# Influence of cardinal directions on corticolous myxomycetes associated with *Swietenia macrophylla* King

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## Abstract

Barks of living trees serve as a microhabitat for a distinct assemblage of myxomycetes, the corticolous myxomycetes. In this study, we sampled 86 living *Swietenia macrophylla* trees for bark samples at four cardinal directions (North, East, South, West) to prepare 344 moist chambers. Of these, only 134 moist chambers yielded myxomycetes recorded either as fruiting bodies or plasmodia. Our study also recorded a total of 125 determinable fruiting bodies which were identified as belonging to 22 species, 11 genera, and 7 taxonomic orders and with the most number of taxa recorded in the west (17) and south (14), followed by east (12) and north (11) directions. Eleven taxa were recorded as abundant, with three taxa of *Licea* having the highest number of records. Comparing species composition, only four species were common in all directions. Following statistical analysis, we did not observe any significant differences between the diversity values per cardinal direction.

# Introduction

Tree barks are suitable substratum for myxomycetes (Snell & Keller 2003, Liu et al. 2015). These bark-associated myxomycetes often possess minute fruiting bodies, and hence are very difficult to observe in the field (Novozhilov et al. 2017). However, their presence can easily be confirmed with the moist chamber culture technique. Interestingly, various factors were reported to influence the occurrence and distribution of corticolous myxomycetes. For instance, the acidity (pH) of the bark, a factor that is dependent on the host plants, significantly influenced the occurrence of corticolous myxomycetes, with a significant change in bark pH resulting in a change in myxomycete assemblages (Everhart et al. 2009). In the same study, the percent cover of epiphytes did not influence myxomycetes. Other bark characteristics such as the bark texture and water-holding capacity showed varying results when correlated with corticolous myxomycetes (Stephenson 1989, Snell & Keller 2003, Schnittler et al. 2006, Everhart et al. 2009).

In the study of Stacey et al. (2018), the percentage cover of bryophytes and lichens were highly dependent on the host trees, although cardinal points were noted to play a role in the interaction between these organisms. Oftentimes, bryophytes prefer locations with more shade and moisture while lichens can generally withstand more wind and sunlight exposure. Their study also stated that the north side of the trees generally received less sunlight, and hence, offer a competitive advantage for bryophytes over lichens. For myxomycetes, earlier unpublished theses of Peterson (1952), Klinge (1974), and Pendergrass (1976) gave contrasting results on the possible influence of bark directions on myxomycetes. This led us to investigate the influence of the four cardinal directions (North, East, South, West) on species diversity of corticolous myxomycetes. We used the tropical tree, *Swietenia macrophylla* King., commonly known as mahogany, as the model host for bark-associated myxomycetes. We hypothesized that the east and west directions which often receive most sunlight would harbor fewer communities of myxomycetes.
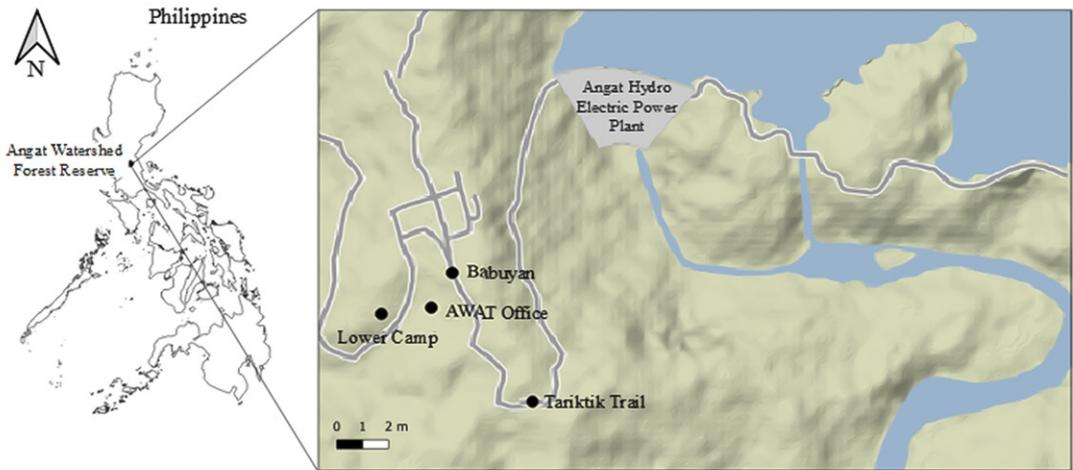
# Materials and Methods

## Sampling area

The Angat Watershed Forest Reserve (14.90201°N, 121.15344°E), a protected landscape situated in the province of Bulacan, Northern Philippines, served as the study area for the host trees. Its lowland forests are often dominated by dipterocarps standing on moderate to rough terrains and has a Type I climate characterized by two pronounced seasons – dry from November to April and wet during the rest of the year. The mean annual rainfall is approximately 2,385 mm with the maximum rainfall occurring from June to August. Due to the availability of host trees for bark collection and accessibility of the forested areas within the Angat watershed, only four sampling points were selected for the study: (1) the forest near the Angat Watershed Area Team (AWAT) Office [AW], (2) the Tariktik trail [TK], (3) Babuyan [BB], and (4) Lower Camp [LC], as illustrated in **Figure 1**. The sampling localities have flat (AW, TK) to moderate slopes (BB, LC).

## Collection of bark substrata

The field expedition was conducted from late August until mid-September 2019. A total of 86 living mahogany trees (*Swietenia macrophylla*) were selected from the four sampling sites: AWAT forest area with nine trees, Tariktik trail with three trees, Babuyan with 70 trees, and Lower Camp with four trees. The inclusion criteria for the selection of the trees were as follows: (i) sampled trees must be more than 5 m apart from each other and (ii) must have a DBH (diameter at breast height) of ≥150 cm. For each selected host tree, approx. 20 pieces of bark were randomly removed around the trunk at four cardinal directions, i.e. North-, East-, South- and West-facing sides of the trunk, at the convenient height of 1.2 to 1.5 m height above the ground to exclude the soil-inhabiting myxomycetes. The cardinal directions were determined using a GPS Status app ver. 9.2.194. For substrate collection, the outermost bark was carefully removed without injuring the host tree. The tree barks collected in each direction were placed inside the brown paper bags separately.

Map of Angat Watershed Forest Reserve

**Figure 1.** Map of the Angat Watershed Forest Reserve with sampling points indicated by black dots. Map generated using QGIS 3.12.2.

Thus, one bag corresponded to one direction. The bags were labeled accordingly with the collection site, date of collection, tree species, and DBH. The bags were transported back in the laboratory for air-drying for one week and later for preparation of moist chamber culture.

## Determination of water-holding capacity and presence of epiphytes of bark samples

Following the procedure of Härkönen et al. (2004), the water-holding capacity (WHC) was initially determined. Approximately, five grams of the dried bark samples collected in each direction were soaked in distilled water overnight. After 24 hours, the saturated bark samples were placed in a funnel to drain the excess water. Afterward, the bark samples were re-weighed, and the weight of the drained bark samples was subtracted to the weight of the soaked bark samples. Mean WHC was computed for each direction. The presence of the epiphytes such as lichens, bryophytes, and woody lianas was also noted during the field collection through visual observation in each direction of the tree trunk at 1.2 – 1.5 m height above the ground. Any presence of epiphytes on each cardinal point was recorded as a positive occurrence, otherwise considered as negative.

## Preparation of moist chamber cultures and taxa identification

In this study, one moist chamber (MC) was prepared for each bag in the manner described by Stephenson & Stempen (1994) resulting to 344 moist chamber cultures. To do this, three to five pieces of barks were placed evenly in disposable Petri dishes (9 cm diam.) lined with two layers of filter papers. Pieces of barks were not overlapping and arranged with their

cut surfaces facing downwards on the filter paper. The samples were flooded with distilled water and soaked overnight. After 24 hours, the pH level was measured using a pH meter and the surplus water was drained. The moist chambers were incubated at room temperature (24 - 26°C) under diffused light and were examined regularly (at least three times a week) for any presence of plasmodia, fruiting bodies or sclerotia under the stereomicroscope (Olympus SZ61-ILST) for 12 weeks. During the span of the observation period, small amounts of water were added periodically to maintain the moist condition of cultures. All mature fruiting bodies obtained in the moist chambers were removed, air-dried, and placed inside the herbarium boxes (5.2 cm x 3.8 cm) for voucher specimen collection. Each herbarium boxes were labeled with the moist chamber code and the place and date of collection. For the identification of the fruiting bodies, specimens were described based on their fruiting body description and spore morphologies. For the fruiting body descriptions, the specimens were observed under a stereomicroscope and the morphological characters of the fruiting bodies, e.g. type, size, shape, color, and appearance of the fruiting bodies, including the other special features such as the presence of calcium carbonate deposits, capillitium, peridium, columella, calyculus, etc., were recorded. For the spore morphology, the fruiting bodies of the collected myxomycetes were mounted in a clean glass slide with a drop of 15% potassium hydroxide (KOH). The prepared slides were then be viewed under a compound light microscope (Olympus-CX31). The morphological characteristics of the spores such as the size, shape, texture, and color, were noted for each specimen. Following the fruiting body description and spore morphology, morphological data were compared with the published literature, identification keys, and web-based electronic databases (Lloyd 2020; Mitchell 1978, 2004). Online nomenclatural data for the eumycetozoans served as the basis for the valid names of the myxomycetes (Lado 2005-2020). All voucher specimens were deposited in the myxomycetes collection of the Mycology Laboratory at the Research Center for Natural and Applied Sciences, University of Santo Tomas, Philippines. A species list of the collected corticolous myxomycetes is presented herewith.

## Data Evaluation and Analysis

Initially, we did the t-test to evaluate any significant differences between the mean bark pH and the mean WHC per cardinal directions. The number of positive MC cultures served primarily as main raw data for ecological analysis. To assess the moist chamber productivity, percent yield was calculated by dividing the number of positive MC cultures to the total number of moist chambers prepared. To determine whether the sampling effort on the bark collection from mahogany trees is sufficient, the species accumulation curve (SAC) was constructed using the program EstimateS (ver. 9.1.0, Colwell 2013, 200 randomizations). The results from Chao 1 estimators were used to compute the percentage completeness by dividing the actual number of species recorded by the mean number of species estimated by the Chao 1 estimator (Macabago et al. 2017). To determine the relative abundance, the number of occurrences for each myxomycetes species was used. The abundance is determined by counting the number of positive moist chambers where a certain myxomycete species is present. The abundance index (AI) was determined for each species as described by Dagamac et al. (2012) owing to the low number of positive moist chambers as expected for very specialized guilds of myxomycetes such as the corticolous myxomycetes. Thus, abundance index values were as follows: (1) abundant (A) if the species has an RA value is ≥ 10% of the total number of collections, (2) common (C) if the species has an RA value is >5% but <10% of the total number of collections, (3) occasional (O) is the species has an RA value is >3% but <5% of the total number of collections, and rare (R) if the species has an RA value is <3% of the total collections. To indicate the overall taxonomic diversity (TDI), the mean number of species per genus (S/G ratio) was used. A relatively low S/G value implies a higher taxonomic diversity (Stephenson et al. 1993). Diversity indices were also used to estimate the myxomycete diversity in each cardinal direction. Shannon diversity index (HS) was computed to measure species diversity as influenced by species richness and evenness. Gleason Index (HG) measured the species diversity in relation to species richness. Pielou's Index of Species Evenness (E) was calculated to determine the evenness of species diversity. Additionally, Fisher's

**Table 1.** Mean bark pH, water-holding capacity (WHC), and epiphytic count of *Swietenia macrophylla* per cardinal direction.

| Direction | Bark pH[ac] | WHC[abc] (g) | No. of trees with epiphytes (n=86) | | |
|---|---|---|---|---|---|
| | | | Lichens | Bryophytes | Lianas |
| North | 6.44 ± 0.40 | 2.67 ± 1.24 | 83 | 14 | 0 |
| East | 6.45 ± 0.40 | 2.57 ± 1.46 | 86 | 7 | 2 |
| West | 6.45 ± 0.39 | 2.48 ± 0.79 | 78 | 13 | 3 |
| South | 6.43 ± 0.38 | 2.52 ± 1.14 | 83 | 9 | 1 |

[a] Mean pH/WHC ± standard deviation.
[b] WHC (g) is computed as weight of the soaked bark less the weight of the drained bark (g).
[c] t-test showed no significant diffences between mean bark pH values and mean WHC per cardinal direction.

Alpha Index (FAI) and Simpson Index (SID) were used in the analysis as both indices were more intuitive in analyzing diversity. HS, HG, and E were calculated using Microsoft Excel based on the published formula (Magurran 2004) while FAI and SID values were computed using EstimateS ver. 9.1.0. To test for any significant differences between the diversity values, we used the Kruskal-Wallis test and the Diversity t test which was computed using PAST ver. 4.02 (Hammer et al. 2001).
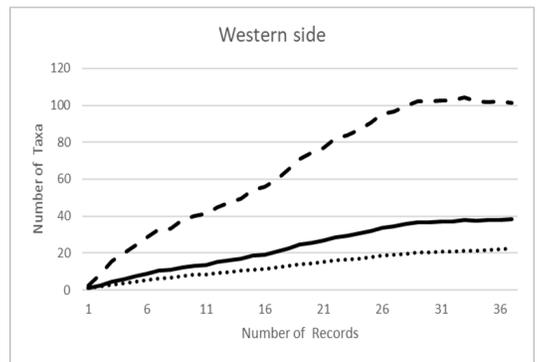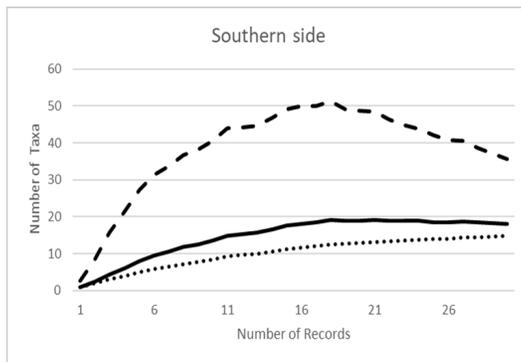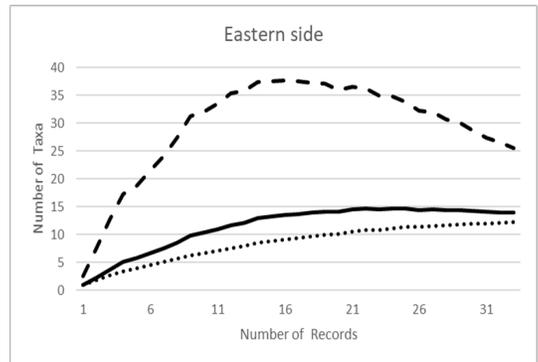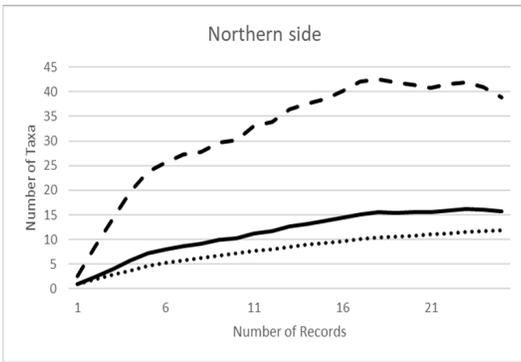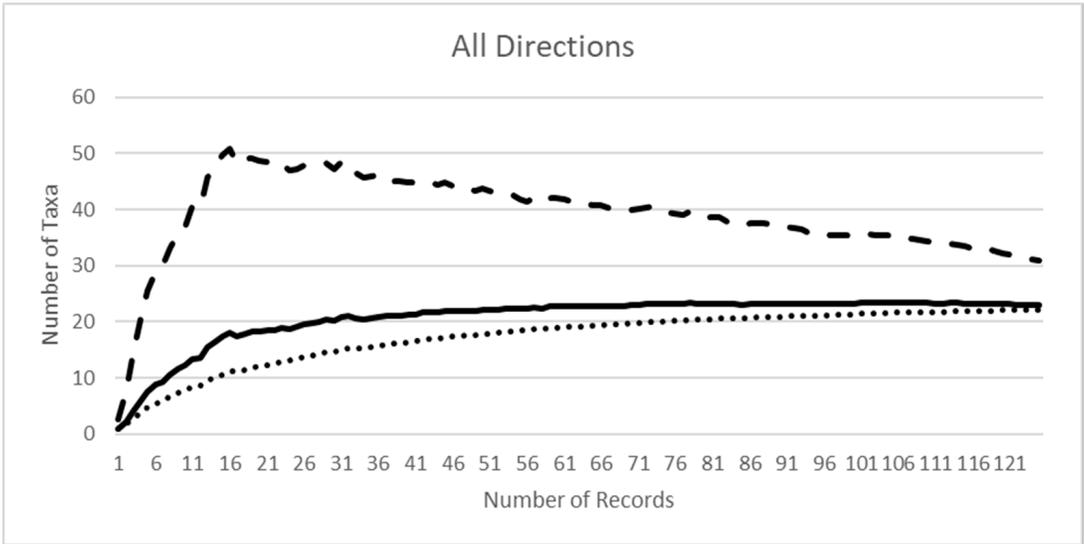
Similarities of communities were analyzed between the four cardinal directions. Sorenson's Coefficient of Community (CC) and the Percentage Similarity (PS) indices were computed following the protocols of Stephenson (1989). Sorenson's coefficient of community is the percentage of myxomycetes species that are common between two directions. It is calculated based on the presence or absence of species between the directions being compared. The CC values range from 0 (no common species in two different directions) or 1 (all species are present in two different directions). Percentage similarity is also an effective tool in comparing community structures of myxomycetes, which considers both the presence or absence of a species and their relative abundance (Stephenson 1989).

## Results

Tree bark properties, moist chamber productivity, and sampling effort

Tree barks of *Swietenia macrophylla* collected from each of the four cardinal directions were evaluated for its bark pH, water-holding capacity, and the epiphytic organisms present (**Table 1**). The mean bark pH for all directions was slightly acidic (pH 6.43 – 6.45) with no significant differences between the cardinal directions ($p$ = .928, alpha = 0.05). The mean water-holding capacity (WHC) showed slight differences, with the highest WHC observed in the northside direction, albeit not statistically significant ($p$ = .781, alpha = 0.05). In terms of the epiphytes present on the tree trunks, lichens were clearly observed to be the most dominant epiphytes regardless of cardinal directions, recorded in almost all of the sampled trees, followed by the bryophytes (mosses) and woody lianas (**Table 1**).

In this study, a total of 344 moist chamber cultures or 86 moist chambers per direction were prepared from bark samples of *Swietenia macrophylla*. From these, 134 moist chambers yielded positive growth either as fruiting bodies or plasmodia, in which 34 moist chambers with plasmodia did not develop into fruiting bodies. Between the four car-

**Figure 2.** Species accumulation curve generated from the collected corticolous myxomycetes.

dinal directions, the highest myxomycete yield was observed on the east side (41 positive MC), followed by the west (34 positive MC) and south (34 positive MC), and lastly, by the north-facing side (25 positive MC). Species accumulation curve for all directions (pooled data) showed a computed percent completeness of 96%, indicating that a large proportion of the assemblage of corticolous myxomycetes was recovered in all directions (**Figure 2**). If the results from each direction were assessed separately, the eastern side had the highest computed percent completeness of 86%, followed by south (78%), north (70%), and west (44%).

# Annotated species list

Species of corticolous myxomycetes recorded in this study was presented per taxonomic order and arranged alphabetically. The total number of collections equivalent to the number of moist chambers where the species were recorded and the corresponding Abundance Index was presented as [number, AI]. The number of collections in each direction (N, E, W, S) in parenthesis (number) and the mean pH of the bark samples with the corresponding standard deviation were also indicated.

## Ceratiomyxales

*Ceratiomyxa fruticulosa* (O.F. Müll.) T. Macbr.
[4 collections, O], direction: N (0), E (2) at mean bark pH = 7.10 ± 1.46, W (1) at bark pH = 8.30, S (1) at bark pH = 6.77
CRIBARIALES
*Cribraria microcarpa* (Schrad.) Pers.
[4 collections, O], direction: N (1) at bark pH 5.80, E (0), W (1) at bark pH = 6.80, S (2) at mean bark pH = 6.53 ± 0.20
*Cribraria violacea* Rex
[4 collections, O], direction: N (2) at mean bark pH = 6.20 ± 0.57, E (1) at bark pH = 6.43, W (1) at bark pH = 6.26, S (0)

## Echinosteliales

*Echinostelium minutum* de Bary
[2 collections, R], direction: N (0), E (2) at mean bark pH = 6.82 ± 0.53, W (0), S (0)

## Liceales

*Licea operculata* (Wingate) G.W. Martin
[11 collections, C], direction: N (1) at bark pH = 6.59, E (4) at mean bark pH = 6.30 ± 0.23, W (4) at mean bark pH = 6.44 ± 0.32, S (2) at mean bark pH = 6.61 ± 0.7.
*Licea* sp.1
[36 collections, A], direction: N (6) at mean bark pH = 6.61 ± 0.18, E (13) at mean bark pH = 6.77 ± 0.48, W (9) at mean bark pH = 6.67 ± 0.37, S (8) at mean bark pH = 6.73 ± 0.4.
*Licea* sp.2
[6 collections, O], direction: N (0), E (2) at mean bark pH = 6.67 ± 0.00, W (2) at mean bark pH = 6.53 ± 0.38, S (2) at mean bark pH = 6.51 ± 0.40

## Physarales

*Diderma hemisphaericum* (Bull.) Hornem.
[1 collection, R], direction: N (0), E (0), W (1) at bark pH = 6.45, S (0)
*Physarum album* (Bull.) Chevall.
[2 collections, R], direction: N (1) at bark pH = 6.81, E (0), W (1) at bark pH = 5.87, S (0)
*Physarum cinereum* (Batsch) Pers.
[2 collections, R], direction: N (0), E (1) at bark pH = 6.57, W (1) at bark pH = 6.73, S (0)
*Physarum leucophaeum* Fr. & Palmquist
[20 collections, A], direction: N (6) at mean bark pH = 5.32 ± 2.62, E (2) at mean bark pH = 6.92 ± 0.49, W (8) at mean bark pH = 6.27 ± 0.30, S (4) at mean bark pH = 6.57 ± 0.30
*Physarum viride* (Bull.) Pers.
[5 collections, O], direction: N (0), E (0), W (2) at mean bark pH = 6.37 ± 0.09, S (3) at mean bark pH = 6.35 ± 0.20.

## Stemonitidales

*Collaria arcyrionema* (Rostaf.) Nann. -Bremek. ex Lado
[1 collection, R], direction: N (0), E (0), W (0), S (1) at bark pH = 6.47

*Comatricha nigra* (Pers. ex J.F. Gmel.) J. Schröt.
[5 collections, O], direction: N (0), E (3) at mean bark
pH = 6.27 ± 0.28, W (1) at bark pH = 5.90, S (1) at bark
pH = 6.13
*Comatricha pulchella* (C. Bab.) Rostaf.
[2 collections, R], direction: N (0), E (0), W (1) at bark
pH = 5.90, S (1) at bark pH = 6.47
*Comatricha tenerrima* (M.A. Curtis) G. Lister
[3 collections, R], direction: N (1) at bark pH = 6.30,
E (1) at bark pH = 6.10, W (1) at bark pH = 6.03, S (0).

## Trichiales

*Arcyria cinerea* (Bull.) Pers.
[1 collection, R], direction: N (0), E (1) at bark pH =
6.17, W (0), S (0)
*Arcyria denudata* (L.) Wettst.
[1 collection, R], direction: N (0), E (0), W (1) at bark
pH = 5.90, S (0)
*Hemitrichia pardina* (Minakata) Ing
[5 collections, O], direction: N (3) at mean bark pH
= 6.49 ± 0.19, E (0), W (1) at bark pH = 6.00, S (1) at
bark pH = 6.53.
*Hemitrichia serpula* (Scop.) Rostaf. ex Lister
[2 collections, R], direction: N (1) at bark pH = 6.67,
E (0), W (0), S (1) at bark pH = 5.77
*Perichaena chrysosperma* (Curr.) Lister
[3 collections, R], direction: N (1) at bark pH = 6.67,
E (0), W (0), S (2) at mean bark pH = 6.65 ± 0.20.
*Perichaena pedata* (Lister & G. Lister) G. Lister ex E.
Jahn
[5 collections, O], direction: N (2) mean bark pH
= 6.42 ± 0.11, E (1) at bark pH = 6.10, W (1) at bark
pH = 6.00, S (1) at bark pH = 6.10

# Species composition and diversity

From the 125 determinable fruiting bodies, 22 species of myxomycetes belonging to 11 genera and 7 taxonomic orders were identified in the present study (Table 2). Species were distributed among the following orders: Trichiales (6 species), Physarales (5 species), Stemonitidales (4 species), Liceales (3 species), Cribrariales (2 species), Echinosteliales

(1 species), and Ceratiomyxales (1 species). Differences in the species composition in each direction were also noticeable. For instance, species under Trichiales seem to be dominant in north (= 4 taxa) and south (= 4 taxa) directions. On the other hand, species under Liceales (3 taxa) were recorded more often in the east while species under Physarales (5 taxa) occurred in the west direction. Four species, *Licea operculata, Licea* sp.1*, Physarum leucophaeum,* and *Perichaena pedata*, were present in all four directions as illustrated in **Figure 3**. In terms of the number of records, *Licea* sp.1 with 36 collections and *Physarum leucophaeum* with 20 collections had the highest number. Other taxa had less than 10 occurrences. Among the four directions, the western side (37 collections, 17 taxa) had the most number of species, followed by east (33 collections, 12 taxa), south (30 collections, 14 taxa), and north (25 collections, 11 taxa).

The taxonomic and species diversity of corticolous myxomycetes recorded from *S. macrophylla* were also assessed for each direction (**Table 2**). In this study, the east and north directions (TDI = 1.50) had the highest myxomycete taxonomic diversity as compared to other directions, i.e. west (TDI = 1.89) and south (TDI = 1.75). However, our results showed the western side with the highest species diversity (HS = 1.04, FAI = 12.18) and richness (HG = 4.43) as compared to the other directions, though species in the south direction were more evenly distributed (E = 0.70). However, Kruskal-Wallis test (*p* = .635, alpha = 0.05) and Diversity t test (NxE, *p* = .795; ExW, *p* = .170; WxS, *p* = .884; SxN, *p* = .296; NxW, *p* = .248; SxE, *p* = .203, alpha = 0.05) showed no significant differences between the shannon diversity indices of the four cardinal directions. Additionally, a high CC and PS values of 0.71 were observed between the western and southern sides of the host trees, indicating high similarities between these two cardinal points (**Table 3**).

# Discussion

The goal of the present study is to document the assemblages of corticolous myxomycetes present on the barks of *Swietenia macrophylla* in relation to the four cardinal directions based from records in the moist chamber cultures. Initially, we looked at different bark properties and observed a slightly acidic bark pH and with a water-holding capacity of 2.48 – 2.67 grams as opposed to the initial weight of the bark (= 5 grams). Epiphytic coverage was also observed with lichens covering most sampled trees regardless of cardinal directions. Moreover, the lichens present in the host trees were mainly crustose type and were described by Lakatos et al. (2006) as crust-like that strongly adheres to the bark surface. This could be responsible for the low number of recorded myxomycetes species in the present study. Lichen thalli made the bark surface smooth, which consequently decreased the attachment of myxomycete spores onto the bark microhabitat. Rubino & McCarthy (2003) reported a similar observation and stated that lichens had a significant, negative influence on the occurrence of myxomycetes and protostelids. However, the presence of other epiphytes such as bryophytes and woody lianas could facilitate colonization of bark surfaces by myxomycetes. Stephenson and Stempen (2004) stated that bryophytes are good spore traps for myxomycetes. Woody lianas served as a unique microhabitat for myxomycetes in tropical forests as shown in the study of Wrigley de Basanta et al. (2008). In the study, few tree hosts recorded bryophytes and woody lianas (Table 1).

The productivity of moist chamber cultures was also considerably low in this study, which is expected for many specialized guilds of myxomycetes such as the bark-inhabiting corticolous myxomycetes in the tropics. This is further supported by the study of Macabago et al. (2010) which reported barks had the lowest productivity among the four microhabitats they studied. Similarly, Dagamac et al. (2010) obtained a productivity yield as low as 22.5% from the bark samples collected from *Samanea saman* trees in the tropical Philippines, albeit higher productivity was observed for other substrata collected in the country, e.g. in the studies of Dagamac et al. (2015a, 2015b), Rea-Maminta et al. (2015), Macabago et al. (2016), Carascal et al. (2017), Dagamac et al.

(2017), and Pecundo et al. (2017). Comparably, Vaz et al (2017) obtained a productivity yield of 46.7% from the barks of different trees in a seasonally dry tropical forest in Brazil. However, the result was in contrast with corticolous myxomycetes in temperate forests. Schnittler et al. (2016) obtained an overall productivity yield of 80% from the barks of *Picea glauca* (white spruce) trees. Nevertheless, the sampling effort equivalent to 96% was sufficient in this study to reflect the total species composition of the myxomycetes associated with barks of the model host tree *Swietenia macrophylla*, albeit differences in the sampling effort was observed for each direction (Figure 2).

In the present study, a total of 22 species belonging to 11 genera and 7 taxonomic orders were identified. The number of taxa was slightly lower than those recorded from the barks of *Picea glauca* and other deciduous trees and shrubs in the temperate forests of Alaska by Schnittler et al. (2016). In that study, they recorded 24 species of myxomycetes from 326 moist chambers. In contrast, the barks of *Pinus* species from a global distribution study yielded 34 species from only 240 moist chambers (Stephenson et al. 2020). In terms of species composition, all of the species recorded in this study were previously reported in the Philippines except for two unidentified *Licea* species. Species belonging to genus *Licea* were also clearly dominant in terms of the number of occurrences recorded from the moist chambers. Even though there were only three *Licea* species recorded, the number of records from these species were significantly higher than that of other genera. The high occurrence of *Licea* species in the bark samples is expected since this genus is known to be corticolous myxomycetes and develops rapidly on bark (Novozhilov et al. 2017). Likewise, *P. leucophaum* is also reported to occur on bark substrates with a high number of collections as observed in this and other studies. Dagamac et al. (2010) reported that *P. leucophaeum* had the highest occurrence on the bark samples of *Samanea saman* as determined by the moist chamber culture technique. With regards to the cardinal directions, the west side (37 records) had the greatest number of records of corticolous myxomycetes while the north side (25 records) had the least. A high number of *P. leucophaeum* was observed on the west while *Licea*

**Table 2.** Taxonomic and species diversity of corticolous myxomycetes associated with *Swietenia macrophylla* in relation to cardinal directions.

| Taxa | Number of Records | | | | |
|---|---|---|---|---|---|
| | North | East | West | South | All Directions |
| **CERATIOMYXALES** | | | | | |
| *Ceratiomyxa fruticulosa* | 0 | 2 | 1 | 1 | 4 |
| **CRIBRARIALES** | | | | | |
| *Cribraria microcarpa* | 1 | 0 | 1 | 2 | 4 |
| *Cribraria violacea* | 2 | 1 | 1 | 0 | 4 |
| **ECHINOSTELIALES** | | | | | |
| *Echinostelium minutum* | 0 | 2 | 0 | 0 | 2 |
| **LICEALES** | | | | | |
| Licea operculata | 1 | 4 | 4 | 2 | 11 |
| Licea sp.1 | 6 | 13 | 9 | 8 | 36 |
| Licea sp.2 | 0 | 2 | 2 | 2 | 6 |
| **PHYSARALES** | | | | | |
| *Diderma hemisphaericum* | 0 | 0 | 1 | 0 | 1 |
| *Physarum album* | 1 | 0 | 1 | 0 | 2 |
| *Physarum cinereum* | 0 | 1 | 1 | 0 | 2 |
| *Physarum leucophaeum* | 6 | 2 | 8 | 4 | 20 |
| *Physarum viride* | 0 | 0 | 2 | 3 | 5 |
| **STEMONITIDALES** | | | | | |
| *Collaria arcyrionema* | 0 | 0 | 0 | 1 | 1 |
| *Comatricha nigra* | 0 | 3 | 1 | 1 | 5 |
| *Comatricha pulchella* | 0 | 0 | 1 | 1 | 2 |
| *Comatricha tenerrima* | 1 | 1 | 1 | 0 | 3 |
| **TRICHIALES** | | | | | |
| *Arcyria cinerea* | 0 | 1 | 0 | 0 | 1 |
| *Arcyria denudata* | 0 | 0 | 1 | 0 | 1 |
| *Hemitrichia pardina* | 3 | 0 | 1 | 1 | 5 |
| *Hemitrichia serpula* | 1 | 0 | 0 | 1 | 2 |
| *Perichaena chrysosperma* | 1 | 0 | 0 | 2 | 3 |
| *Perichaena pedata* | 2 | 1 | 1 | 1 | 5 |
| Total Number of Records | 25 | 33 | 37 | 30 | 125 |
| Number of Species | 11 | 12 | 17 | 14 | 22 |
| Number of Genera | 6 | 8 | 9 | 8 | 11 |
| TDI | 1.83 | 1.50 | 1.89 | 1.75 | - |
| $H_S$ | 0.92 | 0.89 | 1.04 | 1.03 | - |
| $H_G$ | 3.11 | 3.15 | 4.43 | 3.82 | - |
| E | 0.66 | 0.59 | 0.67 | 0.70 | - |
| FAI | 7.50 | 6.78 | 12.18 | 10.22 | - |
| SID | 6.58 | 5.07 | 7.56 | 8.04 | - |

**Table 3.** Community similarity of corticolous myxomycetes at different cardinal directions based on Sorensen's Coefficient of Community (lower left) and Percent Similarity (upper right).

|  | North | East | West | South |
|---|---|---|---|---|
| **North** |  | 0.43 | 0.66 | 0.59 |
| **East** | 0.52 |  | 0.63 | 0.55 |
| **West** | 0.64 | 0.69 |  | 0.71 |
| **South** | 0.64 | 0.54 | 0.71 |  |

sp.1 occurred mostly in the east direction. A similar collection of *Licea* sp. 1 was also reported from the barks of *Samanea saman* collected from the same locality (Policina & dela Cruz 2020). However, it is still not understood whether there is an affinity between a particular species of myxomycetes and the cardinal directions. This would be an interesting future study for corticolous myxomycetes.

In terms of the different diversity indices, high taxonomic diversity was observed in the east direction while the west direction had the highest species diversity as shown by the Shannon Index and Fisher's Alpha Index values (**Table 2**), although statistical analysis showed no significant differences between Shannon diversity values per cardinal directions. This indicates that cardinal directions did not influence species diversity of myxomycetes in contrast to our hypothesis, although the western side had the highest number of recorded taxa. Bark pH and WHC also did not influence the observed species diversity as we computed no significant differences between

pH and WHC of the four cardinal points. Furthermore, a high similarity in species composition, supported by high CC and PS values (**Table 3**), was observed between the west and south sides of the tree trunk (**Figure 3**). The north side was observed to have the lowest values in all ecological analyses. We speculated the possible influence of wind direction in explaining our observations. During the collection period (August – September 2019), the country was experiencing southwest monsoon which brings the prevailing wind from south to west. Tesmer and Schnittler (2007) reported that most myxomycetes spores can be carried away by wind. Even a slight breeze can disperse myxomycete spores more than a kilometer distance (Stephenson et al. 2008). Perhaps the wind brought more spores from the ground to the bark surfaces. It can be noted that in this study, the south and west directions had the highest number of species records. Still, further studies are needed to support this assumption.
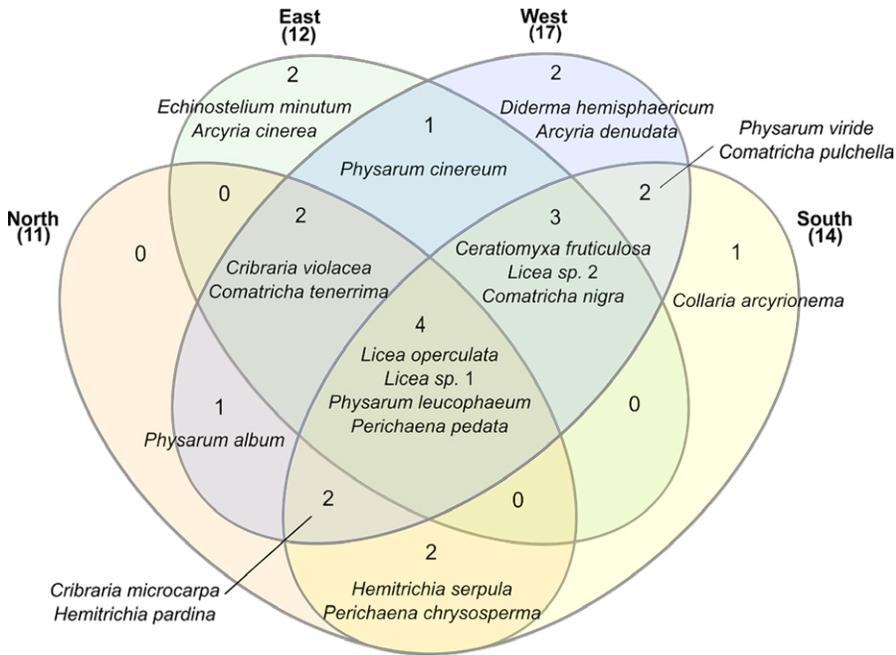
**Figure 3.** The distribution and similarity of species of corticolous myxomycetes at different cardinal directions. Number of species recorded per direction is reported in parenthesis.

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