Observations of Insect-Fungi Interactions at Finca Las Piedras

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Abstract

The interactions of fungi and insects in tropical forests are complex and fundamental for the soil, plants, and the whole ecosystem health, however little is known about their diversity and the strength of the interactions. Sometimes, fungi and insects work together in symbiotic relationships to help each other survive. Insects benefit from fungi by being provided nourishment, a home, and a place to lay eggs. In return the fungi are given a stronger way to reproduce. All of these things are extremely necessary to survive in the Amazon rainforest. This study explores the relevance of insect-fungi interactions and attempt to describe the exact nature of the interactions during dry season at Finca Las Piedras. Observations were conducted on two separate trails in the old growth forest. Every Basidiomycota that was seen within two meters of the trails was recorded. For each fungi, their fruiting body have been thoroughly observed to see if there are any insects located on them. Then, descriptions of each interaction were made. In this study, we showed that there are in fact many insect and fungi symbiotic relationships taking place in the Amazon Rainforest. The observations are showing many more interactions than anticipated. Out of the 55 fungi found, 20% had an insect living, consuming, or interacting in a way. One of the most charismatic findings was about beetles laying eggs in the fungi lamella which entice ants to crawl into to eat the larva. By studying fungi-insect interactions, we improve our understanding on how certain species work together to support a healthy ecosystem in a Neotropical region.

Introduction

The Amazon rainforest is the most biodiverse place on the planet. Within this region there are thousands of different species of animals, plants, and fungi with unbelievable methods of working together. Without these relationships to help drive and support the ecosystem, it would not be able to function. But sadly, many of these relationships have not been studied to a great extent. For example, insect and fungi relationships remain largely unexplored in this region. We know insects can gain many essential needs from fungi including things like food, a place to live, and a place to raise their offspring. In return the insects are capable of giving back to the fungi by feeding them and aiding them in reproduction by spreading their spores. The diversity of fungi and the insects in the Amazon Rainforest are also poorly studied, making their interactions a vastly unexplored field. Within the Madre de Dios region, we know of the Erotylidae which are more commonly known as Pleasing Fungus Beetles. These beetles are fungivores which mean they only eat fungus. In this study I will

explore the relevance of insect-fungi interactions and attempt to describe the exact nature of the interactions for my time at Finca Las Piedras. What kind of insect-fungi interactions exist in a disturbed forest like the one at Finca Las Piedras? Do fungi help support the insects? Do insects help support the fungi? Do they both help support each other? These are some of the questions explored in this project, which will set the baseline for further research.

Methods

This study takes place in Madre de Dios, Peru, at the Finca Las Piedras (FLP) Research Station (-12.2263°, -69.1126°). This area has been selectively logged around 25 years ago and is currently under protection by the NGO Alliance for a Sustainable Amazon. My field observations took place over the course of a week in August, during the driest time of the year. I walked two trails in the old growth forest which is a primary forest and located at Finca Las Piedras. These trails are called the Lindero trial and the Tapir trial. For each of these trails here at Finca Las Piedras I recorded every Basidiomycota that I see within two meters of the trail. A Basidiomycota is basically a fungi that has a fruiting body. For each of these Basidiomycota I observed if there were any insects located on it. For each different Basidiomycota I labeled it with a number.

The first one I saw I labeled sp.1 and the second one was sp.2 and so on. I took take a picture of each type of fungi I saw and each insect I saw on the fungi. I watched the insects closely with my naked eye and a magnifying glass. Analysis of the data included me attempting to describe the exact nature of each interaction I saw and keeping note of which fungi the interaction occurred on. Additionally, I had a specialist help to figure out each insect species that I saw.

Results

In the two trails I observed, with a total length of about 1200 meters, every Basidiomycota seen was catalogued. In total, 45 different species of Basidiomycota were found. Within these 45 species, 16 different insects were observed.

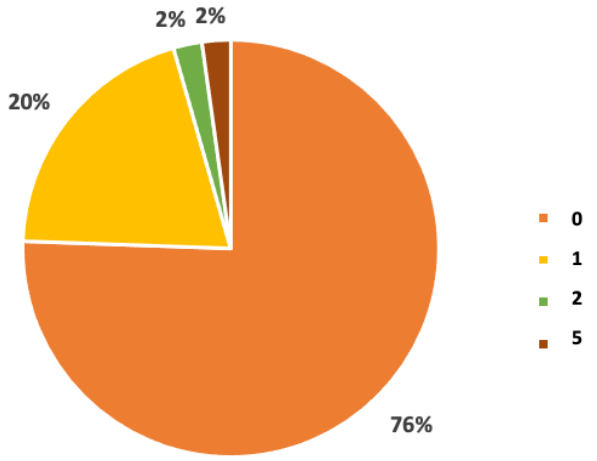

Figure 1. Insect orders interacting with fungi.

According to my observations, 76% of the fungi contained zero insect orders. Along with this, 20% contained 1 type of insect order, 2% contained 3, and 2% contained 5 (Fig.1).

Of my 16 different insect species observed, 56% of them were Coleoptera, 25% were Hymenoptera, 7% were Blattodea, 6% were Diptera, and 6% were Dermaptera. This shows that the majority of insect-fungi interactions at Finca Las Piedras happen with Coleoptera (Fig. 2).

Insect-Fungi Relationships

The 2% of Basidiomycota that contained 5 insects orders was in one single

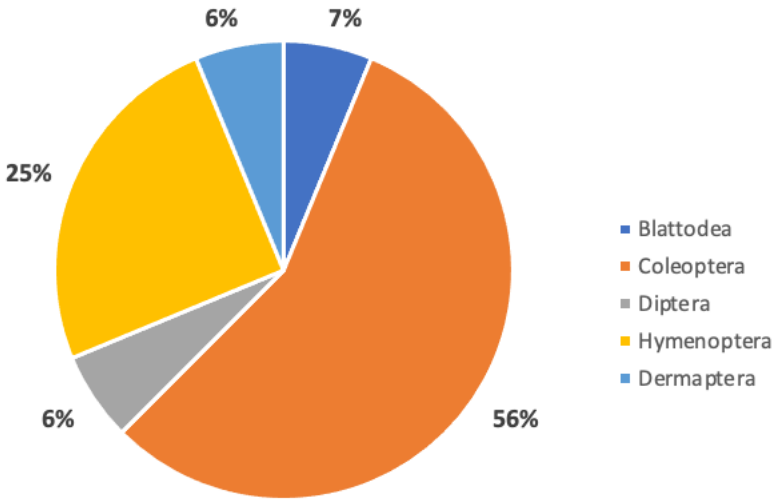

Figure 2. Insect Order proportion found in fungi at Finca Las Piedras.

type of Basidiomycota. This was sp.6 which contained 3 types of Coleoptera, 1 type of Blattodea, and 1 type of Hymenoptera.

Figure 3. Fungi species 6 with spores.

Based on my observations, this species of Basidiomycota was a good place for these insects because of how the Pileus (caps) are shaped. The caps are curled downward which provides a good place for the insect to be hidden from the outside world. This means it could be a good place for insects to lay their eggs and raise their offspring because they cannot be seen by predators. This Basidiomycota also contains a lot of spores.

When I gave it a gentle flick, I saw a mass amount of spores fall out of the bottom (Fig 3). This means these insects that I found inside sp.6 must have some amount of these spores stuck to them. After the insect leaves sp.6 it will still have some of these spores stuck to it which will eventually fall off and help sp.6 reproduce and form elsewhere.

Among the Coleoptera that were found on sp.6, I saw one beetle larva (Fig. 4).

Figure 4. Fungi species 6 with a Coleopteran larva.

This leads me to believe that beetles in this region use sp.6 as a place to raise their offspring and lay their eggs. Insects and sp.6 have a symbiotic relationship where sp.6 gives

Figure 5. Fungi species 27 with Coleopterans (white arrow).

them a place to live, lay their eggs, and raise their offspring and in return they help sp.6 reproduce.

In sp.27, I observed two Coleoptera and one Hymenoptera. The two Coleoptera were *gibbifers* which are a type of Erotylidae. Erotylidae are known to be fungivores which means that they feed on fungi (Fig. 5).

On sp.27 I noticed little white things that looked like tiny grains of rice in between the lamella of the Basidiomycota.

After talking to an entomologist about these little grains of rice, he believes that they could be beetle larva. I saw with my naked eye one Hymenoptera grab one of these beetle larvae and run off to bring it elsewhere.

Figure 6. Fungi species 27 lamella.

Figure 7. Fungi species 8 with ants feeding on its base.

Sp.27 have lamella with large crevices in-between them (Fig.6). This makes for a great spot for the *gibbifers* to lay their eggs and raise their offspring. The Hymenoptera seemed to learn this fact for the reason that they love to feast on beetle larva. Since the spores of this Basidiomycota is held within the crevices of the lamella it is safe to assume that both the Coleoptera and the Hymenoptera get covered in spores during these processes.

An interesting Basidiomycota that I have found in my observations is sp.8. Sp.8 is interesting because it seems that it somehow clusters all of its spores into a pile on top of its Pileus. I saw many Hymenoptera feeding on the bottom of sp.8 (Fig. 6). Since the ants need to walk over the top of sp.8 to get down to the bottom it seems that putting the spores on the top of the Pileus was a good idea for the species. I observed ants walking through the spores on the top on their way to feed on the bottom of the fungus.

After the Hymenoptera walked through the spores I saw them get stuck to the insects' feet. This way the fungus has a way to reproduce throughout the rainforest while at the same time providing the Hymenoptera nourishment (Fig. 8).

Discussion

Results of my observations support what I have found about insect-fungi interactions in scholarly articles. Throughout my time observing insect-fungi interactions here at Finca Las Piedras, it seemed that some of the most common benefits that the fungus received from insects is a stronger ability of reproduction. Fungi spores are extremely sticky which get stuck to insects when they are trying to feed, live, or lay their eggs on the fungus. When the insects travel elsewhere in the forest, the spores will eventually fall off of the insect and allow the fungus to reproduce all throughout the forest. Like I previously stated,

the insects benefit from this by being provided nourishment, a home, and a place to lay their eggs. All of this information I found supported the interactions that I have seen in scholarly articles. They all talked about the same ways that fungi and insects benefit from each other. The one thing I found that I did not see in the scholarly articles was how Coleoptera and Hymenoptera can interact on a single Basidiomycota. I saw Coleoptera laying eggs in Basidiomycota lamella which enticed Hymenoptera to crawl into fungi to eat the larva. Throughout this interaction between the Coleoptera and Hymenoptera, they are both covered in spores which benefit the fungi with stronger reproduction in the rainforest.

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Figure 8. Fungi species 8 spores transported by ants.