The impact of deforestation of tropical rainforest on herpetofauna in Madre De Dios, Peru

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Abstract

The Madre de Dios region in Peru is known as one of the most biodiverse tropical forests, especially when it comes to reptiles and amphibians. However, a high rate of deforestation affects the biodiversity of this region. These groups suffer the most because of their vulnerability to habitat degradation. To check the influence of deforestation on these groups within the Madre de Dios region, I compared the relative abundance and species richness between two different habitats: a terra firme rainforest and a grassland habitat. These buckets were checked twice a day over a period of 20 days. In total 132 individuals were caught over this period. It appears that more individuals of fewer species occur in the grassland habitat. Less individuals of more species were found in the forest habitat. For the number of individuals per habitat, a statistically significant difference was found. For the number of species and the day and night activity of individuals no statistical significance was found, even though a small difference was found between the diurnal and nocturnal activity of herpetofauna in the grassland habitat.

Introduction

Tropical rainforests are known for their rich biodiversity (Asner et all., 2009). It's estimated that 50% of the terrestrial species live in these forests (Cusack et all., 2016), with new species discovered each year (Metcalf, et al., 2020). In 1990 there were 1635 million ha of tropical forest around the world. By 2010 the number of ha had decreased by 7.5% to 1514 million (Achard et al., 2014). The Amazon rainforest covered about 5.4 million km^2 in 2001, that is estimated to be about 87% of the original coverage, this year 837.000 km^2 of Amazon forests have been chopped (Malhi et al., 2008). These forests make up 40% of global tropical rainforests. (Zambrano, et al., 2010)

Peru houses the second biggest part of the Amazon tropical rainforest. Here 24.334 km^2 of forest was lost between 2001 and 2019, around 3.4% of its original size. Deforestation is mostly done on the border of the San Martin

and Loreto region and the Madre de Dios region. (Rojas, et al., 2021)

The current threats to the biodiversity of the Madre de Dios region in Peru are mostly due to habitat loss associated with human activities such as gold mining, slash-and-burn agriculture and illegal logging. (May, et al., 2008) Slash-and-burn agriculture and cattle ranching on these degraded areas are major ecological concerns. These degraded areas are big negative disturbers of the biodiversity and wildlife population within the rainforest. (Metcalf, et al., 2020) The grass-dominated vegetation which replaces most of the degraded areas consist of low native species diversity and is mostly dominated by one or two species of grass. These grasses inhibit the regrowing ability of the forest. (Veldman & Putz, 2011)

Degradation of forest has a huge impact on species. The Peruvian Amazon is thought to house the most diverse and rich amphibian and reptile communities in the world (Metcalf, et al., 2020). Some species of amphibians decline in numbers due to deforestation of tropical rainforests in Peru. This group is the most sensitive to habitat fragmentation and degradation. It appears that the main reasons for the increased sensitivity are the dispersal limitations, habitat preferences and physiological responses. Forest specialized reptiles seem to be more affected by habitat loss and fragmentation, while amphibians are more affected by habitat degradation. Amphibians are particularly vulnerable when it comes to habitat degradation (May, et all., 2008) as well as habitat pollution, disturbance and disease (Warren-Thomas, et all., 2013).

I compared a terra firme forest with a degraded forest to study the possible impact of habitat degradation on the diversity and abundance of herpetofauna. Additionally, I looked at the habitat preference of the species and their diurnal/nocturnal activity. I predict to find a higher diversity of species within the rainforest, due to the bigger diversity of habitats and layers in the forest. The grassland will have a higher number of individuals due to a couple of dominant species.

Methods

Study location

The Alliance for a Sustainable Amazon research station, Finca Las Piedras, is located in the Madre de Dios region in the Southern part of Peru. The 54 ha-property consists of habitats as mostly intact terra firme rainforest, grassland and palm swamp (aguajal). The terra firme forest habitat is a relatively intact forest with only a subjection to selective logging for the last 30-40 years. This logging was only done to mature big-leaf trees species as ironwood (*Dipteryx micarantha*), Tornillo (Cedrelinga sp.) and Spanish cedar (*Cedrela odorata*). The grassland area at the site was created by deforestation for agriculture ca. 10-20 yrs ago and is now dominated by invasive African cattle grass.

Study group

The study groups for this research are terrestrial reptiles and amphibians within the Madre de Dios region of Peru. This study group was chosen because of its big part of the Tetrapod's in the Amazon region (Metcalf, et al., 2020). They also are more abundant compared to most other vertebrates and are smaller. (May, et all., 2008)

Data collection

The data for this research was collected by the use of four drift fences. Two were located in a forest area and two were located in a grass-

dominated area, to allow comparisons of reptile and amphibian communities across the disturbance gradient.

Trap locations

The two drift fences in the forest were built at least 100 meters from each other 5 m from a trail. This was done to avoid human disturbance. Both fences in the forest were located at least 80 m from the forest edge.

The locations for the two fences in the grassland habitat were selected based on the distance from a tree and the amount of trees in the direct area. Each trap was placed at least 5 meter from a tree. Also, the amount of shade mattered. Because of the heat of this region, the buckets were placed so amphibians wouldn't dry out during the day. These locations were at least 100 m from each other and 5 meters from a road or path.

Drift fences

The drift fences were built in a Y shape, with three equidistant and equal-length arms radiating from the center point. Each arm was 5 m long and 1 m high and consisted of two 1 meter poles which were dug in the ground for 30 centimeters. A black plastic carpet was stretched between the poles to work as a fence. This fence was dug in for 10cm to prevent reptiles and amphibians from crawling under it. At each end of an arm and in the center of the trap a 18.9L bucket was dug in to be used as a trap.

Data collection sessions

Each trap was checked twice a day, five days per week. Once around sunrise (5-7 am) and once around sunset (4-6 pm) for 20 days in the period between 05-02-2022 and 06-03-2022. The traps were closed with a lid to prevent animals from falling in during non-sampling days.

Each round all the buckets were checked by protocol. First the buckets were visually inspected for herpetofauna. If herpetofauna were found, pictures of each individual were taken. A dorsal picture was taken of the animal inside the bucket to prevent it from escaping. For the ventral picture, the animals were put in a small plastic cup with a lid. After the pictures were taken, the animal was released. The data collected per individual was the number of the trap, the number of the bucket, the date, and if it was a diurnal or nocturnal encounter.

The data was later added into an excel sheet. The species name, family name, the number of individuals, the habitat, the trap number, day or night activity, bucket number, Amphibian or reptile and the date were noted.

Determination was done by checking the species with the book;" Amphibians of the Manu learning centre", and determination sheets of the Cocha Cashu, Los Amigos, Madre de Dios and Amarakaeri region of Peru.

Data analysis

The data were analyzed with the help of the Mann-Withney U test. First the mean and the standard deviation of the individuals per habitat per day, the number of individuals per day and the diurnal and nocturnal activity of both habitats was calculated.

Results

The mean numbers of individuals between the two habitats per day were statistically different (Mann-Withney: N1=42 , N2=42 , W= 434,5, P<0.01 (Figure 1). With a mean of 0.29 for the forest and 2.79 for the grassland.

Species richness

The number of species between the both location are almost equal. In total 11 species were located within Fienca las Piedras, without a big difference between the forest (N=7) and the grassland (N=4), see figure 2.

Three of the species, *Adenomera andreae* and *Adenomera hylaedactyla* and *Ameiva ameiva* show a clear preference for the grassland area. *Adenomera andreae* was most common within the grassland area (N=91) and hardly present in the forest (N=3). *Adenomera hylaedactyla* was also more common in the grassland (N=23) then in the forest (N=3). *Ameiva ameiva* was only found in the grassland area (N=4).

Day versus night

No statistical significance was found for the number of individuals with diurnal vs nocturnal activity per day in the forest . (Mann-Withney: N1=21 , N2=,21 W=250, P=>0,05) (figure 3)

Also no statistical significance was found for the number of individuals with diurnal vs nocturnal activity per day in the grassland. (Mann-Withney N1=21 N2=21 W=194 P=>0.05) (figure 4)

The number of diurnal active individuals was almost the same compared to the nocturnal compared to the nocturnal activity, see figure 3.

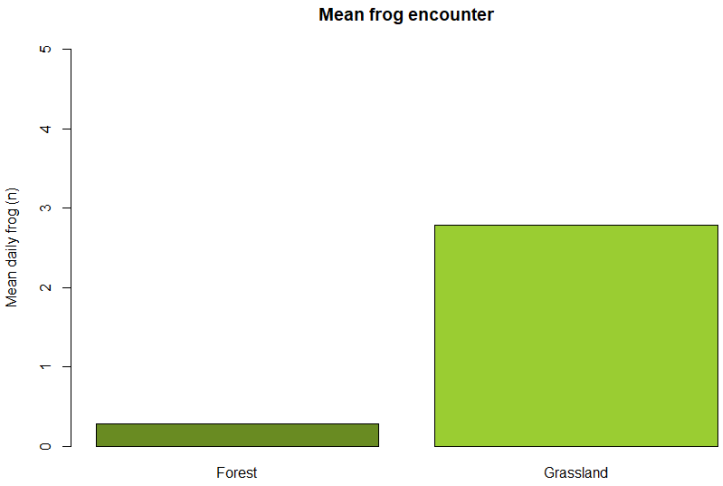

Figure 1 The number of individuals per habitat. Statistically significant.

Figure 2 The number of species between the Grassland and the Forest habitats.

The diurnal activity in the grassland was lower than the nocturnal activity(figure 4).

Discussion

There is statistical evidence of a correlation between the effects of deforestation on herpetofauna. The number of individuals within the grassland is statistically significant. The influence of diurnal and nocturnal activity is not statistically signific ally proven.. This

means that the diurnal and nocturnal factor doesn't affect the number of individuals within the habitats. The hypostasis can be accepted because of the statistically significance. More individuals of less species were found in the grassland area compared to fewer individuals of more species in the forest.

The scale of this research

This study was done with two drift fences within two habitats, terra firme forest and grassland. This makes the number of data really small. To really see the influence of deforestation on herpetofauna, the scale of this research mush increase massively. When the number of drift fences increases, the number of data might increase. Also the number of habitats should be higher.

Drift fence

The condition of the two forest drift fences might be worse then was estimated. There might be some holes who were not noted during the repairing moments, what might have resulted in species being able to go through these holes. With the building of the second grassland drift fence a couple of obstacles where found. Three logs and two big holes made the building of the drift fences a little harden. This might have decreased the efficiency of this drift fence. Although all the plastic was dug in for 10cm and no digging marks were spotted around all of the fences, there could have been weak points where species were able to get underneath the plastic, especially within the second drift fence of the grassland area. It is also possible that species could be able to climb of jump over parts of the plastic. At spots where de plastic was at its lowest point, it might have been possible for frogs to jump over them.

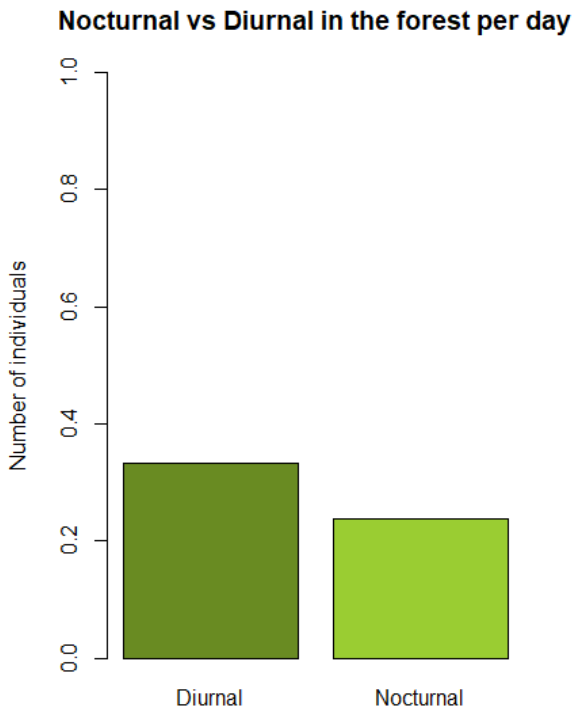

Figure 3 The number of individuals with day or night activity within the forest per day.

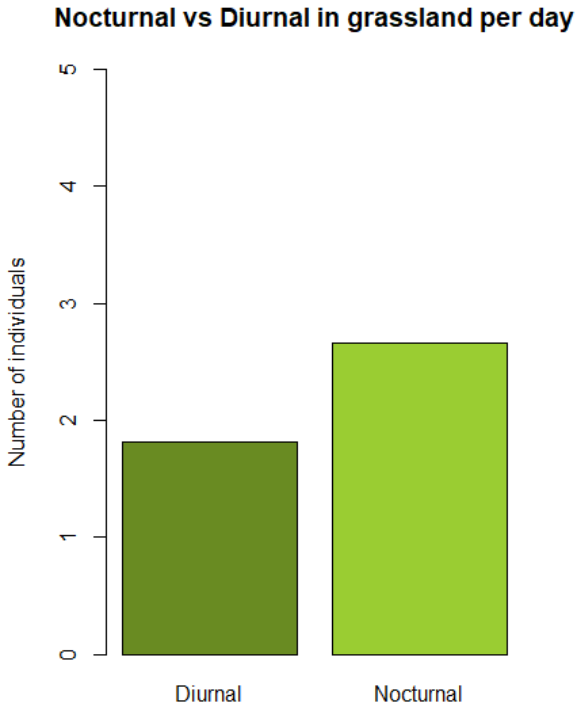

Figure 4 The number of individuals with day or night activity within the grassland.

Season of collection

The data collection was done between 2022-05-02 and 2022-06-01. This period is the end of the rain season and the begin of the dry season. During the research multiple fiagés (ice winds from Antarctica) can over the research area. The colder weather because of this phenomenon could affect the amount of movement herpetofauna make. This could have affected the results by a lower number of individuals.

Determination of species

Adenomera Andreae and Hyliacdeale are difficult species to identify. Identification is done by morphology and vocalizations (de Carvalho et all, 2019). Vocalizations are commonly used to identify an individual (de Carvalho et all, 2019). During this research the identification was only done on morphologic difference of individuals. This might results in wrong identification of the individuals because of the individuals differentness within species.

The research of Tobias Süess in the same area shows a lower amount of individuals of the two adenomera species. This research shows that the *Adenomera andreae* was more abundant in the forest compared to the grassland. Because of the dates of this research, the habitat of the *A. andreae* could have changed or due to migration reasons the numer of individuals of this research is much higher in the grassland. Adenomera frogs make Terrestrial foam nests and therefore don't need water to lay eggs. The non-feeding tadpoles complete the development in these nests. The Adenomera genus is the only known neotropical genus to produce this kind of nests. (Hödk, 1990)

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