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Fungal Conservation



INTERNATIONAL SOCIETY FOR FUNGAL CONSERVATION

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The *International Society for Fungal Conservation* was established in August 2010, and now has members in over fifty countries. The objective of the Society is to promote conservation of fungi globally. It acts as a global federation for fungal conservation groups, supporting, guiding, co-ordinating and functioning as a forum for regional, national and local bodies seeking to promote fungal conservation. Membership is open to any individual or organization with a genuine interest in fungal conservation. The Society's Council consists of its Officers, Elected Councillors, Representatives of External Organizations and Regional Delegates.

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Myxomycetes from a Conservation Perspective

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Myxomycetes, also known as slime moulds, are poorly-known and mysterious but amazingly photogenic organisms. At first they were thought to be fungi, but now there is general agreement that their true position is among the protozoa. The traditional association with fungi remains, however: many of those who study them are mycologists, they are covered by the same nomenclatural code, and are listed in mycology's main reference work, the *Dictionary of the Fungi* (Kirk *et al.*, 2008). As a result, they are also covered by our Society. There are just over a thousand known species, but doubtless many more remain to be described. With a few exceptions, there has been little interest in their conservation. In 2009, however, the IUCN Species Survival Commission established a Chytrid, Zygomycete, Downy Mildew and Slime Mould Specialist Group, and that group has now begun a project to look at myxomycetes as a group from a global conservation perspective. The *Mohamed bin Zayed Species Conservation Fund* [www.mbzspeciesconservation.org] has most generously agreed to support the initial work of this project.

The project aims to prepare a global-level assessment of what is known about the habitats and populations of these organisms, the ecological services they provide, and the threats they may face. Until that is done, nobody knows if there is any evidence for population changes, or (with very few exceptions) if there are any clearly identifiable threats. It is clear that, for myxomycetes, this is pioneer work. At this starting point, we don't even know for certain what information is needed or what questions we should be asking. The project is thus only the start of a long journey. It will prepare a foundation on which future conservation policy for myxomycetes can be developed.

As a first step, an outline has been prepared. This is a simple structure listing the main topics and, within them, the more specific components (pieces of information) which we think may be needed. We have not found any other general reviews of large taxonomic groups in mycology made from a conservation perspective which could be used as a template, and so have had to invent our own. In making our outline, one important source has been the IUCN's MS-WORD questionnaire, distributed as part of its red-listing process. That questionnaire deals with individual species rather than attempting to review about 1000 species at once as we are trying to do, but it provides highly relevant indicators of the sort of data which will be needed further down the road. Our outline, set out below as an appendix to this note, is likely to have many omissions and deficiencies. We emphasize that it is only a first draft which is likely to change and, probably, become more extensive.

The outline is rather large, with a lot of different components. After some of the headings, there are brief notes describing the direction of the component, or indicating what is already known. These are also very much in draft form. For some of those components, there is already published information. A full review of existing literature will therefore be important during the early stages of this project. In other cases, the issues raised have probably never been investigated and, indeed, may never previously have been considered. We are expecting that, for many components, the present state of affairs is that we simply do not know. Some of the components may seem odd in the current context. For example questions about exploitation or persecution. It will not be a surprise if these turn out to be irrelevant to myxomycetes, but they are issues which are routinely explored when applying IUCN red listing categories and criteria

and, by including them, the present template is also made more suitable for further use with fungi. In conjunction with this outline, a bibliography of publications about myxomycetes is also being prepared.



Craterium minutum, one of four "charismatic endangered myxomycetes" appearing on Darwin Initiative postcards distributed at ICSEM6 [6th International Congress on the Systematics and Ecology of Myxomycetes, Yalta, 2008] (photo: Alain Michaud).

Mycologists in general, and myxomycetologists in particular, are invited to look at the outline and consider what improvements and additional items might be appropriate. Constructive comments and offers of assistance will be warmly received. We are particularly anxious to know if there is any existing review of the general conservation status of myxomycetes (or indeed of fungi) which we have missed. Please notify us of important questions we have not thought to ask, and if you have knowledge of relevant publications providing information about individual components, please draw them to our attention. Lastly, if you have relevant unpublished information which you are willing to make available to this project, we will be most grateful to receive it. All contributions will be acknowledged in the review when it is published. We hope that, after such improvements, this outline could serve as a template for other similar work in conserving fungi and similar organisms.

References

Kirk, P.M., Cannon, P.F., Minter, D.W. & Stalpers, J.A. (2008). *Dictionary of the Fungi*. Edn 10. 771 pp. UK, Wallingford: CAB International.

Appendix: draft outline document

Information Needed for Reviewing Myxomycetes from a Conservation Perspective

1. Taxonomic diversity and species numbers of myxomycetes

- 1.1 What taxonomic systems exist for myxomycetes? **Notes.** *IndexFungorum* and *nomen.eumycetozoa.com*. What others are there?
- 1.2 Which taxonomic system should be used for this evaluation? **Notes.** For conservation purposes, a widely-available rather conservative system may be better than a very up-to-date system which is as a result subject to more changes.
- 1.3 What classes, orders, families and genera are recognized by that system? **Notes.** This information can now be derived from on-line taxonomic systems.
- 1.4 How many species are there? **Notes.** The *Dictionary of the Fungi* [edn 10] gives a figure of just over 1000. What other estimates are there?
- 1.5 What molecular-based information is there about myxomycete taxonomy?
- 1.6 Is that molecular information likely to affect the arrangement of higher taxonomic ranks of myxomycetes?
- 1.7 Is that molecular information likely to affect estimates of species numbers?
- 1.8 Are there any estimates of the proportion of myxomycete taxa not yet discovered / described and, if so, which groups are thought to contain them?

2. Sources of information about myxomycetes

- 2.1 Is there a list of people who are expert in myxomycetes? **Notes.** We have lists of participants from the three most recent ICSEM [*International Congress for Systematics and Ecology of Myxomycetes*] meetings.
- 2.2 What dried reference collections exist with myxomycete specimens?
- 2.3 What culture collections of myxomycetes exist?
- 2.4 What searchable databases are there for myxomycetes? **Notes.** Google and other search engines. *Cybertruffle's Robigalia* [www.cybertruffle.org.uk/robigalia], *Genbank* [<http://www.ncbi.nlm.nih.gov/Taxonomy>], *GBIF* [www.gbif.org], *New Zealand Fungi (and Bacteria)* [<http://nzfungi.landcareresearch.co.nz>], *USDA Fungal Databases* [<http://nt.ars-grin.gov/fungalbases>].
- 2.5 What are the main myxomycete publications relevant for conservation? **Notes.** A bibliography is being prepared. Are there any serial publications dedicated to myxomycetes? *Biodiversity Heritage Library* [www.biodiversitylibrary.org] and *Cyberliber* [www.cybertruffle.org.uk/cyberliber] both have search facilities providing access to publications about myxomycetes.
- 2.6 What websites are there dedicated to or with significant information about myxomycetes? **Notes.** *Eumycetozoa Project* [<http://slimemold.uark.edu>], *Myxomycetes* [www.myx.dk], *Myxomycetes of Ukraine* [<http://myxomycet.com.ua>]. *Encyclopedia of Life* [<http://eol.org/pages/5742/overview>], *Wikipedia* [http://en.wikipedia.org/wiki/Slime_mold] also contain a growing corpus of information. Information about websites in languages other than English particularly welcomed.

3. Geographical distribution of myxomycetes

- 3.1 Do any distribution maps of myxomycetes exist (globally, by continent, by region, by countries, within countries)? **Notes.** For the larger countries (Australia, Brazil, Canada, China, India, Kazakhstan, Russia and the USA) within country information is

particularly important. There are extensive maps on the *Eumycetozoan Project* and the *GBIF* websites: what other distribution maps are available?

3.2 What checklists have been published for myxomycetes?

3.3 What countries have information about their myxomycetes, and what countries have none? **Notes.** To what extent is this an indication of their distribution?

4. Ecology of myxomycetes

Notes. The WWF classification scheme with 14 terrestrial habitat categories is used here (it does not cover ruderal or artificial habitats). The IUCN scheme, with 18 categories (including marine and freshwater) is similar and does cover ruderal and artificial habitats, but is currently under review. What other habitat classifications should be considered?

4.1 What is known about myxomycetes in the different WWF habitat types? **Notes.** These habitat types are defined primarily on the basis of plant communities, so this component of the outline is a review of myxomycetes from a plant perspective.

4.1.1. Tropical and subtropical moist broadleaf forests (tropical and subtropical, humid).

4.1.2. Tropical and subtropical dry broadleaf forests (tropical and subtropical, semihumid).

4.1.3. Tropical and subtropical coniferous forests (tropical and subtropical, semihumid).

4.1.4. Temperate broadleaf and mixed forests (temperate, humid).

4.1.5. Temperate coniferous forests (temperate, humid to semihumid).

4.1.6. Boreal forests/taiga (subarctic, humid).

4.1.7. Tropical and subtropical grasslands, savannas, and shrublands (tropical and subtropical, semiarid).

4.1.8. Temperate grasslands, savannas, and shrublands (temperate, semiarid).

4.1.9. Flooded grasslands and savannas (temperate to tropical, fresh or brackish water inundated).

4.1.10. Montane grasslands and shrublands (alpine or montane climate).

4.1.11. Tundra (Arctic).

4.1.12. Mediterranean forests, woodlands, and scrub or sclerophyll forests (temperate warm, semihumid to semiarid with winter rainfall).

4.1.13. Deserts and xeric shrublands (temperate to tropical, arid).

4.1.14. Mangrove (subtropical and tropical, salt water inundated).

4.2 Are any myxomycetes restricted to only one of those habitats and, if so, is that habitat endangered?

4.3 Are any myxomycetes known from freshwater or marine habitats?

4.4 Can ecological groups of myxomycetes be determined on the basis of communities of sporocarps of different species (i.e. can myxomycete communities be discerned in the same way as plant communities - is there such a thing as geomyxomycetology, analogous to geobotany)?

4.5 Are there ecological groups of myxomycetes determined by substratum? **Notes.** Myxomycetes are known from the following substrata: animals (animal bodies, dung), artefacts, fungi (lichen-forming species and their symbionts, non-lichen-forming fungi), naturally occurring materials (soil), plants (bark, bryophytes, deciduous trees, herbs, leaves, lianas, wood, xerophytes).

4.6 What is known of the ecology of the plasmodial stage of myxomycetes?

4.7 How are myxomycetes dispersed?

4.8 What role do myxomycetes play in ecosystems, and what would be the impact of their loss?

4.9 Are any myxomycetes obligately associated with other organisms and, if so, are any of those organisms endangered?

- 4.10 Are there any organisms obligately associated with myxomycetes?
- 4.11 Are any organisms associated with myxomycetes themselves endangered?

5. General biology of myxomycetes

- 5.1 What is known about the length of myxomycete life cycles, and of individual components of their life cycle?
- 5.2 Are there any aspects of life cycle length which might make myxomycetes vulnerable to particular threats?
- 5.3 Are there any aspects of myxomycete physiology which might make them vulnerable to particular threats? **Notes.** These aspects could be considered for their spores, plasmodia and fruitbodies.

6. Evidence for changes in population status

- 6.1 Has any work been done on myxomycete population biology?
- 6.2 Is it possible to define individuals in myxomycete populations and, if so, how should this be done?
- 6.3 Are there any agreed ways to determine abundance of myxomycetes?
- 6.4 Have any estimates been made of the size of populations of any myxomycete species?

7. Threats to Myxomycetes

- 7.1 The following is a list of threats which have been identified for other organisms. Which of those threats affect myxomycetes? Are there other threats to myxomycetes not listed?

Climate change: changes in available associated organisms / substrata; decreased precipitation; expansion of subtropical deserts; forest fire; increased frequency of extreme weather; increased precipitation; loss of ice caps; loss of permafrost; marine acidification; sea level change.

Pollution: air pollution (carbon monoxide, chlorofluorocarbons, dust e.g. from fires associated with clear felling, nitrogen oxides, sulphur dioxide / acid rain); litter; radioactive pollution; soil pollution (acidification, arsenic, benzene, fertilizers, fungicides, heavy metals, herbicides, hydrocarbons, MTBEs, pesticides, zinc); thermal pollution (local, as opposed to climate change which is general); freshwater and marine pollution (chlorine, fertilizers, fungicides, heavy metal, herbicides, pesticides, sewage).

Habitat destruction: conflict; conversion of land to agriculture; deforestation (temperate old-growth forests, tropical dry deciduous forests, tropical rainforests); desertification; fragmentation of habitats; infrastructure extension (e.g. holiday resorts, new roads, urbanization); invasives; loss of wetlands; mining; monocultures replacing species-rich sites; nutrient depletion.

Exploitation / persecution. **Notes.** This category of threat is unlikely to be relevant for most myxomycetes, but there may be some collecting for medicinal purposes, and there may be some "trophy" collecting of rare species, and control of myxomycete plasmodia, for example on lawns and golf courses.

8. Analysis of IUCN criteria in context of Myxomycetes

- 8.1 What efforts have been made to evaluate myxomycetes using IUCN categories and criteria? **Notes.** Ten nivicolous myxomycetes have been evaluated provisionally (*IMI Descriptions of Fungi and Bacteria* Set 184).
- 8.2 Do any other red-lists of myxomycetes exist using other systems?

9. Infrastructure for myxomycete conservation

- 9.1 Do any societies exist which are devoted entirely to myxomycetes?
- 9.2 What other societies have an interest in myxomycetes? **Notes.** Generalist mycological societies are known to be interested; are there other societies, for example general conservation groups, plant pathology societies, geographical societies etc. with an explicit interest in myxomycetes?
- 9.3 Which countries provide legal protection for myxomycetes? **Notes.** What form does this legal protection take? Is it a blanket protection of all organisms, or are myxomycetes specifically mentioned?
- 9.4 Are there any protected areas (nature reserves etc.) set up primarily for myxomycetes?
- 9.5 Do any more general protected areas have policies for managing myxomycetes?
- 9.6 Are myxomycetes taken into account anywhere in biodiversity management plans on military land?
- 9.7 Do any national reports or action plans for the CBD (Rio Convention) explicitly consider myxomycetes?

10. Conservation of Myxomycetes

- 10.1 Have any efforts been made actively to promote in situ conservation of myxomycetes?
- 10.2 What prospects exist for ex situ conservation? **Notes.** Are there any culture collections which include myxomycetes and which are sympathetic to conservation rather than regarding their holdings as no more than a resource for industry?
- 10.3 Public awareness of myxomycetes is very low, but myxomycetes are visually very attractive organisms. What if anything is to be gained by trying to raise public awareness?
- 10.4 What other resources exist for promoting myxomycete conservation? **Notes.** Amateurs donating their time and skills, funds etc.

Possible impacts of climate change on fungal diversity in Cuba: a pilot study on members of the *Meliolaceae*

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Introduction

This note briefly reports a pilot study using climate change data to model possible changes in one group of fungi in Cuba. Thirty two species of the ascomycete family *Meliolaceae* have been recorded from Cuba. All are obligate plant parasites, and each is generally found only on plants of one or a few closely related genera. Sixteen of them parasitize Cuban endemic plants, and these plants are in any case vulnerable because of their restricted distribution. Those sixteen fungi were the subject of the present work.

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