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MANGROVE FUNGI ON *NYPA FRUTICANS*

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ABSTRACT

Fungi are of great ecological value for the nutrient cycling in the mangroves. This study was conducted to monitor the occurrence of mangrove fungi in the mangroves of Del Carmen, Siargao Island, Surigao del Norte. Specifically, it was conducted to identify the mangrove fungi associated with *Nypa fruticans,* determined the frequency of occurrence of the mangrove fungi and compared the species collected in this study with a study in 2000. *Nypa fruticans* is a true mangrove plant species which is economically and ecologically important. Dead, submerged fronds of *Nypa fruticans* were collected from a mangrove forest in Del Carmen, Siargao Island, Surigao del Norte. The samples were examined for the presence of mangrove fungi. Thirty-four fungal species were identified from the decomposing parts of *Nypa fruticans* from studies conducted in 2000 and 2015, including 26 Ascomycota, 7 mitosporic taxa and 1 Basidiomycota. The most frequently collected species was *Linocarpon apendiculatum,* followed by *Astrosphaeriella striatispora,* all the other species were less frequently collected. Twenty-three fungal species were collected in 2000, while 20 species were collected in 2015. The variation in the fungal species collected in 2000 and 2015 was statistically significant. Eleven species (55%) out of 20 species were new records for Siargao, while the other species were collected both in 2000 and 2015. This study demonstrates that there were changes in the fungal taxa associated with *N. fruticans* in a span of 15 years. Hence, extensive studies will be needed to systematically generate data on the condition of this ecosystem.

Keywords: mangrove fungi, intertidal, monitoring

INTRODUCTION

Coastal wetlands are known to be one of the most productive natural ecosystems on earth [1]. One of these wetlands is the mangrove ecosystem, wherein the intertidal mangrove fungi are believed to be an important link between primary mangrove productivity and the consumer food chain [2]. The mycota are considered to be extremely important in nutrient cycling [3]. Studies of the involvement of fungi in the breakdown of mangrove leaves and wood have been conducted [4]. Ecological studies of mangrove fungal communities has been done by many scientists [5], [6], [7] . Locally, [8] reported 66 species of mangrove fungi which was conducted in Siargao Island, a protected landscape and seascape in Surigao del Norte.

More recently, climate change has been the subject of interest of many scientists due to its effect on all organisms, including fungi. This has been proven by studies such as the influence of temperature on the seasonal and geographic distribution of marine fungi [9]. In 2010, [10] reported the long-term data sets that revealed effects of climate change on saprotrophic and ectomycorrhizal basidiomycetes. Hence, studies on monitoring biodiversity and the environment were conducted in different parts of the world to determine the condition of biodiversity and detect changes, such as the studies conducted by [11], [12], [13], [14], and [15].

This study was conducted to monitor the occurrence of mangrove fungi in the mangroves of Del Carmen, Siargao Island, Surigao del Norte, specifically to identify the mangrove fungi associated with *Nypa fruticans*, determine the frequency of occurrence of the mangrove fungi and compare the species collected in this study with a study in 2000 [8]. The conduct of a monitoring of biodiversity in a mangrove ecosystem is essential to systematically generate data on the condition or change of this ecosystem.

Nypa fruticans is a true mangrove plant species which is the most economically important of all mangroves because many parts of the plant are useful, such as the leaves for roofing of houses, young flowers as source of vinegar or wine, and fruits could be made into candies. This mangrove plant species and the fungi associated with it has ecological and economic importance, thus, this study was conducted.

MATERIALS AND METHODS

This study was conducted in Del Carmen, a town located on the central westernmost point of Siargao Island, Surigao

del Norte, Philippines which has the thickest mangrove population in the island. Dead, decaying *N. fruticans* leaf fronds were collected from the living stands of the mangrove plant (80 samples in 2000, 80 samples in 2015). Sediments were gently washed from the samples in sterile seawater. Samples were incubated at temperatures ranging from 28 – 31^{o} C for two weeks. Collected materials were placed in polyethylene bags and kept moist by addition of sterile absorbent paper moistened with sterile seawater, and sealed well to prevent loss of moisture.

Samples were examined under a stereo-microscope with magnifications between 10 – 40X for the presence of fungi, especially for sporulating structures which are required for their identification. The wall of superficial ascomata was sliced off and the sporulating structures were picked up with fine-tipped forceps (number 5). Superficial fruiting bodies of Basidiomycetes and the conidia of Hyphomycetes were directly picked up and placed in water for examination. Sporulating structures were examined in water under the compound microscope. Measurements of various structures such as ascospores and asci were made in fresh mounts. Temparary slides of the fungi that could be kept for one year were prepared by replacing the water with lactophenol. Identification and classification were based on taxonomic keys of [16], [17], and the pictorial key to higher marine fungi by [18].

Documentation of results include date of collection, fungi present in each sample on initial examination and subsequently on incubation. From this, a list of species for each collection or site were collated. Frequency of occurrence of different species were calculated. The variability of the fungal species in relation to the year it was collected was determined using G-test [19].

RESULTS

A total of thirty-four fungal species were identified from the decomposing parts of *Nypa fruticans* from studies conducted in 2000 and 2015, including 26 Ascomycota, 7 mitosporic taxa and 1 Basidiomycota. In the study in 2015, fifty-five percent (11 species) were newly recorded, out of a total of 20 species, including 15 Ascomycota and 5 mitosporic taxa collected from 80 wood samples. There were more species identified in the study in 2000, with 23 fungi taxa, including 19 Ascomycota, 3 mitosporic taxa and 1 Basidiomycota collected from 80 wood samples. The most frequently collected species was *Linocarpon apendiculatum*, followed by *Astrosphaeriella striatispora,*

and all the other species were less frequently collected. Table 1 shows the frequency of occurrence of the mangrove fungi collected from *Nypa fruticans* in Del Carmen, Siargao Island, Surigao del Norte. Result of the G-test indicated a statistically significant variation (P=.01) in the fungal species collected in the year 2000 and 2015.

Table 1: Frequency of occurrence of fungi associated with *Nypa fruticans* in Siargao Island

List of Fungi	2000	List of Fungi	2015
Ascomycetes		**Ascomycetes**	
Linocarpon appendiculatum	**53**	***Linocarpon appendiculatum***	**28**
***Microthyrium* sp.**	**25**	***Astrosphaeriella striatispora***	**7**
Astrosphaeriella striatispora	**18**	***Lignincola nypae***	**4**
Oxydothis nypicola	**12**	***Aniptodera intermedia***	**3**
***Didymella* sp.**	**7**	***Lulworthia grandispora***	**2**
Lignincola nypae	**6**	***Lignincola tropica***	**2**
Aniptodera intermedia	**4**	***Anthostomella nypensis***	**2**
***Massarina* sp. 1**	**3**	***Vibrissea nypicola***	**2**
Lulworthia grandispora	**2**	***Leptosphaeria* sp.**	**2**
***Massarina* sp. 2**	**2**	***Pontogeneia* sp.**	**2**
Lignincola tropica	**1**	***Lignincola longirostris***	**2**
Ascomycete sp. 1	**1**	**Ascomycete sp. 2**	**1**
Ascomycete sp. 4	**1**	***Payosphaeria* sp.**	**1**
Anthostomella nypensis	**1**	***Mycosphaerella* sp.**	**1**
Linocarpon angustatum	**1**	***Lignincola laevis***	**1**
Vibrissea nypicola	**1**		
Halorosellinia oceania	**1**		
Aniptodera chesapeakensis	**1**		
Carinispora nypae	**1**		
Mitosporic Fungi			
Chaetospermum sp. 1	**1**	***Helicorhoidion nypicola***	**3**
Helicorhoidion nypicola	**4**	***Periconia prolific***	**1**
Phialophorophoma litoralis	**2**	***Trichocladium nypae***	**1**
		Hyphomycete sp. 1	**1**
		Coelomycete sp. 1	**1**
Basidiomycete			
Halocyphina villosa	**8**		

DISCUSSION

Nypa fruticans is a mangrove palm growing along the fringes of intertidal rivers where it is regularly flushed with river freshwater. The fungi that grow on decaying *N. fruticans* palm in the intertidal region are mostly different from those in higher salinity mangrove [3]. Many of the fungi associated with *N. fruticans* are unique marine species belonging to genera consistently found on terrestrial palms [20]. A few are found throughout mangrove ecosystems, such as *Lignincola laevis* [3], *Halocyphina villosa*, and *Lignincola tropica* [8].

The most frequently collected species in this study is *Linocarpon appendiculatum*, followed by *Astrosphaeriella striatispora.* The two were recorded in Brunei, Malaysia, Indonesia, and Papua New Guinea and both were also common in the following studies:

[21], the most common intertidal species reported were *Neolinocarpon nypicolum, Astrosphaeriella striatispora, Linocarpon appendiculatum, Oxydothis nypae* and *Rosellinia* sp. In [22], the most common fungal species were *Linocarpon appendiculatum, Oxydothis nypae, Lignincola laevis, Linocarpon nipae* and *Astrosphaeriella striatispora.*

In [21], 63 fungal species associated with *N. fruticans* were recorded. Many of which were collected in this study, such as *Linocarpon appendiculatum, Astrosphaeriella striatispora, Oxydothis nypicola, Lignincola nypae, Aniptodera intermedia, Lulworthia grandispora, Anthostomella nypensis, Linocarpon angustatum, Vibrissea nypicola, Aniptodera chesapeakensis, Carinispora nypae, Helicorhoidion nypicola, Lignincola longirostris, Lignincola laevis, Trichocladium nypae,* and *Halocyphina villosa*. The other species in this study were also reported to be associated with other mangrove plant species, such as Ascomycete sp. 2, which was also collected in the study in 2000 from *Xylocarpus granatum.* It is one of the unidentified species which is believed to represent a new genus (Hyde, K.D. pers. com, May 5, 2000). The fungus is a unitunicate, with hyaline and muriform ascospores. Its occurrence on *Nypa fruticans* could be explained by its proximity to the *Xylocarpus granatum* stands which are located very near the *Nypa fruticans* stands. The two mangrove plant species are growing in the area having the same salinity level (10-15 ppt) in the upper river of the mangrove ecosystem.

The occurrence of mangrove fungal species in 2015 was found to vary from the study conducted in 2000 and the number of fungal species decreased from 23 species in 2000 to 20 species collected in 2015. There were 9 mangrove fungal species collected in both 2000 and 2015: *Linocarpon appendiculatum, Astrosphaeriella striatispora, Lignincola nypae, Aniptodera intermedia, Lulworthia grandispora, Lignincola tropica, Anthostomella nypensis, Vibrissea nypicola,* and *Helicorhoidion nypicola.* Though there are fewer number of species collected in 2015, fifty-five percent or eleven species were newly collected from *N. fruticans*, such as: *Lignincola longirostris, Leptosphaeria* sp., *Pontogeneia* sp., Ascomycete sp. 2, *Payosphaeria* sp., *Mycosphaerella* sp., *Lignincola laevis, Periconia prolific, Trichocladium nypae,* Hyphomycete sp. and Coelomycete sp. 1. It is important to note that *Microthyrium* sp. and *Oxydothis nypicola,* were two of the

frequently collected species in 2000, in 2015 the two were not present. Another commonly collected species in 2000 was *Halocyhina villosa,* a Basidiomycete which was not collected also in the study in 2015.

The occurrence of mangrove fungal species within the mangrove forest is influenced by environmental factors such as salinity, nutrient availability, oxygen level in the soil and temperature. The interactions of a plethora of factors may govern the existence of the fungal species in the mangrove ecosystem. In [9], the effects of temperature on the growth of 3 marine fungi were determined in the laboratory. The result revealed that each fungus grew best at a temperature range corresponding to its observed natural temperature regime. A study by [10] reported the long-term datasets that reveal effects of climate change on saprotrophic and ectomycorrhizal basidiomycetes.

Another explanation for the absence of some fungal species could be environmental. The study area is near a bridge and construction of an extension from the base of the bridge was done recently which lead to the cutting of some *N. fruticans.* The residue of the cement and other construction materials could have been carried to the surrounding mangroves by the tides and it could have contributed to the change in the species composition. Some of the large stones had also been removed to be used as construction materials which could have indirectly affected the mangrove ecosystem. Further, continuous monitoring is needed to obtain a better and complete picture of the ecology of fungi associated with *Nypa fruticans.*

CONCLUSION

A total of thirty-four fungal species were identified from the decomposing parts of *Nypa fruticans* from studies conducted in 2000 and 2015, including 26 Ascomycota, 7 mitosporic taxa and 1 Basidiomycota. The fungal mycota associated with *N. fruticans* decreased in number of species collected from 23 taxa in 2000 to 20 taxa in 2015. Fifty-five percent (11 species) were newly recorded in 2015, out of a total of 20 species, including 15 Ascomycota and 5 mitosporic taxa collected from 80 wood samples. The most frequently collected species was *Linocarpon apendiculatum*, followed by *Astrosphaeriella striatispora*, all the other species were less frequently collected. The variation in the fungal species collected in 2000 and 2015 was statistically significant. This study demonstrates that there were changes in the fungal taxa associated with *N. fruticans* in a span of 15 years. Hence,

extensive studies will be needed to systematically generate data on the condition of this ecosystem.

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