Comparing ant diversity between light gap-, and forest plots at Finca Las Piedras, Madre de Dios, Peru

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Abstract

In this study, I examine ant-diversity in two habitats trying to find clues of how ants adept to forests effected by features of global change, particularly deforestation and raising temperatures. To archive this, I compare diversity in light gap-, and forest plots using the Shannon-Index. Although light gaps occur naturally, they resemble some key conditions found in forests suffering from human influences. Although temperature measurements confirm alternating conditions, data analysis found no significant difference in ant-diversity between both habitats. These results suggest a potentially good temperature resistance in ants, although data is not sufficient to draw final conclusions.

Introduction

The ongoing process of climate change is one of many threats the Amazon rainforest, - the largest and most diverse of all lowland tropical forests (Dirzo & Raven, 2003), must face. Amazonian rainforests do not only host some of the most remarkable, unique creatures earth has to offer, but also play a key role in storing carbon and thereby, avoiding an even faster acceleration of global warming.

One major concern for tropical forests is deforestation in favor of money generating activities. Forest clearings create edges, which can be used for agricultural farming, space for new settlements, or most likely just left untouched. On a much smaller scale, similar open spaces, called light gaps, occur naturally within forests. Light gaps emerge whenever tall trees fall and take most of the surrounding vegetation away.

In terms of habitual composition, forest edges vary in numerous factors, such as increased sun light exposure, less vegetation and a poorness of species in contrast to large, undisturbed areas (Ferraz et al., 2003). Although to a smaller extent, these are conditions that can be found within light gaps as well. My premise is that light gaps resemble habitat that will occur more frequently in human interevent forests, where deforestation and hostile growing conditions will lead to an abundance of open territory.

Adapting to changing environments at such rapid speed, which climate change is happening already, requires organisms to renew their trophic niches in ways, not all species might be possible to keep up with. Therefore, my goal is to examine the diversity of ants in light gaps compared to their diversity in forest territory at Fincas Las Piedras, Madre de Dios, Southeastern Peru.

Study results hopefully enable me to draw first conclusions on what effect future forest conditions can have on ant diversity. I predict to discover a greater ant-diversity in non-light gap habitat, because I hypothesize to find dominat, thermally well adapted, species within light gaps, which potentially repress others.

Methods

Study Sites

Within 54 hectares, Finca Las Piedras (FLP) hosts agricultural fields, palm swamps and a species-rich upland secondary forest, regenerating from logging activities of previous owners. Characteristic for the field research and education center concession is the appearance of numerous Brazil nut trees. Surrounding the ASA-facilities numerous small agricultural fields with fruits, vegetables and Cacao-plants can be found.

Sampling takes place within the secondary forest. There, light gaps, usually caused by fallen trees, are abundant. To identify a light gap, I look for an obvious absence of canopy-cover from tall trees, at least five meters in each direction. After sampling in the light gap, I walk a minimum of 50 meters towards the most densely covered forest area, which will serve as my second sampling habitat.

Ant Survey and Collection

For the study, I went to 14 light gaps and their respective comparison plots. For 6 weeks I sampled two or three times each week, entering the forest around noon. Arriving in a light gap, I visually defined a sampling plot, which included soil and understory habitat, the size of about 40cm*40cm. I placed a thermometer next to me and set my timer on ten minutes. During this time, I collected each individual belonging to a new morphospecies by using tweezers placing them in tubes containing 70% Ethanol.

Back in the facilities, I measured body sizes, from the tip of the head to abdomen, using a ruler. In order to store and revisit morphospecies, they were placed in labeled containers filled with Ethanol. Pictures and small descriptions helped me to recognize my morphospecies.

Data analysis

Using Microsoft Excel, a Shannon-diversity index was calculated for each sampling plot. In the following, a paired t-test, conducted in the data analysis program “R”, reveals potential correlations between ant-diversity and sampling habitat. In order to compare temperature data, another paired t-test was conducted in R.

Results

Sampling resulted in a total of 36 ant-morphospecies, divide to 1036 individuals within 26 morphospecies in light gaps and 542 individuals within 24 morphospecies in non-light gaps.

Table 1. Data summary

	Light gaps	Non-light gaps
#of morphospecies	26	24
Total individuals	1036	542
Average body size	5.1mm	5.2mm
Average temperature	31.9°C	28.6°C

The most abundant morphospecies consisted of 341 individuals, while for several, especially larger morphospecies, only one individual was found. Body Measurements revealed a maximum of 32mm (Bullet ant) and a minimum of circa 0.5mm, it’s average was 5.1mm and 5.2mm for light gap-, and non-light gap patches, respectively. Temperatures were found to be significantly different between sampling plots (paired t.test, df=13, p<0.001***), having a temperature difference of 3.3°C (Table 1).

There is no significant difference in ant diversity between light gap-, and non-light gap patches (paired t.test, df=13, p=0.55).

Discussion

The absence of differences in ant diversity between sampling habitats can be interpreted in multiple ways. On one hand, these findings suggest a potentially good temperature tolerance in ant communities. This would imply ants might be more resistant to changing climatic and habitual conditions than many other taxonomic groups. Indeed, ants are known for their capability of inhabiting almost any territory, although not in the same variety and abundance as they appear in the tropics. A possible explanation for their temperature resistance could be related to the social structure within ant colonies. Because the working caste does not reproduce, they might make most of their thermal limits, including taking greater risks during foraging activities. Reproduction is known to more likely be affected by temperature extremes than most other physiological functions (Bursell, 1964).

On the other hand, similarities of species and abundance in my findings might be the result of pitfalls within the study set-up. Often, I found the same species in light gaps and its neighboring forest patch.

A greater distance between sampling locations would possibly help discovering more meaningful results. Additionally, more sophisticated trapping tools would help in order to find a greater number of species, since some of them live inside the soil or high in the canopy. Furthermore, nocturnal species were largely ignored in this study. This could possibly bias my study towards a greater diversity in light gaps, since some species may only forage in light gap habitat, while returning to their nesting sites at night.

Another potential fallacy limiting meaningful conclusions, is the assumption that light gaps can resemble conditions of heavily disrupted forest territory properly. Light gaps are minor disturbances, forests do normally not struggle to recover from. In fact, a new opening can benefit some space-dependent plant species and ensure the forests variety. As for deforested territories, often a much larger space is demolished from existence. Whereas ants must not travel far to find intact forest in the studies sampling territory, this can differ immensely in logged forest habitats. The availability of sun-protective shelters is of major importance for their thermal regulation. In this aspect, light-gaps fail to mirror potentially large territories without canopy-cover.

In order to make a more realistic

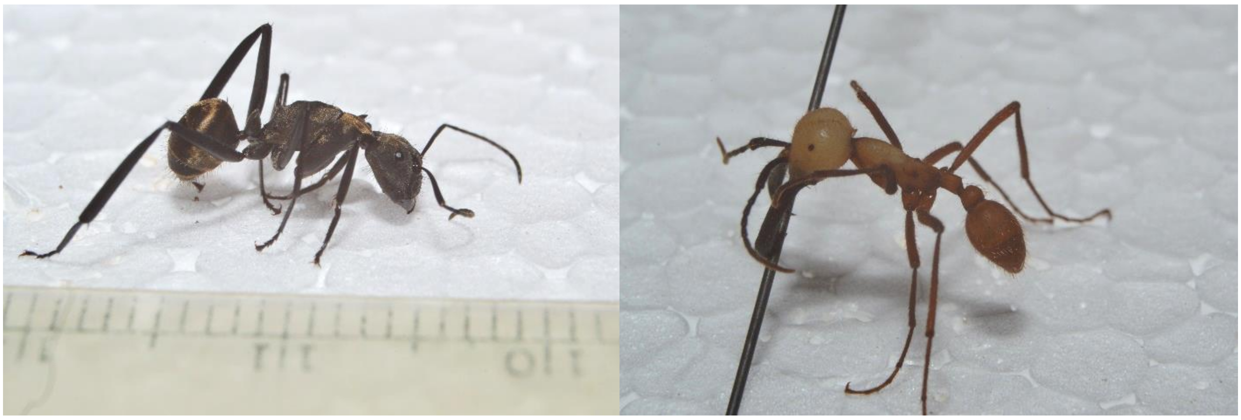

Figure 1. Some ant specimens collected for further identification.

prediction about ant diversity in future forests affected by raising temperatures and deforestation, possible follow-up studies should explore logged territory, in comparison to intact forests. Naturally occurring light gaps can't resemble potentially disrupted future forests to a magnitude which would allow this study to make a feasible prediction about ant-diversity in climate change affected forest habitat.

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