitude-elevation relationships that have been noted for many other organisms, including such well-studied examples as the red spruce (*Picea rubens*) in eastern North America (Cogbill & White 1991).

The predominance of the order Trichiales in this survey of Patagonia contrasts with the predominance of the Physarales in South America considered as a whole, and some other high-latitude cold-dominated ecosystems in the Southern Hemisphere. However, our data are similar to those obtained in a more limited study of *Nothofagus* forests in Tasmania and to results from Alaska in the Northern Hemisphere. Other aspects of the data set reported herein are consistent with similar studies in both hemispheres. The low productivity of southern beech in moist chamber cultures versus natural conditions in the field may be due to the slow decomposition of the substrate material. The present survey has increased the known biodiversity of the myxomycete biota of South America and of Argentina, bringing the total number of species recorded from the latter to 173 (Lado & Wrigley de Basanta 2008). In addition, the known distribution of previously recorded species in Argentina has been substantially increased as a result of collections made during this survey. Our data also indicate that an increase in the range of microhabitats available, as observed in Lago Puelo National Park, results in an increase in myxomycete abundance and diversity. The results we obtained also suggest that patterns of myxomycete distribution are affected by macroenvironmental factors such as latitude and elevation, although this may be largely an indirect effect through their influence on available substrates and microhabitat conditions.
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References


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