

Citizen Taxonomy in Social Media: The Use of Facebook for Mapping Species Distribution of Myxomycetes

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ABSTRACT

Citizen science is a research collaboration between scientists and volunteers who provide data for education, conservation, and environmental protection. Volunteers, often the locals in the area, provide data on species occurrence while researchers perform distribution mapping or other data analysis. Social networking sites including Facebook, Twitter, and Flickr can be used as platforms for the public to share their photos of species and for scientists to aid in identification. In this article, we show how social media groups can be used to generate data on species distribution of myxomycetes.

Key Words citizen science; distribution map; social media; Facebook; slime molds.

○ Introduction

Citizen science traces its beginning to modern science when citizen scientists volunteer to gather and collect data as part of a science inquiry (Silvertown, 2009). Irwin (1995) first coined the term *citizen science* and described it as a form of research collaboration between “expert” and “non-expert” individuals. This modern way of collaborative study provides a speedy gathering of data by many individuals in a relatively short period of time (Catlin-Groves, 2012). Citizen scientists provide data about occurrence and distribution across habitats around the world over a given time while citizen science projects significantly advance scientific knowledge and promote scientific literacy (Bonney et al., 2009). Collection of records without these volunteers would also be costly and even impractical (Kosmala et al., 2016). Bruyere and Rappe (2007) have further stated that volunteer citizen scientists equally benefit

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from this engagement, and if provided with learning opportunities, they are likely to volunteer again in future projects (Ryan et al., 2001). Outputs generated from these collaborations could also be used in conservation studies, environmental protection, and species mapping (Pocock et al., 2017; Sumner et al., 2019). A very successful example of citizen science is the Christmas Bird Count, now a program of the National Audubon Society in the United States. The Christmas Bird Count started in 1900 and has so far documented a total of 63 million birds (Silvertown, 2009). Webinars, conferences, and other information about citizen science—including an open-access, peer-reviewed journal dedicated to the publication of research papers, case studies, essays, and method papers on citizen science—can be found at <https://www.citizenscience.org>.

The advent of technology created global connectivity among citizens. It also led to virtual “field assistants” who can easily be mobilized to assist in the data gathering of species’ presence and distribution. Promising platforms for citizen scientists to post their species observations are social networking sites, including Facebook and Twitter (Catlin-Groves, 2012; Liberatore et al., 2018). Surveys have shown the enormous reach of these social networking sites. For example, in developing countries in 2015, 54% of adults were internet users while 37% of the population owned mobile technology (Poushter, 2016). In 2017, 2.86 billion social network users were reported worldwide, and the number increased to 3.6 billion in 2020 (Statista, 2020). Here, when extensive field collection would not be possible, we use a social media group to gather information on the occurrence and distribution of myxomycetes. We list the species posted in the social media site, categorize them into taxonomic genera and orders, and prepare a distribution map. We describe how these activities can be used in teaching.

○ The Myxomycetes

Myxomycetes, also known as plasmodial slime molds, are a group of fungus-like protists that disperse spores from a single fruiting body and later germinate to either myxamoebas or swarm cells (Rojas & Stephenson, 2013; Dagamac & dela Cruz, 2019). Sexual reproduction occurs when two compatible haploid cells fuse to form a diploid cell (Clark & Haskins, 2013). The diploid zygote begins feeding which initiates mitosis without cytokinesis to form an assimilative, protoplasmic, multinucleated mass called plasmodium (Everhart & Keller, 2008). Plasmodium comes in different sizes and color and moves via cytoplasmic streaming on different substrata to prey on food microorganisms, thereby maintaining the balance among the microbiota in soil (Feest & Madelin, 1988). When conditions are unfavorable, the plasmodium transforms into fruiting bodies that appears like miniature fungi. The fruiting bodies of myxomycetes are often observed in the field and are useful for species identification.

Myxomycetes are found almost anywhere on the earth, both in temperate and tropical regions (Lado et al., 2013; Rojas & Stephenson, 2013; Dagamac & dela Cruz, 2015). They are abundantly present in many forested regions, especially in areas with decaying twigs, logs, and leaf litter (Stephenson & Stempfen, 1994). These substrata, also called microhabitats, provide them with sufficient supplies of bacteria, yeasts, fungal spores, microalgae, and other microbes, upon which they prey (Lado et al., 2013). Myxomycetes also colonize other unique substrata such as grass litter, woody vines, and inflorescences (Carascal et al., 2017; Pecundo et al., 2017). Fruiting bodies of myxomycetes can therefore be observed in the field on these substrata. More information about myxomycetes can be found at <http://slimemold.uark.edu>.

○ The Slime Mold Identification & Appreciation Facebook Group

Facebook (FB) is one of the most used social networking sites where people can easily upload photos, share personal details, and even leave online messages. Among its features is the FB group, which allows for a more private platform where users with similar interests or hobbies share information and discuss certain topics common to all (Pi et al., 2013). In the study of Park et al. (2009), students joined FB groups for information on both on- and off-campus activities, for socializing with friends, for seeking self-status, and for finding entertainment. Specific FB groups are also created for dissemination of advocacies on environmental protection, for information about certain groups of organisms, and for sharing of images. Such is the case of the FB group called Slime Mold Identification & Appreciation, which is accessible at <https://www.facebook.com/groups/SlimeMold>. Created on December 4, 2014, the group is for species identification through sharing of images of slime molds and other exchanges of information on myxomycetes. Species identity is considered only as “best guess” since a detailed microscopic examination is required for proper species identification. The administrators of the group also set rules and posting guidelines. For example, posts should be on or related to myxomycetes only. Accurate information should be provided in relation to the location and substrata where the myxomycetes was observed. If identification is not certain, this should be indicated as an educated guess by those commenting on the posts. It is also expected that members are kind and courteous in their posts as the group aims to create

a welcoming environment, particularly to those who do not know a lot about slime molds. On January 22, 2022, this public FB group had about 32,500 members worldwide, was moderated by 9 administrators, had more than 650 posts in the last month, and had gained 161 new members in the last week. The group site does not provide any information on the number of members per country.

○ Profiles of Myxomycetes from Facebook Posts

Initially, permission request from the group administrators and members to use the information from their FB posts was posted on the group site. Data was generated from the whole month of May 2020. We gathered the presumptive species names of myxomycetes posted in the FB group and the locality or geographic origin (country). During the one-month survey, a total of 164 images of myxomycetes were posted from 21 countries, most of which came from the United States (96 entries), followed by Canada (14), Australia (6), United Kingdom (5), Czech Republic (5),

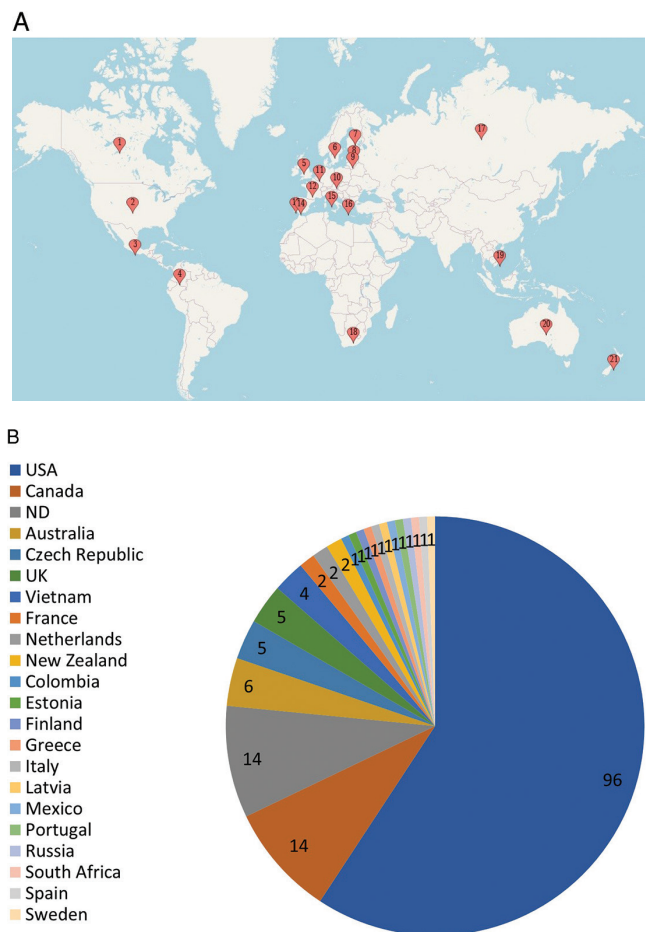


Figure 1. (A) Global map showing the 21 countries where the posted images of myxomycetes were observed. Map was generated using MapCustomizer (<https://www.mapcustomizer.com>). (B) Number of entries (= number of specimens) of myxomycetes recorded for each locality (country). ND denotes unspecified locations on the posted images.

Table 1. Species list of myxomycetes posted on the Facebook group Slime Mold Identification & Appreciation for the month of May 2020.

Taxonomic Order	Documented Species	Number of entries (n = 164)
Cribrariales	<i>Cribraria cancellata</i> (Batsch) Nann.-Bremek	2
	<i>Cribraria purpurea</i> Schrad.	1
	<i>Cribraria</i> sp.	1
Liceales	<i>Alwisia lloydiae</i> Leontyev, S.L. Stephenson & Schnittler	1
Physarales	<i>Diderma effusum</i> (Schwein.) Morgan	1
	<i>Diderma</i> sp.	1
	<i>Diderma spumarioides</i> (Fr. & Palmquist) Fr.	1
	<i>Didymium</i> sp.	3
	<i>Didymium squamulosum</i> (Alb. & Schwein.) Fr. & Palmquist	1
	<i>Didymium vaccinum</i> (Durieu & Mont.) Buchet	1
	<i>Fuligo intermedia</i> T. Macbr.	1
	<i>Fuligo septica</i> (L.) F.H. Wigg.	26
	<i>Fuligo septica</i> var. <i>candida</i> (Pers.) Meyl.	1
	<i>Leocarpus fragilis</i> (Dicks.) Rostaf.	3
	<i>Mucilago crustacea</i> P. Micheli ex F.H. Wigg.	4
	<i>Physarum album</i> (Bull.) Chevall.	3
	<i>Physarum compressum</i> Alb. & Schwein.	1
	<i>Physarum leucopus</i> Link	1
	<i>Physarum roseum</i> Berk. & Broome	1
<i>Physarum</i> sp.	3	
Protosteliales	<i>Ceratiomyxma fruticulosa</i> (O.F. Müll.) T. Macbr.	15
	<i>Ceratiomyxma fruticulosa</i> var. <i>poroides</i> (Alb. & Schwein.) G. Lister	1
	<i>Ceratiomyxma poroides</i> (Alb. & Schwein.) J. Schröt.	1
Reticulariales	<i>Enteridium lycoperdon</i> (Bull.) M.L. Farr	2
	<i>Lindbladia tubulina</i> Fr.	1
	<i>Lycogala epidendrum</i> (L.) Fr.	18
	<i>Lycogala flavofuscum</i> (Ehrenb.) Rostaf.	1
	<i>Lycogala</i> sp.	2

	<i>Reticularia jurana</i> Meyl.	1
	<i>Reticularia lycoperdon</i> Bull.	5
	<i>Reticularia olivacea</i> (Ehrenb.) Fr.	1
	<i>Tubifera montana</i> Leontyev, Schnittler & S.L. Stephenson	1
	<i>Tubifera ferruginosa</i> (Batsch.) J.F. Gmel.	3
	<i>Tubifera</i> sp.	2
Stemonitidales	<i>Amaurochaete atra</i> (Alb. & Schwein.) Rostaf.	1
	<i>Brefeldia maxima</i> (Fr.) Rostaf.	2
	<i>Comatricha alta</i> Preuss	1
	<i>Comatricha nigra</i> (Pers. ex J.F. Gmel.) J. Schröt.	1
	<i>Stemonitis axifera</i> (Bull.) T. Macbr.	2
	<i>Stemonitis flavogenita</i> E. Jahn.	1
	<i>Stemonitis fusca</i> Roth	3
	<i>Stemonitis</i> sp.	15
	<i>Stemonitis splendens</i> Rostaf.	5
	<i>Stemonitis typhina</i> F.H. Wigg. (= <i>Stemonitopsis typhina</i> (F.H. Wigg) Nann.-Bremek.)	2
	<i>Symphytocarpus amaurochaetoides</i> Nann.-Bremek.	1
	Trichiales	<i>Arcyria ferruginea</i> Saut.
<i>Arcyria incarnata</i> (Pers. ex J.F. Gmel.) Pers.		2
<i>Arcyria</i> sp.		3
<i>Arcyria stipata</i> (Schwein.) Lister		1
<i>Dictydiaethalium plumbeum</i> (Schumach.) Rostaf.		1
<i>Hemitrichia calyculata</i> (Speg.) M.L. Farr		1
<i>Hemitrichia clavata</i> (Pers.) Rostaf.		1
<i>Hemitrichia serpula</i> (Scop.) Rostaf. ex Lister		1
<i>Metatrachia vesparia</i> (Batsch) Nann.-Bremek. ex G.W. Martin & Alexop.		2
<i>Perichaena papulosa</i> C.H. Liu & J.H. Chang		1
<i>Trichia decipiens</i> (Pers.) T. Macbr.		3
<i>Trichia persimilis</i> P. Karst.		1
<i>Trichia scabra</i> Rostaf.		1

Vietnam (4), France (2), the Netherlands (2), and New Zealand (2) (as shown in Figure 1).

Listing the species of myxomycetes collected from the FB posts, a total of 56 species were likely identified, with 2 varieties and 8 specimens identified only to genus level. The identified myxomycetes with the recorded number of entries or specimens are shown in Table 1. These taxa belonged to 7 taxonomic orders and 25 genera (Figure 2).

○ Suggestions for Classroom Use

Previous study has showed how FB groups can be used in teaching and learning. Schroeder and Greenbowe (2009) used

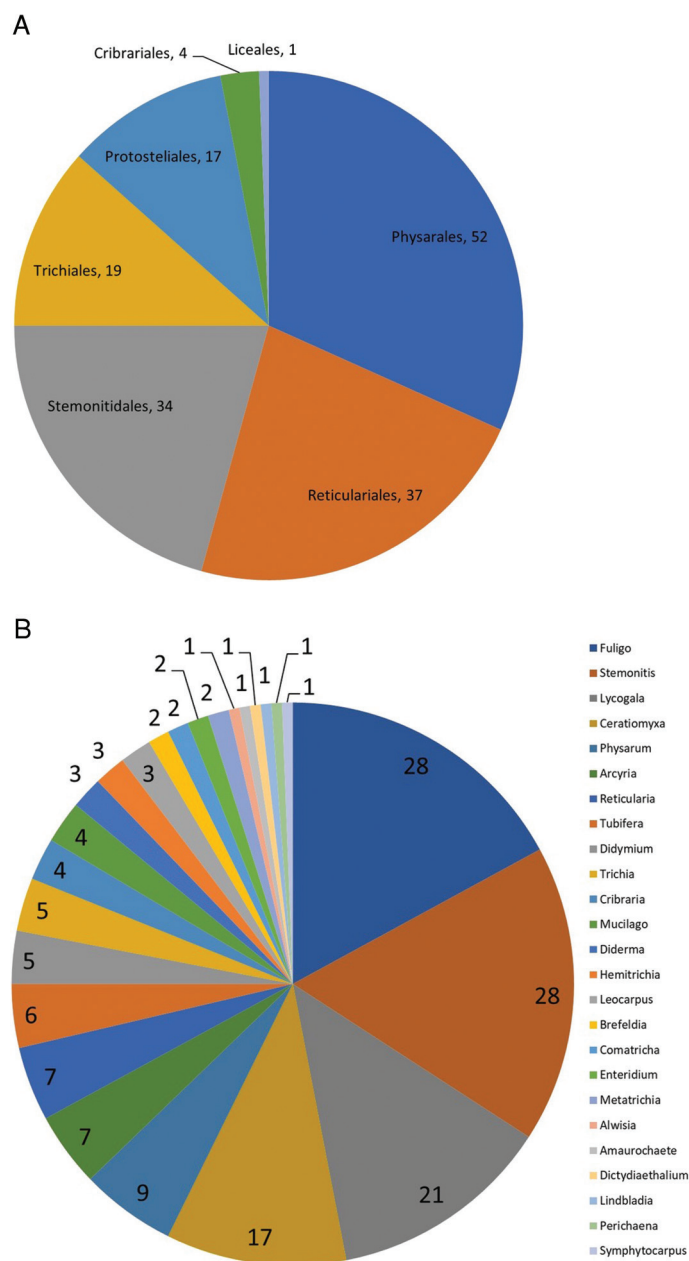


Figure 2. The number of specimens, or records, of myxomycetes grouped per taxonomic order (A) and genera (B).



Figure 3. Sample distribution map of *Ceratiomyxa fruticulosa* based on Facebook posts.

WebCT and FB to obtain questions on their discussions from undergraduate students and found that there were four times more student responses with FB than with WebCT. In their study, other students also provided more detailed answers using FB. This demonstrated the effectiveness of FB as a platform to engage students.

We suggest using a FB group page dedicated to a particular group of organisms, such as slime molds, as a source of information or data for a classroom activity. (1) During lectures, teachers use images posted on the FB group page to introduce myxomycetes. Images must be used only with prior permission from the owner. Posted images of specific life stages of myxomycetes, such as plasmodia and fruiting bodies, are used during discussion on the life cycle. (2) Students browse the images in the myxomycete posts to get acquainted with the different species of myxomycetes. This activity aids students in getting familiar with the gross morphology of myxomycetes and is particularly helpful in identifying fruiting bodies of myxomycetes during field collection or field work. (3) Posted images of myxomycetes are used as virtual specimens for species identification in the absence of actual or preserved

Table 2. Sample lesson plan on mapping distribution of myxomycetes.

Lesson Title: Mapping species distribution of myxomycetes	
Recommended grades: Grades 11–12	ALLOTED TIME: 3 hours
<p>Objectives: Students will</p> <ul style="list-style-type: none"> gather occurrence data on myxomycetes from public posts in the Facebook (FB) group Slime Mold Identification & Appreciation prepare a species list of myxomycetes reported in the FB group within a given time map the species of myxomycetes to illustrate their geographic origin and distribution 	
<p>Learning outcomes: At the end of the class activity, the students are expected to be familiar with myxomycetes and be able to plot the distribution of myxomycetes.</p>	

Materials: Students will need a laptop computer with internet connection to access FB.

Directions:

1. The teacher begins the class activity with a short lecture on the morphology, taxonomy, and life cycle of myxomycetes. The teacher may also show images and videos of myxomycetes to familiarize students with the appearance of fruiting bodies.
2. The teacher randomly groups the students in 3–5 member teams and presents objectives, learning outcomes, and mechanics of the class activity.
3. Students access the FB group and list all myxomycetes posted within a given duration and country of origin or locality.
4. Students create a species list and map distribution of myxomycetes. The teacher facilitates the activity by teaching students how to gain maps from online resources (e.g., National Geographic MapMaker Interactive, <https://mapmaker.nationalgeographic.org>, or Google Earth, <https://www.google.com/earth>).
5. Students present their map output orally or in a class exhibit and discuss for ≥ 10 minutes the species composition and distribution of myxomycetes.
6. The teacher asks students to explore their own backyards or any public green space for fruiting bodies of myxomycetes.

Prior skills & understandings: Prior to the learning activity, the teacher delivers a lecture on taxonomy, ecology, and importance of myxomycetes and how to identify or detect their fruiting bodies in the field. The FB group will be a valuable source of images for this lecture.

specimens. Teachers initially illustrate the steps in describing fruiting bodies of myxomycetes and later provide the students with sample images obtained from the FB group. The students visually describe the morphological characters and use these morphometric data to identify the species following comparison with published literature and online identification guides (e.g., the Myxomycetes page on the Discover Life website: https://www.discoverlife.org/mp/20q?guide=Mycetozoa_GSMNP&flags=HAS). Alternatively, the students identify the myxomycetes by comparing images with online galleries, as exemplified by the Mixotropic gallery: <https://www.myxotropic.org/gallery>. (4) Students map the locations of the posted myxomycetes to infer possible distribution patterns. A sample distribution map is shown in Figure 3. (5) Students gather data on the number of entries (i.e., the number of specimens) and the localities for each posted taxa of myxomycetes and use the information as raw data for developing a species listing, for mapping species distribution, and for computation of diversity indices to infer ecological patterns or evaluate species diversity. However, given that the identities of the posted myxomycetes may not always be accurate, limitations of the learning activity must be discussed with the students before any ecological or statistical analyses are conducted. For example, the students need to assume that species identity is correct and that one species observation is considered as one collection or record. Nevertheless, in the absence of field collection, these data will be sufficient as raw data for the computation of diversity indices. A sample lesson plan is also provided in Table 2.

○ Concluding Points

Participation in FB groups that centers on identification of organisms, whether it be animals, plants or microorganisms, indicates great interest and willingness of the individual to learn from and engage with other members of the group, particularly those who have already developed expertise in the said field. In the absence of field work during course delivery, the use of these special FB groups could also facilitate familiarization with species morphologies, useful traits when conducting species identification, and gathering of occurrence and distribution information that could be used as raw data for any ecological or statistical analysis and/or for species mapping. If accurate identification of species is generated from the responses on the posted images (e.g., on citing of endangered species), this could also lead to active participation of citizen scientists in efforts on biodiversity conservation and habitat protection.

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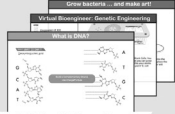


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