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# Records of myxomycetes cultured from active nests of seabirds from New Brunswick, Canada

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**Abstract:** Published information on myxomycete diversity of Maritime Canada is limited, with little reported from offshore marine habitats. Herein we report myxomycetes cultured from seabird nest materials from a marine island in the Bay of Fundy, New Brunswick (Canada). Seventeen species of myxomycetes were recovered from nest material from three species of seabirds. Four species (*Diacheopsis vermicularis*, *Didymium bahiense*, *Did. comatum*, and *Did. verrucisporum*) are new for Canada, and seven species are new records for New Brunswick. These were *Did. difforme*, *Hemitrichia minor*, *H. pardina*, *Licea biforis*, *L. pusilla*, *Physarum apiculosporum*, and *P.* cf. *flavicomum*. Seabird conservation concerns during the nesting period precluded wide-ranging sampling on the island. However, sampling nest materials from species of seabirds served as a proxy for preliminary myxomycete diversity investigations at this protected site and is an approach that may have utility elsewhere.

Keywords: island biodiversity, marine ecosystems, myxomycete sampling, myxomycete vectors, slime molds

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## Introduction

Published information reporting the diversity of myxomycetes for Maritime Canada is limited (Zoll et al. 2023), with most of the available information collected from inland forest sites. Little has been reported from offshore marine habitats (Zoll et al. 2023). Herein we report myxomycetes present on an off-shore island in the lower Bay of Fundy, New Brunswick (NB), specifically, those cultured from the nesting materials of herring gulls (HG) *(Larus argentatus*), great black-backed gulls (GBBG) (*L. marinus*), and double-crested cormorants (DCC) (*Phalacrocorax auritus*).

There is evidence that the species of myxomycetes appearing on substrates in moist chamber cultures also occur in habitats that support such substrates (Whitney 1982; Blackwell and Gilbertson 1984; Stephenson 1988, 1989; Stephenson and Stempen 1994) and that results from moist chamber cultures are generally consistent between surveys (Wellman 2024). However, sampling some habitats for myxomycetes may present challenges where associated plant or animal species are protected and where researcher activity may be judged detrimental. This could include plants subject to trampling or animal species sensitive to disturbance, including those congregating to feed, mate, or care for young. Seabirds, for example, often congregate at nesting sites on offshore islands where predators are few, but where


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human activity has been demonstrated to increase mortality (Anderson and Keith 1980; Carney and Sydeman 1999; Dorr et al. 2026). Undoubtedly, the myxomycetes cultured and reported in this paper are not restricted to seabird nests. However, nest material gathered by birds from the immediate environment may serve as a proxy for myxomycete diversity across the broader seabird nesting habitat. This may be a useful strategy where researcher presence is deemed detrimental to nesting birds or their young and researcher movement across the habit in question may be restricted for conservation reasons. The sampling for myxomycetes reported herein was conducted under just such conditions. Sampling was carried out during a long-term program of monitoring seabird eggs for toxicological analysis (Burgess et al. 2013), which provided us with access to a site (Manawagonish Island) otherwise restricted for reasons of wildlife conservation.

HGs begin nesting in NB in early May, usually on offshore islands, placing nests on the ground on sand, gravel, rocks, cliff edges and grassy fields (Squires 1952; Stewart et al. 2015). HG nests are constructed of materials found close to the nest site and include twigs and decaying wood, grasses, feathers, and lichens (Bent 1922). Nests of 33–61 cm diameter are placed 0.6–10 m apart and typically contain clutches of 2–3 eggs (Harrison 1975; Del Hoyo et al. 1992; Bent 2022). GBBGs begin nesting in NB in late April on the sandy and rocky shores of offshore islands and the gravel roofs of industrial buildings (Squires 1952; Stewart et al. 2015). Nests are typically constructed of grass, seaweed, mosses, twigs, shoreline refuse, and feathers collected from within territory or stolen from other gull species nesting in the immediate area (Bent 1922; Verbeek 1979). GBBG clutches typically consist of 3–4 eggs deposited in a nest of 50.8–137.2 cm diameter (Harrison 1975). DCC in NB begin nesting in early April, usually on the ground and in trees, in large breeding colonies near the coast or offshore on low, bare, rocky islands (Squires 1952; Stewart 2015). Their nests are made with a foundation of twigs gathered from nearby nesting trees or stolen from adjacent nests, but are usually lined with finer materials, including seaweed, grass, feathers, and bark gathered from nearby (Bent 1922; Wire 2014). Egg clutches typically include 3–4 eggs placed in a nest of 61 cm diameter (Harrison 1975).

## Materials and methods

*Study Site*

Manawagonish Island (45.207846° N, 66.10876° W) is a 20 ha site located approximately 1.5 km offshore near the mouth of the Bay of Fundy in the northwest Atlantic Ocean, adjacent to the port of Saint John, NB, Canada (Figs. 1A-B). No humans have been resident on the island for at least a century and it has been protected by the Nature Trust of New Brunswick as a seabird sanctuary since 1992 (McAlpine et al. 2005). A variety of sea and waterbirds nest on the island, including several thousand HGs, GBBGs, and DCCs (McAlpine et al. 2005). Great blue heron (*Ardea herodias*), common eider (*Somateria mollissima* and Canada geese (*Branta canadensis*) also nest in smaller numbers and several less common waterbird species have been recorded nesting on the island (McAlpine et al. 2005). Historically, Manawagonish Island was covered with a coastal conifer-dominant forest. However, an increase in DCC populations starting in the early 1960s, with subsequent accumulations of bird guano, has led to the death of trees and gradual changes in over and understory vegetation (Astle and McAlpine 1985). The vegetation now consists of various native and non-native grasses, sedges and forbs, ferns, scattered white spruce (*Picea glauca*), and thickets of *Rosa* sp., speckled alder (*Alnus incana*), raspberry (*Rubus idaeus* ssp. *strigosus*), and red elderberry (*Sambucus racemosa*) (Fig. 1C).

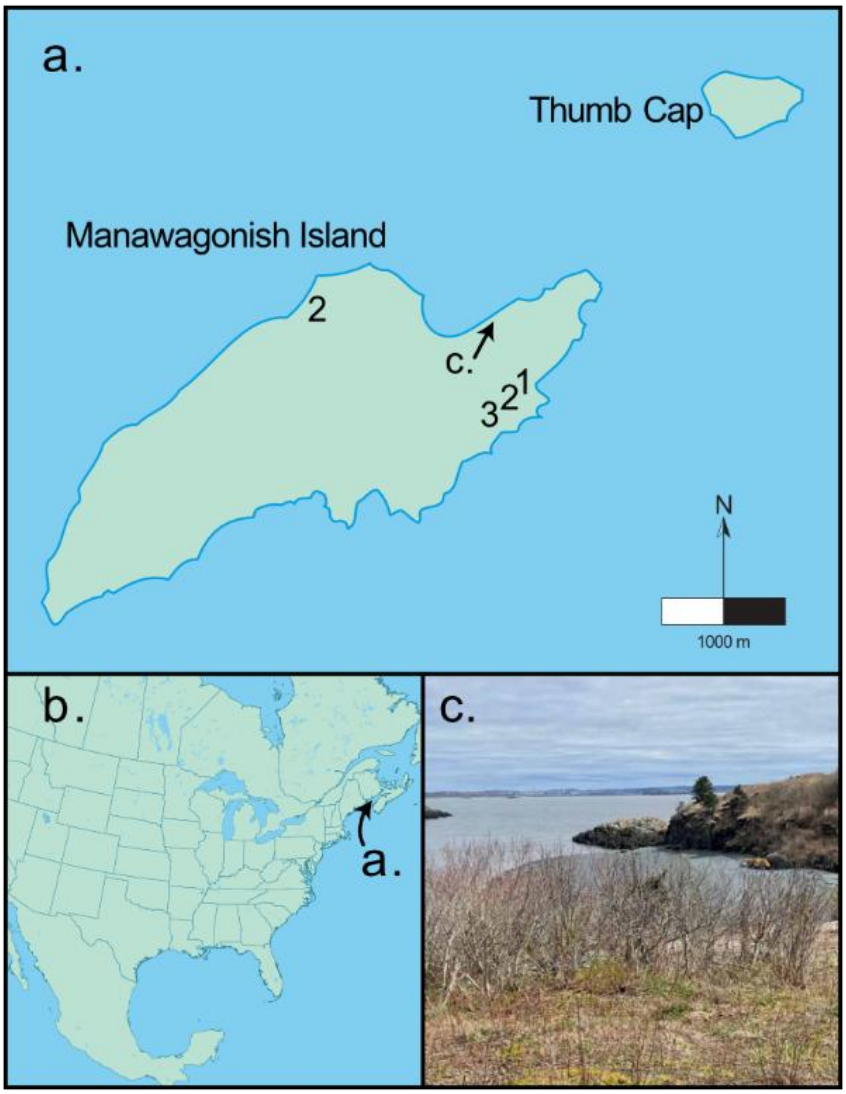


**Figure 1.** (A) Manawagonish Island, in the lower Bay of Fundy, New Brunswick, Canada, (B) Location of the study site in North America, and (C) General view of habitat looking north-east on Manawagonish Island (Photo by DF McAlpine/NB Museum, May 2025).

*Sampling Methods*

Nesting material from ten active ground nests of each of the three seabird species was gathered on Manawagonish Island on 10 May 2023 and 6 May 2025. Material was collected from the inner cup of each nest (about 30 g dry weight) and placed in a labelled paper bag in the field for transport to the lab. HG nests selected were located on the south side of the island at an elevation of 14 m ASL near *Rosa* sp. thickets at the top of a rocky bank over-looking the shoreline (Fig. 2A). HG nesting material consisted of twigs (max diameter ~ 2 mm), lichens, grasses, and feathers. GBBG samples were collected on the south side (2023), among grasses at the top of a rocky bank at about 14 m ASL, and on the north side (2025) of the Island among forbs and driftwood on a cobble barrier beach at < 1 m ASL (Fig. 2B). GBBG nesting

material was mostly of grasses, downy feathers, twigs (max diameter ~2 mm), and pieces of woody debris. DCC nests were located in an open, rocky area, approximately 30 m back from the shore of the island at an elevation 18 m ASL (Figure 2C). DCC nests were bulkier than gull nests and consisted of twigs (max diameter ~5 mm), with grasses, dried rockweed (*Ascophyllum* sp. and *Fuscus* sp.), green algae, and occasionally small smooth stones that had probably been regurgitated by the birds. Unlike gull nests the materials in DCC nests were generally patterned with guano. Plastic shoreline refuse was occasionally incorporated into the nests of all three species of birds.




**Figure 2.** A) Habitat and herring gull (*Larus argentatus*) nest sampled for myxomycetes, B) Habitat and black-backed gull (*L. marinus*) nest sampled for myxomycetes, and C) Habitat and double-crested cormorant (*Phalacrocorax auritus*) nests sampled for myxomycetes on Manawgonish Island, New Brunswick (Photos by DF McAlpine/NB Museum, May 2025).

*Laboratory Methods*

Samples were air dried (second year only) and placed in individual moist chambers (N=60) and monitored for myxomycete development. Moist chambers consisted of 250 ml clear plastic containers with lids. Three layers of thin white paper towel was placed on the bottom of each chamber to help maintain moisture. One or two pieces of each type of nesting material was placed onto the paper towel, sufficient to cover the bottom in a single layer, ensuring there was minimal overlap and some gaps left for air flow. Distilled water was added covering the substrate and left to soak for 24 hours. After soaking, the water was drained from each chamber by gently tilting to minimize disturbance to the substrate. Lids were loosely placed on the chambers to allow air flow. During year one (2023) of the study moist chambers were maintained at 18°C in indirect sunlight. In year two (2025) moist chambers were isolated in an incubator at 18°C with a light/dark cycle of 12 hrs of indirect light (containers were covered with cheese cloth) and 12 hrs of dark. Moist chambers were monitored using a stereoscope by first scanning the chamber for any signs of myxomycete development using 6.4 and 16x magnification. Suspected myxomycetes were then confirmed using 40x magnification. Moist chambers were monitored every few days for the first two weeks, then once every 7-10 days for up to three months. If a portion of substrate became moldy, the moldy portion was removed and discarded. If a moist chamber became over-grown with contaminating molds, the contents of the chamber were discarded. Any live mites or insect larvae observed were removed using fine tipped jeweler's forceps and discarded.

In 2023 samples were placed directly into moist chambers, but many samples were subsequently lost due to contamination from competing molds. In 2025 substrate material was air-dried prior to addition to moist chambers (Wrigley de Basanta and Estrada-Torres 2022). This significantly reduced fungal mold growth and the loss of samples due to contamination. When plasmodia were first observed, the date of observation and the plasmodial color was recorded. When fruiting bodies matured, they were removed from the moist chamber along with the substrate, left to air dry, and the date was recorded. For identification entire fruiting bodies or pieces were mounted on microscope slides, with 95% ethanol used as a wetting agent, followed by immersion in 3% KOH. Microscopic characters were examined using a compound microscope at 400x and an oil immersion lens (1000x magnification). Both macro and micro photographs were prepared for each collection. Measurements and morphological features were recorded for fruiting bodies, spores, capillitia, lime crystals, peridia and stalks. Poulain et al. (2011), Martin and Alexopoulos (1969), Lado (2005-2006), and the Mycoquebec website (Landry et al. n.d.) were consulted for identification. Species of myxomycetes were considered confirmed in the region previously if supported by literature reports or records accompanied by archived specimens reported on GBIF (GBIF.org visited 19 October 2026) or Mycoportal (Mycoportal.org visited 19 October 2026). Samples of all species of myxomycetes cultured and reported herein have been deposited in the herbarium of the New Brunswick Museum.

## Results

Across the 60 moist chambers prepared from collections made in 2023 and 2025, 17 species of myxomycetes were cultured, and these represented six genera (Fig. 3). From 2023 samples, nine species were cultured, while 16 were observed in 2025. Eight species were common to both years. These were *Diacheopsis vermicularis*, *Didymium bahiense*, *Did. comatum*, *Did. difforme*, *Did. verrucosporum*, *Licea operculata*, *Physarum cinereum*, and *P. pusillum*. Eight species were cultured only in 2025. These were *Physarum apiculosporum*, *Hemitrichia leiocarpa*, *H. minor*, *H. pardina*, *Licea biforis*, *L. pusilla*, and *Ophiotheca chrysosperma*. *Physarum* cf. *flavicomum* was observed only in 2023, and with limited fruiting

bodies it is identified only provisionally. Of the 17 species, four (*Dia. vermicularis*, *Did. bahiense*, *Did. comatum*, and *Did. verrucisporum*) are new for Canada (Fig. 4), and seven are new for New Brunswick. The latter were *Did. difforme*, *H. minor*, *H. pardina*, *L. biforis*, *L. pusilla*, *P. apiculosporum*, and *P.* cf. *flavicomum* (Fig. 5). The most abundant species encountered was *P. cinereum*, which was found in 16/60 moist chamber cultures. The second most abundant species was *Did. difforme*, which was found in 12/60 moist chambers cultures. The least abundant species recorded were *P.* cf. *flavicomum* and *P. apiculosporum* (2023), *H. minor*, *H. pardina*, *L. pusilla*, and *O. chrysosperma* (2025), each recorded in 1/60 chambers.

Substrates cultured from each of the three seabird species produced myxomycetes (Fig. 3). HG nests supported the most diverse group of myxomycete species (N= 11), followed by GBBG (N= 8). DCC produced the lowest species count (N=5), and also suffered the highest levels of mold contamination. Three species common to nest materials of all three seabird species were *Did. comatum*, *Did. difforme*, and *P. cinereum*, with two of these new to Canada or New Brunswick (Fig. 3). Species unique to HG nests included *H. leiocarpa, H. pardina*, *L. operculata*, *L. pusilla*, *O. chrysosperma*, *P. apiculosporum*, and *P.* cf. *flavicomum*. Among these species *H. pardina*, *L. pusilla*, *P. apiculosporum*, and *P.* cf. *flavicomum* are new to New Brunswick. Myxomycete species unique to GBBG nests included *Dia. vermicularis*, *Did. bahiense*, *H. minor*, and *L. biforis*. *Diacheopsis vermicularis* and *Did. bahiense* are new to Canada, while *H. minor* and *L. biforis* are new to New Brunswick (Figs. 4, 5). DCC nests produced no myxomycetes unique to this species.

## Discussion

We encountered only three (*H. leiocarpa*, *L. operculata*, and *O. chrysosperma*) of the 80 species Zoll et al. (2023) reported previously for NB. Two species not reported in Zoll et al. (2023), but found in this study, are reported on GBIF as collected in NB; *P. cinereum* was recorded at Hartland, NB (an inland site) and *P. pusillum* was collected in Kings County, NB, fruiting on the skin of a swede turnip (*Brassica napobrassica*) in storage. Among those myxomycetes recorded from Manawagonish Island seabird nest cultures, 11 are new for Canada or New Brunswick. Most of these species are cosmopolitan in distribution, with the exception of *Dia. vermicularis*. For this latter species only nine collections, all from Japan and Europe, are known (GBIF 2026). With two exceptions, all new records for NB and Canada were collected from their characteristic substrates of dead wood or plant debris cultured in moist chambers. *Hemitrichia minor* has been reported on mosses, the bark of living trees and the decaying cladodes of *Opuntia* and *Agave* plants. Although there may have been undetected mosses among the seabird nest materials, we found the fruiting bodies of *H. minor* in culture only on the stems of decaying herbaceous plants. *Diacheopsis vermicularis* is normally found on dead leaves, but we found this species colonizing grass, wood, sticks and a downy feather.

Confirmed myxomycete data from marine island habitats in NB are limited. There is a single previous collection from Manawagonish Island, of *Fuligo laevis* (a globally rare species), taken from a bird nesting platform pole (NB Museum collection). H.C. Green collected *Siphoptychium casparyi* (=*Tubifera casparyi*) in September 1898 and W.G. Farlow and A.B. Seymour collected *Physarum confertum* in July 1902, both from Campobello Island (lower Bay of Fundy; GBIF 2026). Among 11 collections from Campobello Island reported by Zoll et al. (2023) none of these duplicate the species reported herein. Campobello Island, of nearly 4000 ha, is heavily forested, with myxomycete diversity

reflecting this. Further myxomycete collections from seabird colonies and offshore marine islands will be required to determine whether there is a characteristic suite of myxomycete species associated with these habitats in eastern Canada.

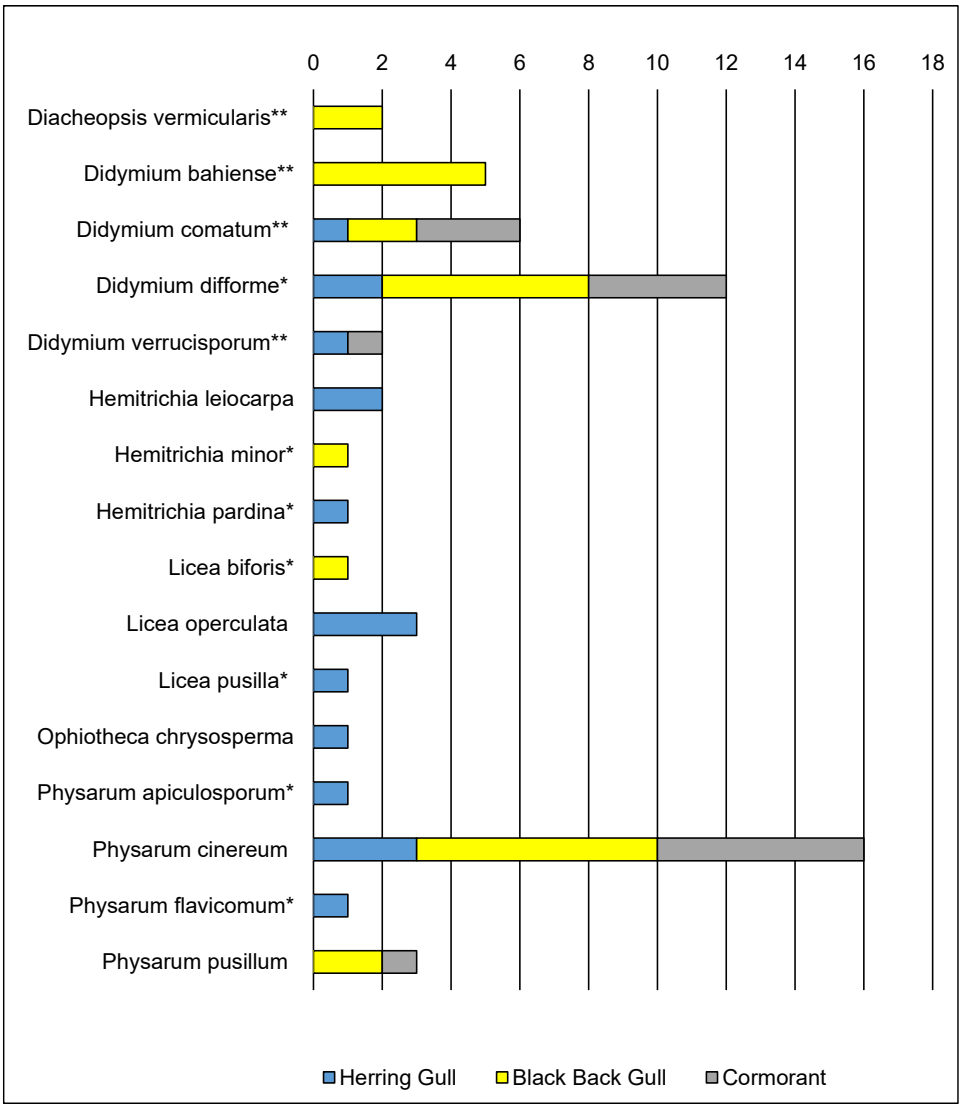


**Figure 3.** Number of myxomycete cultures and species from nest materials of herring gulls (*Larus argentatus*) (blue), black-backed gulls (*L. marinus*) (yellow), and double-crested cormorants (*Phalacrocorax auritus*) (grey) on Manawagonish Island, New Brunswick, Canada, in 2023 and 2025. ** New to Canada, * New to New Brunswick.

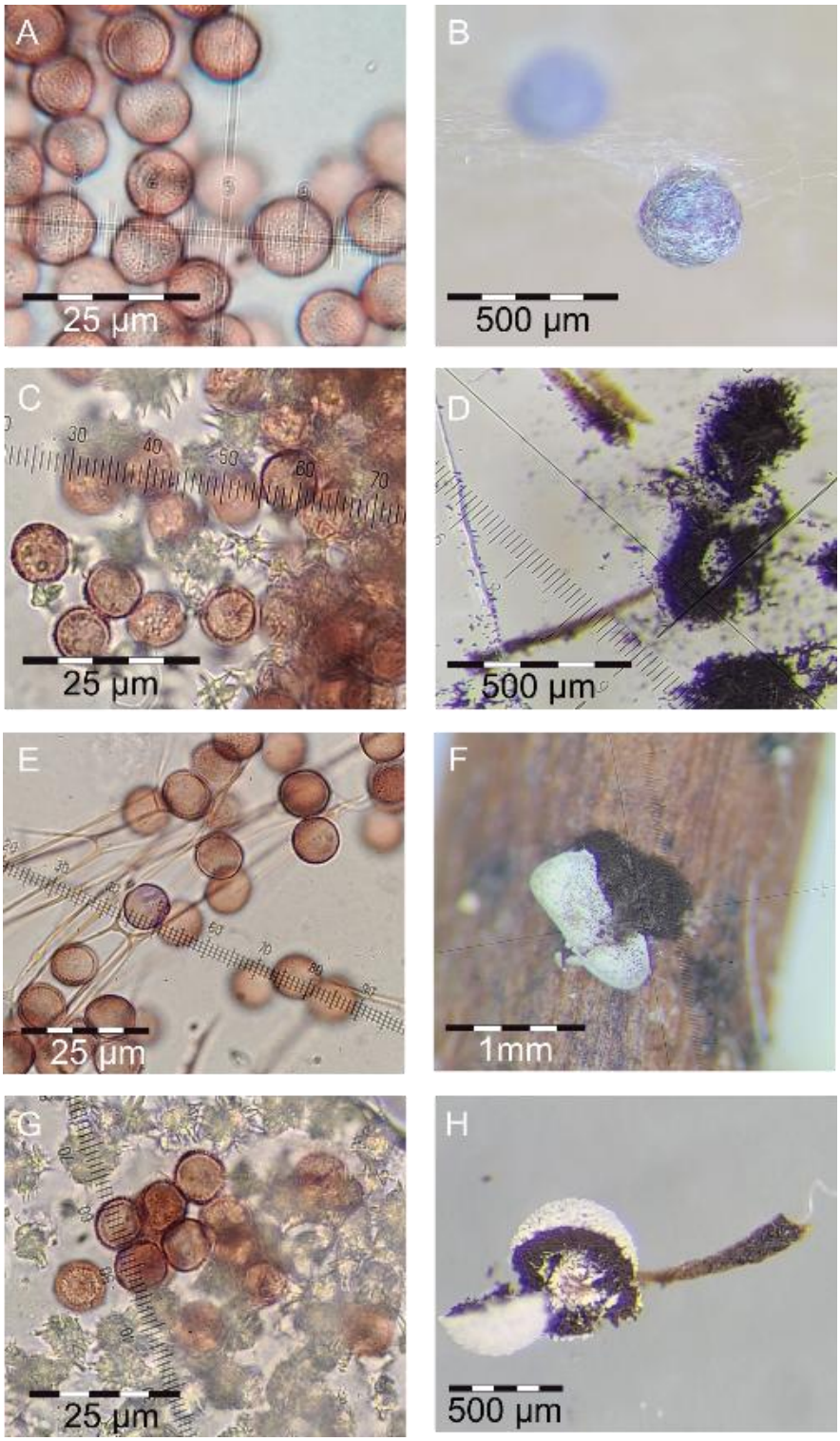


**Figure 4.** Images of myxomycetes cultured from marine seabird nests new to Canada from Manawagonish Island, New Brunswick, Canada. A) *Diacheopsis vermicularis*, spores, B) *Dia. vermicularis*, sporocarp, C). *Didymium bahiense*, note crystals smaller than spores. D). *Did. bahiense*, note pseudocolumella disc shape. E). *Did. comatum*, capillitia and spores. F). *Did. comatum*, note elastic and expanded capillitia. G). *Did. verrucisporum*, note crystals larger than spores. H). *Did. verrucisporum*, note, white, round, columella. Photos: AM Bremner/NB Museum

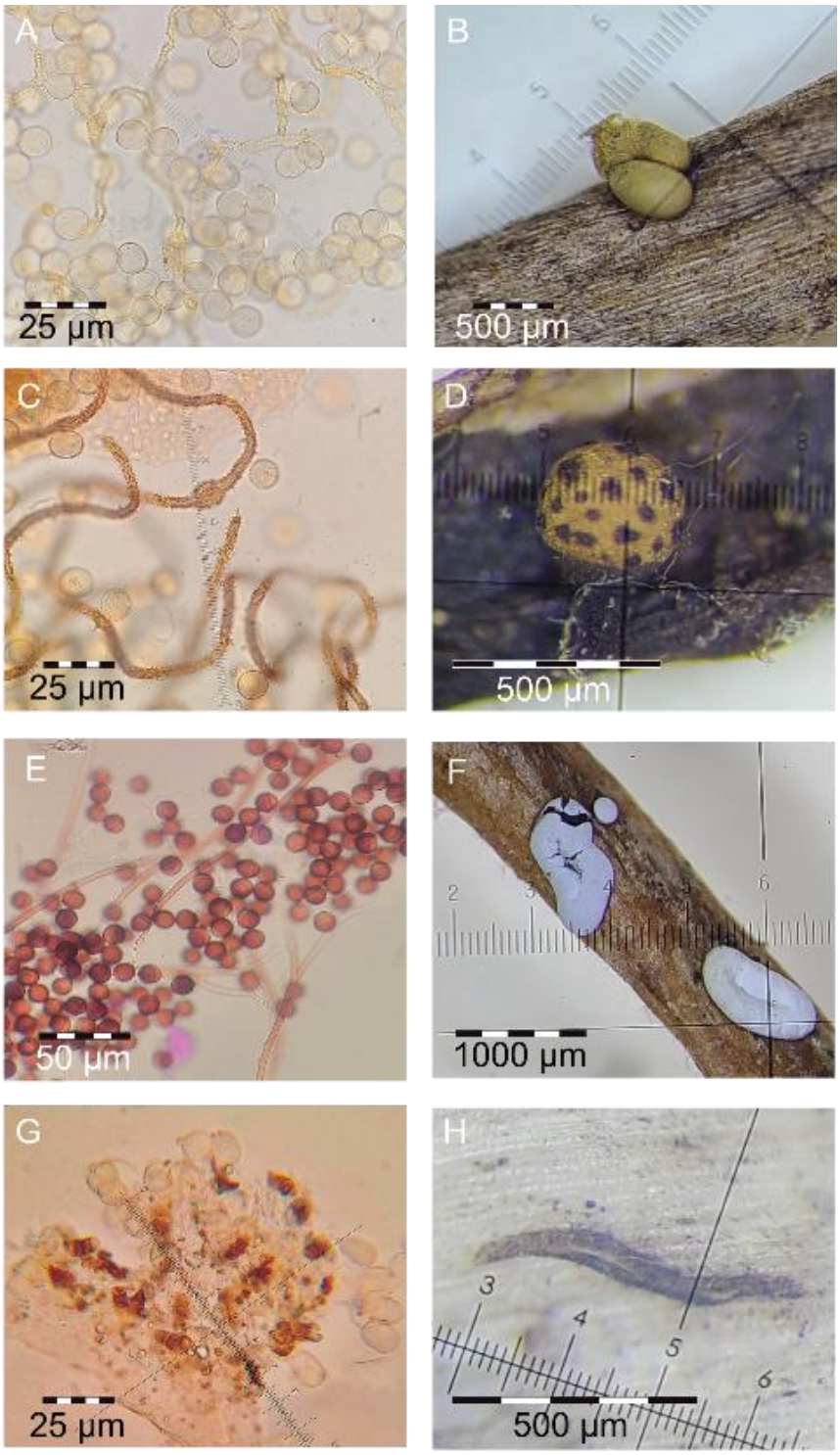


**Figure 5.** Images of myxomycetes cultured from marine seabird nests new to New Brunswick from Manawagonish Island, New Brunswick, Canada. A). *Hemitrichia minor*, capillitia and spores. B). *H. minor*, sporocarp. C). *H. pardina*, peridium, capillitia and spores. D). *H. pardina*, sporocarp. E) *Didymium difforme*, note rigid capillitia and spores. F). *Did. difforme*, sporocarp. G) *Licea biforis*, peridium and spores. H). *L. biforis*, sporocarp. Photos: AM Bremner/NB Museum.

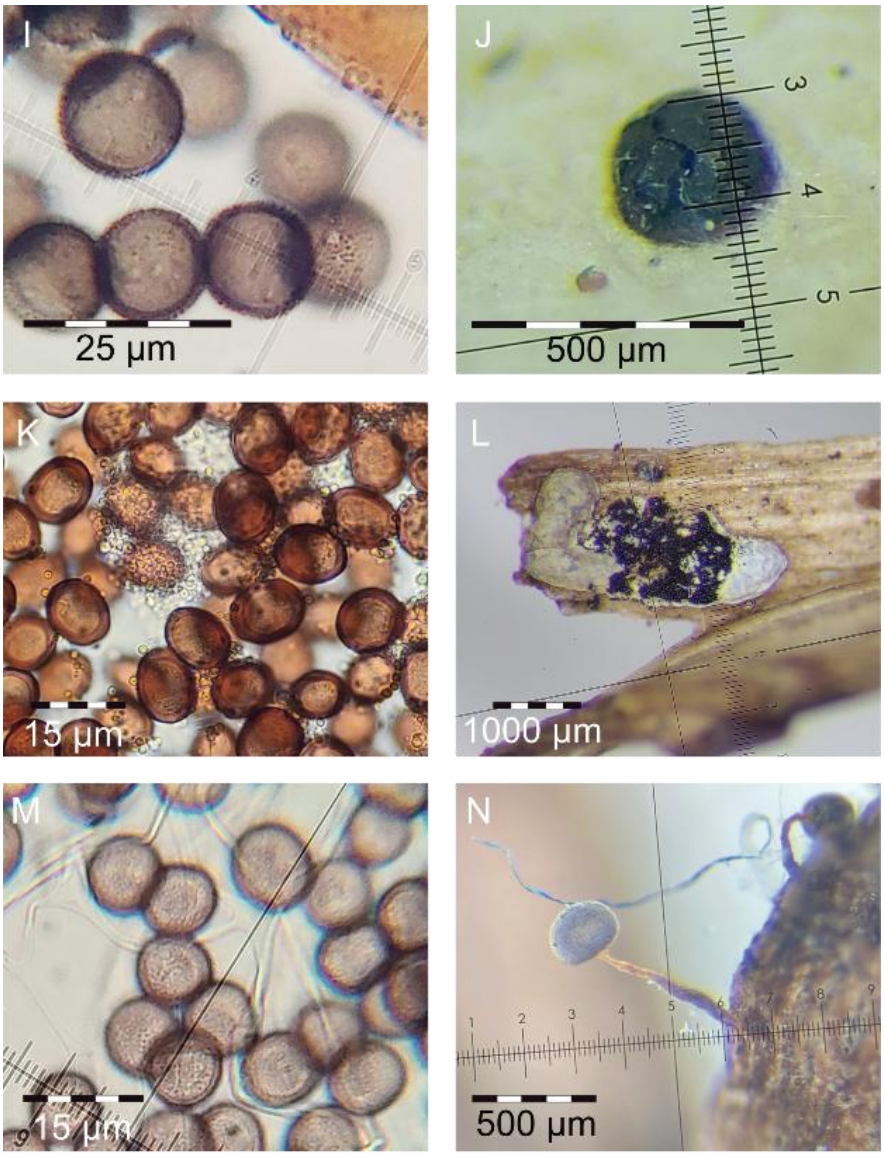


**Figure 5 (cont.)**. Images of myxomycetes cultured from marine seabird nests new to New Brunswick from Manawagonish Island, New Brunswick. I) *L. pusilla*, peridium and spores. J). *L. pusilla*, sporocarp. K) *Physarum apiculosporum*, peridium and spores. L). *P. apiculosporum*, sporocarp. M) *P.* cf. *flavicomum*, capillitia and spores. N). *P*. cf. *flavicomum*, sporocarp. Photos: AM Bremner/NB Museum.

The differences we observed in myxomycete species cultured across species of seabird nests is most likely the result of the variation and diversity in nesting materials the birds utilized. DCC nests included the least diverse nest materials, and this is reflected in lower myxomycete diversity in cultures. This is relevant to the sampling approach we followed. Although our approach of sampling nests allowed a preliminary estimate of myxomycete diversity at a site otherwise not readily accessible to researchers, sampling nests constructed of the most diverse materials will likely produce higher myxomycete diversity. Further sampling at sites where researcher movement is not restricted will also be required to determine what portion of the total myxomycete diversity can generally be captured by sampling nest materials. Nonetheless, we suggest that sampling nest materials from seabird species can serve as a proxy for

preliminary myxomycete diversity investigations at protected sites. In this particular case the approach revealed myxomycete species new to Canada and the region and we suggest it may have utility elsewhere.

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