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An overview of current knowledge and research needs of slime moulds in Africa

By George G. Ndiritu and Katherine E. Winsett

Since 1654, when the first species of myxomycete (or plasmodial slime mould) was described, little effort has been directed towards increasing our knowledge of the group in Africa. Most of the information available on myxomycetes in Africa is the result of mycologists including their observations of the fruiting bodies of a few species during fungal forays. It is not surprising that many people on the continent, including career-trained biologists, ecologists and environmentalists, do not recognize that there is a significant difference between the organisms known as 'slime moulds' and other 'moulds or molds'.

True moulds (or "molds" in some parts of the world) are fungi and include all of the macroscopic and microscopic organisms in the kingdom Fungi with multicellular filaments or hyphae. Alternatively, slime moulds are characterized by very different trophic and fruiting body stages in their life cycles (Fig. 1). The fruiting bodies of some slime moulds are suggestive of those produced by some macrofungi; as a result, initial scientific classification aligned them with this group (Martin 1960). Moreover, slime moulds are


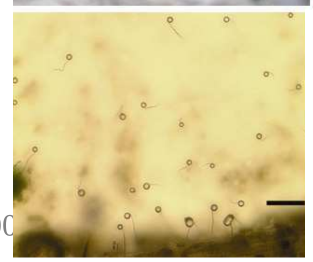

Fig 1. Typical slime mould species fruiting bodies and trophic stages: top left a myxomycete *Stemonitis* sp.; top right a plasmodium (pen knife 15 cm); bottom left is several fruiting bodies of *Protostelium mycophaga* (black bar 0.5um); bottom right a dictyostelid. Pictures myxomycetes credited to KW and protostelids to GGN.

typically found in the same types of habitats as fungi thus it is not surprising that early observations of members of the group were mostly reported by mycologists who also treated them as fungi (Martin and Alexopoulos 1969, Olive 1975, Raper 1984). The presence of both microscopic and macroscopic trophic stages (amoeba and plasmodium) in the life cycle and the absence of hyphae are the key reasons for aligning slime moulds with protozoan organisms rather than with fungi (e.g., Lankester 1885). Unlike fungi, which are primarily saprotrophs, slime moulds are phagotrophs and, according to some research, key predators of bacteria, algae and fungal hyphae in soil (Feest 1987, Spiegel et al. 2004).

Slime moulds are taxonomically known as *Eumycetozoa* and traditionally consist of three major monophyletic groups (Baldauf and Doolittle 1997, Baldauf et al 2000). However, the most recent phylogenetic work by Shadwick et al. (2009) suggests that Eumycetozoa is not a monophyletic taxon as previously thought. Instead, it is an assemblage of several slime mould lineages within the Amoebozoa super group. These lineages include the Myxogastria, Dictyostelia and several lineages that display the protosteloid type of fruiting. By convention, it is acceptable to refer to members of the Myxogastria as myxomycetes or plasmodial slime moulds, protosteloid slime moulds as protosteloid amoebae or protostelids and the Dictyostelia as cellular slime moulds or dictyostelids.

There are approximately 33 species of protostelids, 140 species of dictyostelids and 880 species of myxomycetes described worldwide (Hernández-Crespo and Lado 2005), with the latter representing one of the most species-rich subgroups in the entire Amoebozoa. Members of protosteloid groups have unicellular amoebae and simple microscopic fruiting bodies, whereas dictyostelids and myxomycetes have both microscopic and macroscopic stages to the life cycles. This is particularly for the macroscopic plasmodium and fruiting bodies found in myxomycetes. Regardless of the final taxonomic resolution and the heterogeneity in phenotypes of the fruiting structures and trophic life cycle stages, these slime mould members of the Amoebozoa appear to form an ecological assemblage or trophic guild worth studying collectively.

Studies to document slime moulds in Africa have been carried out only rarely, and what little is known about these organisms is scattered across the literature in various articles, reports and databases that, in most cases, have a limited distribution. However, recent efforts to bridge this documentation gap prompted the compilation of referenced checklists of myxomycetes and protostelids that are known to occur in Africa. Overall, 302 species of myxomycetes are known to occur in Africa (Ndiritu et al. 2009a). A complete annotated species list is available at (http://www.mycotaxon.com/resources/checklists/ndiritu_v107-checklist.pdf). Of the 58 countries and territories on the entire continent, no records of myxomycetes apparently exist for 27 countries. Twenty-eight species of myxomycetes were found to be frequent, 57 species as common, another 43 species were considered to be occasional, and 165 species (56%) were regarded as rare. Although the number of records in the five geo-ecoclimatic-political regions on the continent varied, taxonomic composition with respect to genera and species was similar, although the numbers of records obtained from countries in Central Africa were too low to allow meaningful comparisons with other regions.

Unlike myxomycetes, protostelid records only exist for seven countries in Africa. These are Egypt, Uganda, Malawi, Tanzania, Kenya, Algeria and South Africa (Ndiritu et al. 2009b, Winsett et al., unpublished data). Twenty-eight species are known from Kenya, 18 species from South Africa, 15 species from Tanzania, 18 species from Malawi, nine species from Algeria and only one species from Egypt and Uganda. For both myxomycetes and protostelids, the low number of species reported from Africa and its territories can be attributed largely to too few surveys and inadequately skilled local taxonomists. A detailed checklist of African dictyostelids is in preparation. Some references on African dictyostelids can be obtained in Swanson et al. (1999). Current efforts promise to provide a greatly expanded knowledge of African dictyostelids well beyond what has been previously summarized.

It is apparent from the available literature that little is known about slime mould species and ecology in Africa. Explanations why so little attention is given to these organisms are generally considered to be similar to those reasons why other areas are inadequately studied. Specialists in this field are typically found at American and European universities and museums and thus the greatest collecting effort is on the North American and European continents. There is also a sense that slime moulds fall into a category of organisms understudied because they are perceived to be insignificant. The fact that these organisms are free-living and nonpathogenic makes them poor candidates to attract research funds from governments, non-government organizations and private companies.

However, there are a number of reasons why we should study and understand slime moulds:

- First, slime moulds are ideal biochemical model research organisms. The simplicity of the life cycles of slime moulds (e.g. *Dictyosteliun discoideum* and *Physarum polycephalum*) makes them valuable in the study of genetic, cellular, and biochemical processes in more advanced organisms. For instance, in *D. discoideum,* the movement, chemical signaling, and developmental processes are applicable to human cancer research.
- Second, slime moulds are ideal educational model species. Most species of slime moulds are easy to grow in laboratories thus making them suitable organisms to teach many facets of biology to students. A significant number of species can complete a full life cycle in the laboratory using easy and inexpensive techniques (Stephenson and Stempen 1994).
- Third, slime moulds are ideal biogeographical model organisms. Unlike other amoebae that are difficult to identify, slime moulds are easy to distinguish using the morphological features of sporocarps and amoebae. Thus, slime moulds may serve as model organisms for understanding the local, regional and global geographic distribution patterns of amoebae (Stephenson et al. 2008).
- Fourth, slime moulds have a key ecological importance in nature. The three groups of slime moulds are found at all latitudes and most elevations on decaying vegetation. They are predators of bacteria and to a lesser degree on fungi and microalgae, which makes eumycetozoans important components of decomposition and nutrient cycling in any terrestrial ecosystem. There are suggestions that the feeding activities of slime mould assist in unlocking nutrients held by bacteria and, in the process, facilitate soil fertilization (Feest 1987).
- Fifth, slime moulds are sources of food. A number of organisms such as birds, beetles and animals are known to feed on slime mould fruiting bodies and plasmodia (e.g. Newton and Stephenson 1990). Although inadequately documented, there are suggestions that other large protozoa and amoebae such as *Amoeba proteus* prey upon slime mould amoebae.
- Sixth, slime moulds could be host organisms for certain types of pathogenic bacteria. The recent findings that the guts of amoebae are training grounds for pathogenic bacteria have indeed elevated the need for more research on bacteria-protozoa interactions (Molmeret et al. 2005). More research is needed to establish how this interaction manifests and how prevalent it is among different species of amoebae.
- Seventh, slime moulds can be beautiful and thus have considerable aesthetic value. Some species of slime mould are very beautiful and such opinions have and can continue to draw public interest in the biological significance and conservation of eumycetozoa and associated habitats.
- Last, slime moulds are included in the call for biodiversity conservation. The Convention of Biological Diversity notes that all organisms should be protected. Although none of the slime moulds species have been classified as threatened, emerging data seem to indicate that some of the species are rare and endemic in a number of habitats that are currently threatened by environmental degradation such as deforestation, overgrazing and pollution.

Ongoing taxonomical and ecological research, particularly of two groups of slime moulds (myxomycetes and protostelids), supports the above needs for more studies of slime moulds in Africa. The data resulting from the two collecting efforts described in the following sections suggests that Africa holds a wealth of knowledge relating to the biogeography, distribution, and biodiversity of eumycetozoans.

Status of protostelid and myxomycete diversity in South Africa

A recent review of all known records of myxomycetes from South Africa listed a total of 107 species. (Ndiritu et al 2009a). It was not surprising that no records of protostelids were found to exist. Prior to 2006, when this study was carried out, available literature indicates that no collection data or observations of myxomycetes had been published for South Africa since the mid-20th century (Doidge 1950, Ndiritu et al 2009a). As part of the effort to understand the global biodiversity of eumycetozoans, a collecting trip to South Africa was carried out in fall of 2006 [also see MycoAfrica 1(2)]. The trip focused on obtaining substrate samples from the major habitat types found in the country. Substrate material was collected from various locations in indigenous forests, plantation forests (pine and eucalyptus), *Fynbos,* and savanna, or *bushveld*.

All sample materials collected were brought to the laboratory at the University of Arkansas and standard methods were used to recover both myxomycetes and protostelids. Myxomycetes are normally studied using the moist chamber technique, while protostelids are studied using primary isolation plates (both techniques are described in detail at http://slimemold.uark.edu). Both methods simulate the ideal microhabitat for myxomycete and protostelids to germinate, grow and produce fruiting bodies. The common substrates collected for isolation of members of both groups are ground litter (decaying leaves and organic material on the forest floor), aerial litter (dead plant material still attached to the plant and hanging above ground), bark (especially bark from living trees) and coarse woody debris (twigs and woody pieces of organic material on the ground). Where available, dung of herbivorous or omnivorous animals can also serve as a significant substrate for culturing of myxomycetes.

In total, 79 species of myxomycetes were recorded, of which 39 are new reports for South Africa. Moreover, according to the recent synthesis of the literature regarding collections of myxomycetes on the African continent, seven of the species collected in 2006 have not been collected previously in any region of Africa. Substrate material examined for protostelids yielded 18 species, which represents approximately 55% of all described species known worldwide. These data suggest that extensive and intensive sampling efforts for this group of slime moulds should uncover most of the known species and possibly a few that are currently unknown to science.

The two most species-rich habitats were the indigenous forests and the bushveld habitat of Kruger National Park from which 55 and 43 different species, respectively, were collected. The high species richness found in the grasslands of Kruger National Park and the indigenous forests throughout the country was attributed to more adequate sampling when compared to other habitats, where sampling was less intensive or incomplete. The numbers of species recovered were comparable to those obtained in studies carried out in other parts of the world where similar sampling efforts were employed. The fynbos floral ecosystem, a terrestrial ecosystem unique to southern South Africa, had 24 species of myxomycetes, largely from moist chamber cultures. None of the species was particularly rare; however, several examples, including *Echinostelium cribrarioides* and *Paradiacheopsis fimbriata*, were found only in material from *fynbos* collecting sites and have not been reported previously from the African continent.

Biodiversity surveys of myxomycetes and protostelids in Kenya

In order to increase our knowledge of slime moulds in Africa, taxonomical and ecological surveys were conducted in a number of habitats in Kenya in August of 2004 and 2005 as well as in December 2006. These surveys were carried out under the auspices of the Planetary Biodiversity Inventory (PBI) Eumycetozoan Project, which primarily sought to understand the worldwide distribution and ecology of eumycetozoans. Samples were collected in the Aberdare Mountain region in central Kenya and the Kajiado District, an arid land in southern Kenya. Samples were obtained from several habitats under different land use/cover types, including agricultural lands of coffee and other crops, pastureland, plantation forests, xenomorphic, seasonal and montane forests, and arid shrubland.

Prior to this study, only 19 species of myxomycetes had been reported from Kenya. Interestingly, no records existed for protostelids from the entire country. Collectively, all of the surveys mentioned above yielded a total of 82 myxomycetes and 28 protostelids and subspecific taxa, of which 63 species of myxomycetes and all species of protostelids were new records for Kenya (Ndiritu 2009b). Meanwhile, four species of myxomycetes—*Physarum straminipes, Didymium saturnus, Didymium ochroideum* and *Macbrideola oblonga*—and eight species of protostelids were new records for Africa. As a consequence of these surveys, a significant percentage of the protostelids described worldwide (approximately 70%) are now known from Kenya. Only a small percentage of all of the myxomycetes known worldwide have been reported from the country, with the total representing only 26% of species reported from Africa and 9% of those described globally.

As expected, only a few species occurred in large numbers, while most of the species recorded were uncommon or rare (Ndiritu et al. 2010). This is an interesting ecological pattern and suggests that despite being widespread, these species can also have distinct biogeographical distribution patterns. Meanwhile, a strong relationship was found between protostelids and myxomycetes and certain environmental factors (at the local or microhabitat level) and land use/cover and dispersal rates at the regional level (Ndiritu 2009). All land use/cover types supported significant numbers of species, although community structure and species composition were remarkably influenced by substrate (litter versus bark), microhabitat (aerial versus ground) and land use/cover. Coffee plantations were very rich in myxomycetes and poor in protostelids, while mesic woodlands of either wildlife or livestock were rich in both myxomycetes and protostelids. Similar moderate to high numbers of species were observed in arid shrublands. Meanwhile, assemblages of myxomycetes and protostelids were consistently more diverse on aerial than on ground substrates, which were in contrast with what has been reported in most temperate habitats, where species assemblages are more diverse on ground substrates.

Finally, although a significant percentage of the frequently occurring species were recorded, it is obvious that most species regarded as being occasional or rare were missed. Future studies should seek to document the latter in order to determine their true distribution and abundance. Another interesting finding of this study was the strong spatial species variation and distribution patterns as a product of environmental factors at the local (or microhabitat) level and disturbance regimes at the land use/cover level, and dispersal rate effects at the regional level. This strong relationship found to exist between species assemblages and environmental gradients was an indication that naked amoebae (such as slime mould amoebae) are good indicators of environmental conditions. In addition, these results suggest that ecological studies of these organisms can also be approached using similar methods as macroscopic organisms, thought at different scales.

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Contribution of the National Botanic Garden of Belgium to the knowledge of Myxomycetes in Africa

By Myriam de Haan and Ann Bogaerts

The herbarium of the National Botanic Garden of Belgium (BR) contains about 1000 African exsiccata of Myxomycetes collected in Algeria, Angola, Benin, Burundi, Congo, Canary Islands, Ethiopia, Gambia, Ghana, Guinea, Ivory Coast, Kenya, Liberia, Malawi, Morocco, Niger, Rwanda, Senegal, South Africa, Tanzania, Togo, Tunisia and Uganda. This collection represents a total of 145 species.

Diachea silvaepluvialis M.L.Farr, *Physarum melleum* (Berk. & Broome) Massee and *Physarum pezizoideum* (Jungh.) Pavill. & Lagarde are the oldest specimens of myxomycetes from Africa in BR. They were collected by the American botanist O.F. Cook (1867-1949) during an excursion on Mount Coffee in Liberia. He worked in Liberia from 1892 until 1898 and was elected in 1896 as president of Liberia College. These Cook specimens are part of the important collection of the Dutch myxomycetologist N.E. Nannenga-Bremekamp (1916-1996), containing about 17 000 exsiccata from all parts of the world (Fig. 1). Of these 142 came from Gambia, Ivory Coast, Kenya, Liberia, Malawi, Rwanda, Senegal, South Africa or Tanzania. Mrs Nannenga-Bremekamp did not collect most of these specimens herself. Through her correspondence with many if not all myxomycetologists of her time, she received many “exotic” specimens.

Fig. 1 Specimens of Nannenga-Bremekamp.

The most important collector is certainly J. Rammeloo, mycologist and current director of the National Botanic Garden of Belgium. He specialised in myxomycetes for his master and doctoral thesis. From 1972 until 1990 he collected 466 specimens in Algeria, Burundi, D.R. Congo (formerly Zaire), Malawi, Rwanda and Zambia. This resulted in the description of seven new species and one new variety.

Arcyria afroalpina Rammeloo Bull. Jard. Bot. Belg. 51(1/2):229 (1981), Ref.: BR-MYCO 5839-19, Rammeloo J. 4997; 12 Oct. 1974. Rwanda ; SW of Karisimbi volcano.

Comatricha tenerrima (M.A.Curtis) G.Lister var. *macrospora* Rammeloo Bull. Jard. Bot. Belg. 53(1/2):298 (1983), Ref.: BR-MYCO 5838-18, Rammeloo J. 4996; 11 Oct. 1974. Rwanda; SW of Karisimbi volcano.

Colloderma crassipes Rammeloo, Bull. Jard. Bot. Belg. 53(1/2): 297 (1983), Ref.: BR MYCO 5471-39, Rammeloo 7564; Nov. 1981; Malawi, Mount Mulanje, Lichenya plateau, along Boma-path, on hepatics at a trunk base.

Hemitrichia rubrobrunnea Rammeloo, Bull. Jard. Bot. Nat. Belg. 48: 383–386 (1978), Ref.: BR-MYCO 24560-19, IMI 36917, July 1949, Sierra Leone, Njala, Kori, on fallen branch of *Chlorophora regia* A.Chev.

Perichaena areolata Rammeloo, Bull. Jard. Bot. Belg. 51(1/2): 229 (1981), Ref.: BR-MYCO 7614-48 - Van der Veken 10581, 1 Aug. 1974. Rwanda, west side of Mukavura (= Muhabura) volcano, on leaves of *Dendrosenecio* sp.

Perichaena dictyonema Rammeloo, Bull. Jard. Bot. Belg. 51(1/2): 230 (1981), Ref.: BR-MYCO 5747-24, Rammeloo J. 4582, 7 Sep. 1974, Rwanda, near the village Rugera; Valley Birara, at the base of hill Gisego, underside of rotting *Lobelia* sp. stem.

Perichaena heterobaculata Rammeloo, Bull. Jard. Bot. Belg. 51(1/2): 230 (1981), Ref.: BR-MYCO5837-17, Rammeloo J. 4994, 11 Oct. 1974, Rwanda, SW of Karisimbi volcano.

Metatrichia arundinariae (Rammeloo) Lakhanpal & Mukerji, Proc. Indian Natl. Sci. Acad., B 42(2-3): 128 (1977), Syn. *Trichia arundinariae* Rammeloo, Bull. Jard. Bot. Belg. 43(3-4): 349 (1973), Ref.: BR-MYCO 65761-92, Rammeloo Z116, 16 Mar. 1972, Congo, Kahuzi volcano, bamboo forest, on litter of bamboo (*Arundinaria alpine* K.Schum.)

Metatrichia floripara (Rammeloo) Rammeloo, Icon. Mycol. 1, pl. 47 (1984), Syn: *Trichia floripara* Rammeloo, Bull. Jard. Bot. Belg. 51(1/2): 230 (1981), Ref.: BR-MYCO 7638-72, Van der Veken 11037, 28 Aug 1974, Rwanda, Rugege forest, Butare-Cyangugu road, station of Uwinka, mountain rainforest with mainly *Mumulopsis sp.*

Fig. 2 *Arcyria afroalpina* (l) and *Metatrichia arundinariae* (r).

Another collection present at BR is that of B. Buyck, containing 107 specimens from an excursion in 1984 in Congo. He described one new species from Rwanda in the genus *Diderma*.

Diderma petaloides Buyck Bull. Jard. Bot. Nat. Belg. 53: 294–294 (1983), Ref. BR-MYCO 5701-75, Rammeloo 4428, 31 Aug. 1974, Rwanda, Butare-Cyangugu road , Km 93, Rugege forest, on bark of rotting branch.

J. Schreurs, a Dutch mycologist who worked for the National Botanic Garden, collected 95 specimens in 1986 in D.R. Congo. Other collectors with less than 20 specimens in BR:

D.W. Mitchell 18 specimens, D.R. Congo (formerly Zaire), 1987;

P. Van der Veken 12 specimens, D.R. Congo and Rwanda, resp. 1972 and 1974;

H. Vanderyst 11 specimens, D.R. Congo, 1907-1928;

G. Thiry 10 specimens of moist chamber culture, Namibia and South Africa, 1987 and 1984;

A. De Kesel 6 specimens, Benin, 1999-2002;

P.C. Holland 6 specimens, Tanzania, 1972-1974;

Van Hove 5 specimens, D.R. Congo, 1965-1969;

Goossens-Fontana 4 specimens, D.R. Congo, 1925-1933;

C. Cocquyt 3 specimens, Burundi and Uganda, 1982 and 2009.

Collectors with 3 specimens from D.R.Congo in BR: A. Dewèvre, 1895-1896; M.C. Schmitz-Levecq, 1959; P. Staner, 1926-1930.

Collectors with 2 specimens in BR: A. Leeuwenberg, Côte d'Ivoire, 1959; D. Thoen, Guinea and Senegal, 1988 and 1986; T. Ukkola, Tanzania, 1995.

Collectors with 1 specimen in BR: M. Härkönen, Tanzania, 1988; E. Petit, Burundi, 1967; F. Hendrickx, D.R. Congo, 1960.

For more details about the history and information about some of the collectors:

Rammeloo, J. (1994). The contribution of the National Botanic Garden of Belgium to the mycology of Africa. In J.H. Seyani & A.C. Chikuni, Proc. XIIIth Plenary Meeting AETFAT, Malawi, 1: 671-685.

Important publications of the National Botanic Garden of Belgium related to Myxomycetes in Africa.

The “Flore illustrée des Champignons d’Afrique Centrale” is a series of 17 fascicles, three of which treat a number of genera of Myxomycetes. Fascicules 8-9 on the Trichiales comprise the following genera: *Acryria*, *Calomyxa*, *Hemitrichia*, *Metatrichia*, *Perichaena*, *Prototrichia*, *Trichia*. Fascicule 11 on the genus *Diderma* and the orders Echinosteliales and Stemonitales treats the following genera: *Clastoderma*, *Colloderma*, *Comatricha*, *Diachea*, *Diderma*, *Lamproderma*, *Stemonitis*, *Symphytocarpus*. Identification keys are provided to all the genera of the relevant families and to the collected species of each treated genus. The illustrations consist of pen drawings of the spores of each species and some fruiting bodies. Plates with water colour drawings of all species are also included.

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Buyck, B. (1983) *Diderma* (Physarales, Myxomycetes). Fl. Ill. *Champ. Afr. Centr.* **11**: 201-213, pl. 36-38.

Rammeloo, J. (1981) Trichiales (Myxomycetes). Fl. Ill. *Champ. Afr. Centr.* **8-9**: 133-170, pl. 23-31.

Rammeloo, J. (1983) Echinosteliales et Stemonitales (Myxomycetes). Fl. Ill. *Champ. Afr. Centr.* **11**: 214-245, pl. 39-43.

Projects regarding African Myxomycetes collections in BR

“Digitisation of the water colour drawings and slides of African Fungi kept at the National Botanic Garden of Belgium.” Funded by the Mellon Foundation in 2006.

This project aimed to digitise the water colour drawings and slides of Fungi and Myxomycetes that had been studied in detail (and in most cases published). Besides the resource in BR there are very few resources of images of well-studied specimens. The need for a good iconography is extremely high, not only for African countries but for all mycologists working in tropical regions. The project participated to the repatriation of scientific data originating from African material kept in an institution in the north.

“Linking local databases for collections of plasmodial slime molds (Myxomycetes) to create a global web-based herbarium.” Funded by the GBIF in 2005.

This project was linked and extented five ongoing initiatives (Herbaria BR, M, MA, LE & UARK) to database myxomycete collections in order to create a global virtual herbarium using these databases via the GBIF network. This joint virtual herbarium contains an estimated total of 90 000 specimens, with almost one third of all types. This joint virtual herbarium enables taxonomists to access sufficiently large series of specimens. For BR all the data of the Herbarium of N.E. Nannenga Bremekamp, the collections of J. Rammeloo and other important collections were made accessible on the web. In total 22 857 records are made accessible, of which 11 583 with geographical coordinates. The data can be found on the following website: http://data.gbif.org/datasets/resource/88/

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Opinion

Taxonomic publications of microfungi from Africa

By Jo Taylor

One thing you don't see a lot of in the mycological literature is taxonomic publications written by Africans. There are sometimes papers written by folks from foreign institutions about fungi collected in Africa (often with no African collaboration) but, in general, and this is certainly the case for taxonomic papers, very little in the way of publications. Now, one thing that Africa is not short of is fungi to write about! In fact, the amount of fungi there are in Africa which have not been recorded and treated is almost overwhelming. Another thing Africa is not short of is talented individuals to work on these fungi. I spent 4 years working in Botswana and was privileged to work with some of the hardest working and dedicated students I have ever encountered. Colleagues in the field of mycology at the University of Botswana too were always keen to publish, but it was not easy, and I can testify to that.

There were several main issues. Firstly equipment. For most fungal taxonomic papers (and I will discuss these as I have little experience in cell biology, plant pathology or genetics) you will need a good microscope and stereomicroscope mounted with a digital camera and an associated computer; and a cryostat microtome or some other sort. You will also need access to equipment to culture fungi, store cultures and herbarium specimens; further equipment to extract DNA and carry out PCR and the ability to send your PCR products somewhere to be sequenced and to generate phylogenetic trees. State of the art equipment is expensive to buy, needs to run in specific conditions (e.g. air conditions rooms) and training is needed to use the equipment properly.

Secondly, funding for post graduate students. Lecturers and researchers with busy schedules cannot properly carry out the research and need help from students – plus students need training to continue their career interests. However, this is often not forthcoming and therefore will impact on the volume of publications.

Lastly, and this is where I can offer some help, and is not related to funding, literature. In recent years, huge efforts have been made to make some of the most crucial literature necessary to identify fungi and enable lists to be generated and fungi to be treated. Without this literature you literally cannot make a start in your attempt to identify your fungi. Within your own specific field you should be familiar with the body of literature necessary to pin down some sort of name on your fungi. For instance, for ascomycetes and their anamorphs I would need the following (and this does not include some major references on food or soil borne fungi or the important genera *Penicillium*, *Aspergillus* and *Fusarium*): Arx and Müller (1954), Barr (1987, 1990), Carmichael *et al.* (1980), Ellis (1971, 1976), Hanlin (1990, 1998), Kirk *et al.* (2008), Müller and Arx (1962), Nag Raj (1993), Sivanesan (1984), Sutton (1980), and a French ,German and Latin dictionary.

It would be nice if some of these were digitised as many are out of print now. Already you are up against a stumbling block here. Who has access to all these sources of literature, which are basic to ascomycete identification?? Well many institutions in developed countries do, even individuals for that matter. So your first step might be to try narrow down what you have and contact an individual in that field for assistance. Quite often these days it can be difficult for researchers in developed countries to gain access to material in under researched countries - maybe just in not having the time to visit, so if you can make good collections (properly labelled), *and* get cultures, you might find someone interested in working with you. If they can help you get this fungus to family or genus then there can be a lot of input from you, after all this is now a collaboration and just sending a fungus on a piece of leaf and a culture is not enough!

Once you have a genus name then you can search the genus in **Index Fungorum** (http://www.indexfungorum.org/) and see how many species there are in the genus (you can also check the taxonomic hierarchy in the **Dictionary of the Fungi Hierarchy** to look for other similar genera in the family of fungi you are working on). Index Fungorum allows you to check current names, and shows correct authorities and synonyms. It also has links to pages where the descriptive information is given. **Mycobank** (http://mycobank.org) also has nomenclature information and is linked to Index Fungorum, and recent descriptions also have linked sequence data, descriptions and even figures. The **Taxonomy** browser of NCBI or National Center for Bioinformatics Information (http://www.ncbi.nlm.nih.gov/), also lists classification of fungi, and those are linked to available sequence accession in the database. **Cybernome** on the **Cybertruffle** website (http://www.cybertruffle.org.uk/eng/index.htm) is also useful for these searches. These are a very useful first step. For an idea on literature available you could then try the **Bibliography of Systematic Mycology** (http://www.indexfungorum.org/BSM/bsm.asp). This lists taxonomic and also biodiversity, distribution, evolution literature pertaining to a genus. Also the **Systematic Mycology and Microbiology** website (http://nt.ars-grin.gov/fungaldatabases/index.cfm) which lists literature, host-fungus distributions, specimens, nomenclature etc. for mainly plant pathogenic fungi and mainly those in the USA. Already you will have developed a list of names and sources of literature where you can then search for these fungi. Cyberliber is a superb source of some of the most important and classical fungal publications (http://www.cybertruffle.org.uk/eng/index.htm). It has digitised versions of Annales Mycologici, Grevillea, Mycotaxon and Mycologia. The website of the Centraalbureau voor Schimmelcultures (http://www.cbs.knaw.nl), also has useful polyphasic idenfication databases, and other scanned books.

Regarding journals, **Fungal Diversity** (http://www.fungaldiversity.org/fdp/jumble.php), **Persoonia** (http://www.persoonia.org/) and **Studies in Mycology** (http://www.studiesinmycology.org/) are available online to use for free. Googling the paper you are looking for will often lead to a PDF version of it popping up, or even just the abstract where you might be able to ascertain if the paper is useful. You could contact researchers and ask for PDFs of relevant papers.

So by undertaking these searches (assuming you have an internet connection, which is a reasonable assumption I think), you are well on your way to making a useful contribution to a paper. You must do it carefully and be as comprehensive as possible. You could also further collaborate by undertaking measurements (any microscope with a x100 lens and a calibrated eyepiece graticule), and maybe making drawings if you have access to a *Camera Lucida*. Even if you have all the relevant literature at your fingertips, identifying fungi and compiling lists, etc. is often difficult, so don't expect it to be easy. However, it is now a lot easier than it used to be and it is possible that you may not be aware of these recent developments in terms of access to important literature. So go on, give it a go and let's see some more quality publications out there with African names on them!

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Message from the committee

Dear AMA members

It is the end of 2009 and a promising and clean 2010 is waiting. Herewith I wish you all a successful new year full of new opportunities and completed projects. Those of you with a slightly different system of new year celebration, I hope the same applies to you.

Best wishes,
Marieka Gryzenhout
President

Important Dates

36th Annual Conference of the South African Association of Botanists (SAAB)
Potchefstroom, South Africa
Congress: 11-13 January 2010

First International Conference of Basic and Applied Mycology - Society of Basic and Applied Mycology (SBAM)
Assiut, Egypt
Congress: 9-11 March 2010

International Mycological Congress (IMC9)
(hosted by the British Mycological Society)
Edinburgh, Scotland
Congress: 1-6 August 2010
www.imc9.info

Mycology Society of America (MSA)
University of Kentucky, Lexington, USA
Congress: 28 June-1 July 2010

VISIT THE FOLLOWING SITE FOR COMPREHENSIVE LISTS OF UPCOMING CONGRESSES
Horizon Press for lists of microbiology congresses
http://www.horizonpress.com/conferences/

Useful websites

(Updated every second issue, more websites in previous issues.)

Interesting and fun fungus facts http://www.mycorant.com/

Fungus images
http://www.mycolog.com

Fungal Environmental and Informatics Network
http://www.bio.utk.edu/fesin

German Mycological Society
http://dgfm-ev.de

International Society for Human and Animal Mycology (ISHAM)
http://www.isham.org

Mold testing and identification services
http://www.pioneer.net/~microbe/abbeytab.html

Mycology Education Mart
http://www2.bio.ku.dk/mycology/courses

***Pleurotus* spp.**
http://oystermushrooms.net

Species of Glomeratomycota website
http://www.amf-phylogeny.com

Myxomycete research:
Annotated species list of African myxomycetes
http://www.mycotaxon.com/resources/checklists/nditu_v107-checklist.pdf
Slime molds
http://slimemold.uark.edu
Virtual herbarium
http://data.gbif.org/datasets/resource/88/

African Library

Literature pertaining to slime moulds from Africa and useful for slime mould research

(please refer to two features in this issue)

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QUESTIONNAIRE OF AFRICAN MYCOLOGISTS FOR THE AMA

(please post/fax to Marieka Gryzenhout)

Name:

Title:

Institution and Postal Address:

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Research interests (choose one or between cell biology, physiology, ecology, pathology, molecular biology, systematics, evolution, medical mycology):

Specific interests:

Details of other African mycologists who may want to join AMA:

Skills to offer AMA (committee member, conference organiser, fund raising etc.):