



Plant and arthropod diversity in forest fragments with different levels of disturbance

Maëlle Cario

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Plant and arthropod diversity in forest fragments with different levels of disturbance.

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<p>Résumé (1600 caractères maximum) :</p> <p>La forêt atlantique du Brésil est un hot spot de biodiversité et sa surface est constamment réduite pour la mise en place de culture, causant une fragmentation des paysages forestiers. Depuis plusieurs années, des mesures de protection sont mises en place et la restauration des fragments de forêt par leurs propriétaires est contrôlée via le code forestier brésilien. L'étude de ces fragments de forêts est importante pour évaluer leur importance dans la protection des cultures, mais aussi pour justifier leur préservation. Il existe plusieurs types de fragment de forêt et cette étude vise à étudier les fragments situés le long des rivières et sur les plateaux. Ces deux types de fragment ont des politiques de préservations différentes, et nous avons émis l'hypothèse que des variations de biodiversité et d'interaction plantes-arthropodes seraient mise en évidence. Nous avons montré des différences entre les fragments mais le type de fragment n'a pas permis d'expliquer ces dissimilarités. Ces premiers résultats nous ont permis d'estimer plusieurs variables pour mesurer la qualité des fragments de forêts. Nous avons finalement proposé une méthode d'évaluation de cette qualité pour les fragments étudiés, dont les résultats pourraient permettre de classer les fragments en fonction de leurs besoins de restauration.</p>		

Abstract (1600 caractères maximum) :

Brazil's Atlantic forest is a hot spot of biodiversity and its surface area is constantly being reduced for cultivation, causing a fragmentation of the forest landscape. For several years now, protection measures have been put in place and the restoration of forest fragments by their owners is controlled through the Brazilian Forestry Code. The study of these forest fragments is important to assess their importance in crop protection, but also to justify their preservation. There are several types of forest fragments and this study aims to study the fragments located along rivers and on plateaus. These two types of fragment have different preservation policies, and we hypothesised that variations in biodiversity and plant-arthropod interaction would be highlighted. We showed differences between the fragments, but the type of fragment did not explain these dissimilarities. These initial results enabled us to estimate several variables to measure the quality of forest fragments. We finally proposed a method for assessing this quality for the fragments studied, the results of which could make it possible to classify the fragments according to their restoration needs.

Mots-clés : Biodiversité – Fragments de forêt – Réseau d'interaction – Brazilian Atlantic Forest

Key Words: Biodiversity – Forest fragment – Interaction networks – Forêt Atlantique du Brésil

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RÉSUMÉ

La forêt atlantique du Brésil est un hot spot de biodiversité et sa surface est constamment réduite pour la mise en place de culture, causant une fragmentation des paysages forestiers. Depuis plusieurs années, des mesures de protection sont mises en place et la restauration des fragments de forêt par leurs propriétaires est contrôlée via le code forestier brésilien. L'étude de ces fragments de forêts est importante pour évaluer leur importance dans la protection des cultures, mais aussi pour justifier leur préservation. Il existe plusieurs types de fragment de forêt et cette étude vise à étudier les fragments situés le long des rivières et sur les plateaux. Ces deux types de fragment ont des politiques de préservations différentes, et nous avons émis l'hypothèse que des variations de biodiversité et d'interaction plantes-arthropodes seraient mise en évidence. Nous avons montré des différences entre les fragments mais le type de fragment n'a pas permis d'expliquer ces dissimilarités. Ces premiers résultats nous ont permis d'estimer plusieurs variables pour mesurer la qualité des fragments de forêts. Nous avons finalement proposé une méthode d'évaluation de cette qualité pour les fragments étudiés, dont les résultats pourraient permettre de classer les fragments en fonction de leurs besoins de restauration.

ABSTRACT

Brazil's Atlantic forest is a hot spot of biodiversity and its surface area is constantly being reduced for cultivation, causing a fragmentation of the forest landscape. For several years now, protection measures have been put in place and the restoration of forest fragments by their owners is controlled through the Brazilian Forestry Code. The study of these forest fragments is important to assess their importance in crop protection, but also to justify their preservation. There are several types of forest fragments and this study aims to study the fragments located along rivers and on plateaus. These two types of fragment have different preservation policies, and we hypothesised that variations in biodiversity and plant-arthropod interaction would be highlighted. We showed differences between the fragments, but the type of fragment did not explain these dissimilarities. These initial results enabled us to estimate several variables to measure the quality of forest fragments. We finally proposed a method for assessing this quality for the fragments studied, the results of which could make it possible to classify the fragments according to their restoration needs.

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1. INTRODUCTION

1.1. ATLANTIC FOREST IN BRAZIL

The Brazilian Atlantic Forest is one of the most important and diverse type of tropical forest in the world (Ribeiro *et al.*, 2011). Several definitions are adopted when dealing with such biome; defenders of the *sensu stricto* definition only consider the area of rainforest appearing along the Atlantic coast as Atlantic forest (Oliveira-Filho & Fontes, 2000). In contrast, for *sensu lato* defenders, Atlantic forest is divided into 2 principal areas showing distinct vegetation types: rainforest along the coast and semideciduous forest in the inland. The inland in turn is divided between semideciduous forest occurring at plateau and gallery forests, which are present along the river's margins. Additionally, certain parts of south Atlantic Forest are qualified as mixed forests, with forest vegetation partly composed of plants from *Araucaria* genus (Oliveira-Filho & Fontes, 2000). According to (Morellato & Haddad, 2000), the Atlantic Forest is a biome composed of several types of vegetation (Figure 1), differentiated mainly by the distinct rainfall, drought and temperature regimes.

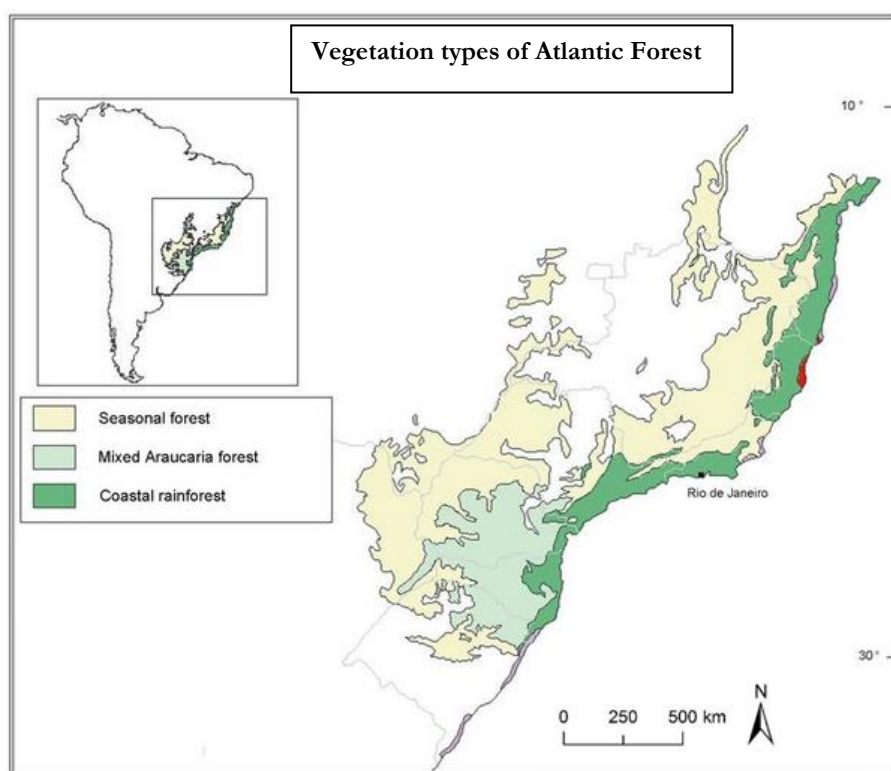


Figure 1: Map of principal vegetation types of Atlantic Forest.

Figure 1: Map modified personally from the map of (Bohrer, 1999) PHD thesis, seasonal forest representing semideciduous forest.

The Atlantic forest has experienced several periods of deforestation along human history (Pinto *et al.*, 2014). This forest originally covered 12% of the country, occupying littoral and interior areas, and in 2017 the remaining forest was estimated at 12% only (Zwiener *et al.*, 2017). Because of the high number of endemic species and its large deforestation, this forest is described as a biodiversity hotspot and its protection is considered as a priority (Mittermeier *et al.*, 2011).

1.2. RESTAURATION POLICY IN BRAZIL

Ecological restoration programmes are increasingly put forward at the international level and are becoming a priority for the preservation of biodiversity (Suding *et al.*, 2015). Today about 53% of Brazil's savannas and forests are privately owned (Soares-Filho *et al.*, 2014), the forest management is partly owner-driven, but state-controlled. To control land use, there is notably the forestry code, developed in 1965. In 2012, a new version of the forestry code concerning the management of land on private property was put in place and approved by the national congress (Pinto *et al.*, 2014).

This new code enable to set up an online register of the country's private property, in which all permanent preservation zones (along watercourses, around towns, on steep slopes and on hilltops) and legal reserves must be registered by the owner. If the quota (20% of properties covered by indigenous vegetation) is not respected, the owner must implement restoration measures (Soares-Filho *et al.*, 2014).

However, a study showed that the new text in force is less constraining to the conversion of native forest into cropland (Vieira *et al.*, 2018). Indeed, the type of restoration to be implemented is not specified in the code, which limits the impact of the measure (Chaves *et al.*, 2015). For fragments of riverside forests (gallery forest) the forest code gives a minimum area of restoration required of fifteen meters (Congresso Nacional, 2012), whereas for fragments of other types, such as forest occupying plateau regions, there is no specification.

This difference can be explained by the fact that the value of conserving areas along rivers has been widely studied in the Atlantic Forest, particularly through stream control for the reduction of soil erosion and loss of fertility, but especially for water management (Wantzen *et al.*, 2006 ; Lowrance *et al.*, 1984). However, forest fragments do not only provide ecosystem services related to water control, in Quebec, Canada, a study has shown an impact of forest fragments on the regulation of pests at the forest edge and for the carbon stock in the soil for example (Mitchell *et al.*, 2014). It is therefore expected that plateau forest will also be providers of important ecosystem services for human well-being and agriculture.

This difference of regulation may lead to a priority preservation of gallery forests at the expense of forest plateau. Therefore, it is interesting to study the biodiversity and variables linked to ecosystem services of these two types of forest fragments to encourage their conservation and restoration.

1.3. LAND USE IN SÃO PAULO STATE

The majority of forests in São Paulo state have been transformed into agricultural land with the expansion of agriculture (Figure 2), and in 2000, only 3% of the forests were still present mainly in fragment forms (Kronka *et al.*, 2005).

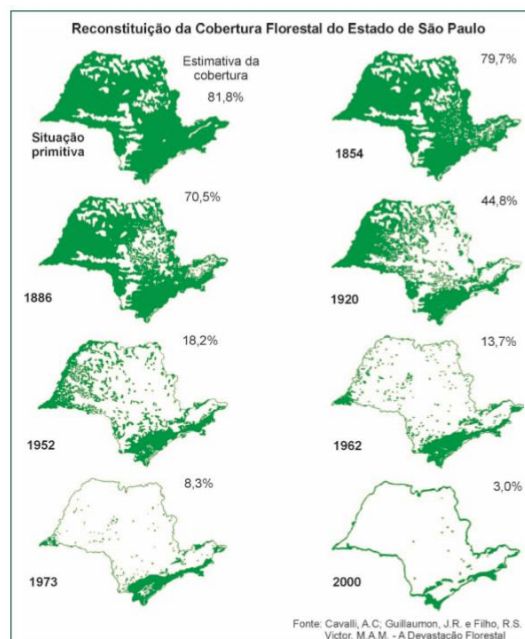


FIGURA 1: Mapas sequenciais do desmatamento no Estado de São Paulo (Victor, 1979).

Figure 2: Evolution of forest cover evolution from its primitive situation to 2000.

Figure 2: from (Kronka *et al.*, 2005).

The expansion of coffee production first and then the fuel ethanol program developed by Brazilian government during the 70's can in part explain this great fragmentation. The state of São Paulo is the most important zone for Brazilian ethanol production from sugarcane crops, holding 54.9% of the Brazilian ethanol production in the year 2008 (Rudorff *et al.*, 2010), which were traduced in an homogenization of cultures along the state landscape.

It has been shown that culture's homogenization leads to a simplification of landscapes which may impact plant and arthropods biodiversity (Gámez-Virúés *et al.*, 2015), resulting on changes in ecosystem services provided to agriculture (Hatt *et al.*, 2018).

1.4. ECOSYSTEM SERVICES OF FOREST FRAGMENTS

Ecosystem services are described by the Millennium Ecosystem Assessment as: “the benefits people obtain from ecosystems” (Millennium Ecosystem Assessment, 2005).

In agriculture, the main ecosystem services provided notably by natural ecosystems are biological pest control, pollination, water quantity and quality, soil structure and fertility and influence of landscapes (Power, 2010).

Biological pest control is an important ecosystemic service that can be provided by forest fragment, as these regions may hold a certain diversity of plants and insects (Ribeiro *et al.*, 2011). Several studies have shown that complex landscapes with different kind of habitats and natural areas have lower quantity of pests and higher presence of predators (Veres *et al.*, 2013 ; Bianchi *et al.*, 2006).

In São Paulo state, forest fragments are surrounded by agricultural crops, especially sugarcane, which are strongly affected by pests, which leads to approximately 10% of losses production in Brazil each year (Oliveira *et al.*, 2014). Although relegated to the background, plant and insect composition of forest fragments may be a key asset to complement the biocontrol methods used in agriculture today (Hatt *et al.*, 2018).

1.5. DIVERSITY AND INTERACTIONS AS ECOSYSTEM SERVICES MEASUREMENTS

There are many factors to consider when assessing the ecosystem services provided by an environment, and measuring aspects of the biodiversity of an environment is one of them (Mace *et al.*, 2012). (Mace *et al.*, 2012) has described the relationship between ecosystem services and biodiversity in several ways. In this study, we are interested in the following definition: “biodiversity is a factor controlling the ecosystem processes that underpin ecosystem services” (Mace *et al.*, 2012).

Assessing the diversity of an environment and its interactions are subjects much studied in ecology (Loreau, 2001 ; Tylianakis *et al.*, 2010). Many tools are used, including the measurement of alpha and beta diversity (McIntosh, 1967) and also the evaluation of interaction networks quality (Tylianakis *et al.*, 2010).

The paper written by (Tylianakis *et al.*, 2010) shows that indexes measuring network quality can help monitor ecosystem conservation. It has been shown that changes in the environment not only affect species diversity, but also the networks formed by such species (Tylianakis *et al.*, 2010). An increasing number of studies rely on the characteristics of networks to study ecosystems, like (Losapio *et al.*, 2015) which used the quality of interaction networks to deduce the stability of the ecosystem under study.

1.6. CONTEXT AND ORDER

This study is the first approach to measure plant and arthropod biodiversity and its role on the ecosystem services (here mainly related to pest control) provided by plateau and gallery forest fragments. Understand ecosystem services delivered by forest fragments on Jaboticabal region, in São Paulo State, is an objective of the Biology and Plant Health departments of College of Agricultural and Veterinary Sciences, Jaboticabal campus, Jaboticabal – São Paulo State University, Brazil. The Unesp University is one of the most important universities in Latin America, being known by its important role on develop

biodiversity and bio-control methods studies. In fact, a Research Centre for Sugar Cane Health was assembled in 2019, with the main aim focused on the control of sugar cane pests and the use of natural services to increase sugar cane health. The study of the ecosystem services provided by forests is therefore an important issue not only from an agronomic point of view but also from an ecological point of view. Increase knowledge of an ecosystem and its biodiversity enables to justify policy management to protect such forest ecosystems (Klink & Machado, 2005). Enlightening plant diversity and interactions among fragment forest surrounded by sugarcane crops could provide useful information to encourage preservation and even restoration of these ecosystems. This internship was supervised by Drs. Davi Rodrigo Rossatto (Associate Professor of Ecology) and Odair Aparecido Fernandes (Full Professor of Entomology).

1.7. PROBLEM

Diversity and interactions between plant and arthropod species have already been assessed around the world, usually by studying host plant diversity for a specific insect type (Burgio *et al.*, 2004) or even analysing arthropod species diversity for a certain plant genus (Slinn *et al.*, 2018 ; Endara *et al.*, 2017). However, we did not find any studies comparing diversity patterns and networks of plant-arthropod interactions in different forest types (plateau or gallery forest) in sugar cane landscapes, which place this approach as a novelty study. As explained previously, forest fragments are subject to a regulation depending on the choices of the owners of the surrounding farms, and this may affect drastically the diversity patterns and interactions between plant and arthropod species.

The first objective will be to compare fragments forest according to their environmental conditions: gallery or plateau forest. These comparisons will be based on diversity and interaction networks.

The second objective will be to use characteristics of these fragments to determine a way to measure quality of a fragment. Determine quality index of a fragment is part of the global evaluation of ecosystem services delivered by these fragments.

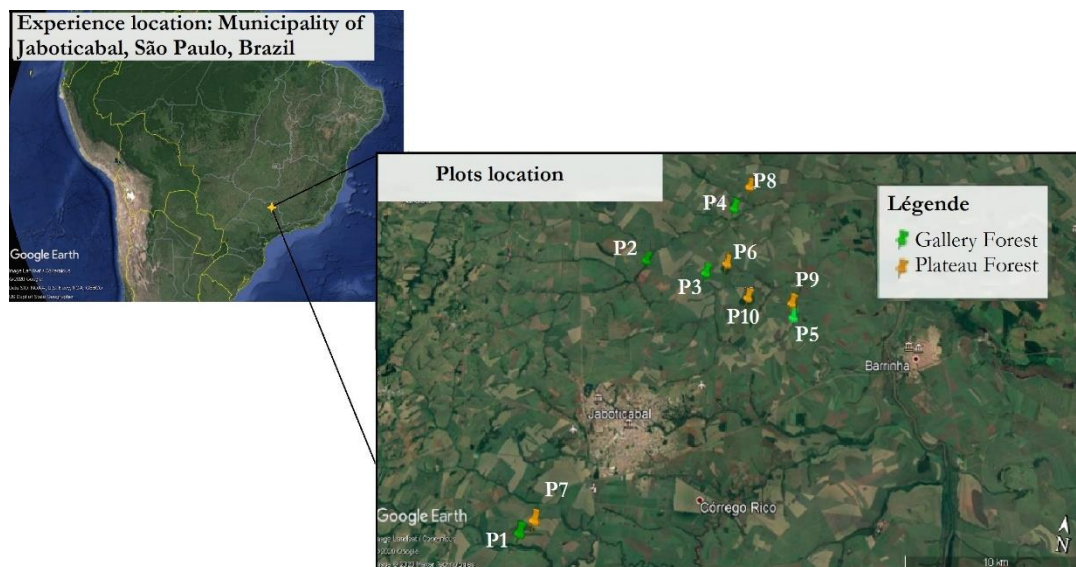
Purpose of this study will be to answer the following questions:

- Which differences arise between fragment forest types, regarding to diversity and interaction network and can this be explained by the land management policy linked to their environmental conditions (gallery or plateau forest)?
- Which preliminary conclusion can be drawn about plant and arthropod species sampled in the fragments?
- What preliminary conclusions can be drawn about the quality of the fragments regarding to biodiversity and interactions networks and can we link it to the management of these fragments?

2. MATERIAL AND METHODS

2.1. STUDY SITE

This study was conducted in the municipality of Jaboticabal (Latitude: 21°15.2832' S Longitude: 48°19.3332' W), in the state of São Paulo (Figure 3). According to Koppen's classification, the climate is Cwa-subtropical-mesothermal type. The mean annual temperature is 22°C and the mean precipitation is 1,424.6 mm. The altitude of the municipality is between 465 and 685 m (Greggio *et al.*, 2009). The primary landscapes were composed of semi-deciduous tropical forests and savannah fragments, inserted in the Atlantic Forest Biome (Veloso *et al.*, 1991). Forest fragments represented only 3.63% of the municipality of Jaboticabal in 1971 and 1.55% in 2000 (Greggio *et al.*, 2009).



As described above (1.1), semideciduous forest vegetation is composed of plateau forest and gallery forest. For both types of fragments, we placed 5 plots per forest type, one plot per fragment, around Jaboticabal municipality (Figure 3). The studied fragments belong to farmers, which agreed with UNESP to study their crops.

2.2. DATA ACQUISITION

The description of the data acquisition is presented in one part because the entire protocol was used to answer the three questions stated in the introduction. Each plot of 50 x 20m was placed, using the software Google Earth to ensure a minimum distance of 1km between the studied areas. For each plot, four transects were drawn on Google Earth, being

separated by 4m from each other. One of the four transects was then randomly selected using random number software. Along the transect, five points were marked in the field, being spaced 11m apart from each other. At each point, a 1x1m quadrat was placed (Annex 1).

Herbaceous vegetation with plant bases within the quadrat was identified (Dengler, 2008). Tree seedlings were not considered as the objective was to identify herbaceous plants diversity in the understory to complete tree diversity measurement. Four trees were identified per quadrat, based on the quadrant sampling method of the book written by (Felfili *et al.*, 2011). The quadrat was divided into four sectors and the closest tree in each quadrat corner was sampled. This sampling was carried out on the first tree corresponding to the following criteria: more than 5 cm trunk diameter, a branch at cutting range, at a maximum distance of 5 m from the quadrat so as not to intersect with the neighboring quadrat.

Each identified tree was sampled; the lowest branch was recovered using a telescopic branch cutter. Each species or morpho-species of trees, herbaceous plants and lianas was referenced to have a code for each individual.

The arthropods observed on the plants were manually collected in vials annotated with the host plant code. Arthropods were collected from herbaceous plants, lianas and harvested branches with an observation range limit set at 1 ± 0.2 m, with an observation time of 5 ± 1 minutes for each sample. At the end of each day the samples were first placed in the freezer to sedate them. They were then immersed in 70% diluted alcohol to ensure their preservation for identification.

Vegetation species were identified by Dr. Davi Rossatto, with latter confirmation using specific botanical guides produced by taxonomists for Brazilian vegetation (Ramos *et al.*, 2007 ; Lorenzi, 2008 ; Souza *et al.*, 2019)

The arthropods samples were then identified at the highest possible taxon level, with specialized books (Delvare & Aberlenc, 1989 ; Rafael *et al.*, 2012 ; Borror & DeLong, 1969) with help of Prof. Odair A. Fernandes, DR. Ana L. Peronti and students of entomology department. Most were identified to family and then classified by morphospecies. Some of the samples were not identified as morphospecies because it was harder and the risk of error in the separation into morphospecies was higher. Others correspond only to exuviae or eggs that did not allow them to be separated into morphospecies. Then all samples were classified and assigned to functional groups (based on the same specialized books used for identification): parasitoid, predator, omnivore and phytophagous (Annex 2).

A qualitative and visual disturbance index has been assembled for each fragment forest, considering canopy cover and the presence of invasive grasses (*Panicum maximum* Jacq.) and lianas. These two types of growth forms are important to take into consideration because they have negative impact on forest fragment development (Mantoani & Torezan, 2016 ; Ingwell *et al.*, 2010). Infestation of forest areas with lianas leads to higher than normal tree mortality and limits tree growth (Ingwell *et al.*, 2010). *Panicum maximum*, also known as *Megathyrsus maximus*, is an invasive herb native to Africa. It has been shown by (Ingwell *et al.*, 2010) that ecological succession is slower when this plant is present in restoration areas, mainly because its affect seed germination and plant establishment.

Percentage of canopy coverage was estimated visually over the entire plot, between 0 and 1, 1 representing 100% of canopy cover. Invasive grasses and lianas cover was estimated visually between -1 and 0, -1 representing a strong presence (Table 1).

The same person evaluated all the plots to avoid measurement bias. Summary of these indicators gave us an index of disturbance for each plot (Annex 3), a negative index means a disturbed area (Felfili *et al.*, 2011).

Table 1: Examples for extremes disturbance index measurement.

Extreme situations	Canopy cover	Lianas presence	Invasive grasses	Disturbance index
Disturbed forest	0.3	-0.8	-0.2	-0.7
Restored forest	0.9	0	0	0.9

This table presents two virtual examples of forests with extreme index disturbance values to illustrate the construction of the index.

2.3. DATA ANALYSIS

For the entire data analysis we used Past326b (Hammer & Harper, 2020) and R(4.0.2) (R Core Team, 2020) software. The convention for statistical probability levels is * $p(H_0) < 0.05$; ** $p(H_0) < 0.01$; *** $p(H_0) < 0.001$.

2.3.1. COMPARISON BETWEEN GALLERY AND PLATEAU FOREST AND AMONG FRAGMENTS

We decided to measure the plant and arthropod diversity of the fragments to assess the differences among the fragments and between the two types of fragments. In this study we decided to measure diversity as species richness since it is an biodiversity index which is not taking into account the abundance of individuals for each species (Béguinot, 2017). Indeed, abundance for arthropods species would have required repeated sampling, which is time consuming to the field work and for identification.

2.3.1.1 Alpha diversity

Alpha diversity represents diversity of a local point or a community (McIntosh, 1967). Plant and arthropod richness of each plot have been calculated with Past326b software (Annex 4, Annex 5) (Hammer & Harper, 2020). This software determine rarefaction curve, to allow comparison of several inventory from different sampling efforts (Béguinot, 2017). Richness is estimated in this software with Chao 1 estimator, based on the publication of (Colwell *et al.*, 2012):

$$S_{est} = S_{obs} + \hat{f}_0 chao1$$

$$\hat{f}_0 chao1 = \frac{f_1^2}{2f_2}, for f_2 > 0$$

or

$$\hat{f}_{0\text{ chao1}} = \frac{f_1(f_1 - 1)}{[2(f_2 + 1)]}, \text{ for } f_2 = 0$$

S_{obs} is the richness observed in the samples and f_0 is the estimated number of species not observed in the sample, based on the number of rare species (Colwell *et al.*, 2012). We tested the correlation between plant and arthropod diversity with the R software (R Core Team, 2020), using Mann-Kendall nonparametric test, which is:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^n \text{sgn}(x_j - x_k)$$

$$\text{Where } \text{sgn}(x) = \begin{cases} +1, & x > 0 \\ 0 & x = 0 \\ -1 & x < 0 \end{cases}$$

H0: S=0 (Hipel & McLeod, 1994).

2.3.1.2 Fragments networks

To illustrate links which occur between plant and arthropods present in these fragments, bipartite networks were created using the bipartite package in R (Dormann *et al.*, 2008). The bipartite package in R allows the calculation of indices to characterize the networks quality (Blüthgen *et al.*, 2006).

The networks are bipartite because it was not possible to determine which arthropod interacts with which other arthropod, considering the level of identification achieved. A bipartite network consists of nodes (the identified species) separated into two levels (here arthropod species at the upper level and plant species at the lower level). The nodes are connected by edges representing the interactions between species (Leclerc *et al.*, 2018). The construction of networks is based on matrices previously constructed with plant species in rows and arthropod morphospecies in columns, grouped into the 4 identified functional groups (phytophagous, predator, parasitoid and omnivore) (Annex 6, Annex 7, Annex 8, Annex 9, Annex 10, Annex 12, Annex 13, Annex 14, Annex 15, Annex 15).

We based the construction of the networks on the study of (Losapio *et al.*, 2015), which compares interaction networks according to a primary succession gradient, classifying the species collected according to their functional group. We built a network with the same construction, for each plot.

To illustrate differences between networks, we used the linkage density index which gives the number of existing links divided by the total number of potential links, which enables us to estimate the complexity of a network ((May, 1973), as cited in (Losapio *et al.*, 2015)).

Linkage density is calculated as:

$$L_q = 0.5 \left(\sum_{j=1}^J \frac{A_j}{m} 2^{H_j} + \sum_{i=1}^I \frac{A_i}{m} 2^{H_j} \right) \text{ (Dormann } et al., 2008).$$

2.3.1.3 Statistic test to compare plateau and gallery forest

The influence of the type of forest on the alpha diversity of plants and arthropods species and on the linkage index have been tested with a non-parametric Wilcoxon rank sum test (Rosner & Glynn, 2009), calculated via the R package ggpubr (Kassambara, 2020):

The test is based on the following statistic test:

$$\hat{\theta} = \sum_{i=1}^m \sum_{k=1}^n U(X_i - Y_k)/(mn)$$

With samples X_1, \dots, X_m and Y_1, \dots, Y_n from continuous distributions F_X and F_Y . Where the hypotheses tested are:

$$H_0: F_X = F_Y \text{ versus } H_1: F_X \neq F_Y$$

2.3.1.4 Beta diversity

To compare diversity among fragments, we calculated beta diversity. Beta diversity “is a measure of the difference in species composition either between two or more local assemblages” (Koleff *et al.*, 2003). Beta diversity of plants and arthropods among plots was evaluated with Past326b to observed difference between plots, based on matrices of interactions between plants and arthropod morphospecies (as in Annex 6 but not grouped by functional groups). Measure is based on the Whittaker’s original measure (β_w) which is the most common used measure in ecological study according to (Koleff *et al.*, 2003):

$$\beta_w = \frac{S}{\alpha}$$

S = total number of species recorded for both quadrats; α = average number of species found within the quadrats.

This method calculates the dissimilarity between sites based on species presence/absence data (Legendre *et al.*, 2005). For example, a beta diversity between two fragments equal to 1 corresponds to 100% dissimilarity between fragments, which means they have no species in common.

2.3.2. PLANT SPECIES IMPORTANCE AND ARTHROPOD SPECIES CHARACTERISTICS

2.3.2.1 Plant species importance

Estimate of the strength of species interaction is usually calculated by considering species abundance (Welter *et al.*, 2017). We did not have the opportunity to rehearse the sampling of arthropod species, so we felt that arthropod abundance could not be included in the calculation.

To study the importance of the different plant species identified in the fragments, we estimated the host strength of plant (Hs) by dividing the total number of interactions (i) of

a plant species with arthropods by the identified number of plant individuals (v) of the species (Annex 16).

$$Hs = \frac{i}{v}$$

The influence of abundance and species origin (exotic or native) of the species was tested on the interaction forces with a non-parametric Wilcoxon rank sum test (Rosner & Glynn, 2009), previously presented. For abundance, species were considered abundant when there were more than 4 individuals identified on all fragments. Species were described as native when described in the Brazilian Atlantic forest books description (Souza *et al.*, 2019 ; Ramos *et al.*, 2007).

2.3.2.2 Arthropods species characteristics

We compared the proportions of the different types of arthropods of interest according to the identified morphospecies to describe the most abundant and illustrate the diversity of arthropod functionality within the fragments (Annex 17). We have chosen to show the proportion of spiders, lepidopters, ants and scale insects because they are taxa with important ecosystem functions. Indeed, spiders and ants (for some species) are predators that can play an important role in the regulation of phytophagous (Way & Khoo, 1992 ; Sunderland & Samu, 2000). Lepidopterans (caterpillars) and scale insects are known to inflict severe damage on crops (García Morales *et al.*, 2016 ; Borror & DeLong, 1969).

2.3.3. QUALITY FRAGMENTS INDICES ESTIMATION

Measuring the ecosystem services of the fragments involves estimating the factors impacting these ecosystem services provided (Mace *et al.*, 2012). The scientific literature shows that species diversity and the complexity of interactions within an environment are related to the ecosystem services provided by those environments (Gardarin *et al.*, 2018 ; Welti *et al.*, 2017 ; Mace *et al.*, 2012).

2.3.3.1 Partial least square path modelling

We therefore sought to estimate the ecosystem services provided by fragments from the perspective of biodiversity and species interactions, leading to a quality of fragment. To differentiate fragments and to estimate the quality of each one, we used the R *pls* package based on the PLS-PM (Partial least square path modelling) method (Sanchez, 2013). The objective of this method is to develop a model that reflects as much as possible the covariances observed in a dataset. It allows the analysis of relationships between measured variables (Sanchez, 2013). Details on the construction of the model are explained in the part

2.3.3.2 Choice of indicators and latent variables

To estimate the secondary latent variable **Quality**, we chose to use three latent variables. **Richness**, **Network** and **Disturbance**. We used the indicators (Annex 18) measured with the data collected in the field to estimate these latent variables.

Richness of fragment

A high species diversity of an environment results in a diversity of individual functionalities, which translates into environment stability, according to the hypothesis put forward by (Loreau, 2001). We chose as the first latent variable the richness of the fragment illustrated by the specific richness of plants and arthropods.

Network stability

As explained above, the linkage density index measures the complexity of networks (May, 1973, as cited in (Losapio *et al.*, 2015)). Due to the complexity of a network that can reflect network stability (Montoya *et al.*, 2006) we have chosen this index to express the stability of the fragments. Linkage density is the indicator of the latent variable network.

Disturbance index

We chose to use the disturbance index estimated in the field because it estimates the abundance of lianas and of the exotic grass *Panicum maximum*. As explained above (2.2), the overabundance of liana has a negative effect on tree growth (Ingwell *et al.*, 2010) and the presence of *Panicum maximum* slows down the succession of an area under restoration (Mantoani & Torezan, 2016). This index is therefore an important element in estimating the quality of forest fragments. This index is the indicator for the disturbance latent variable.

2.3.3.3 Model results

It was then possible to estimate a quality ranking of the fragments studied using parameters of this model (Annex 22) and we used the cluster analyses of plspm package (ward's hierarchical clustering method) to see which fragments can be grouped in term of fragment quality. The results were then discussed in relation with the management of the fragments described by the specialist.

3. RESULTS

A total of 235 plant individuals have been identified, with 97 species belonging to 33 different families. For arthropods, 570 were sampled on these plants and only 310 could be classified into 215 morphospecies, separated into 4 functional groups (predators, phytophagous, parasitoid and omnivore).

3.1. COMPARISON BETWEEN GALLERY AND PLATEAU FOREST AND AMONG FRAGMENTS

3.1.1. ALPHA DIVERSITY

The rarefacted species richness of arthropod and plant species were compared by Wilcoxon's tests, and no significant differences were found for plants (Figure 4 (a)) and neither for arthropods (Figure 4 (b)). There was not a significant correlation between plant and arthropod species (Annex 24).

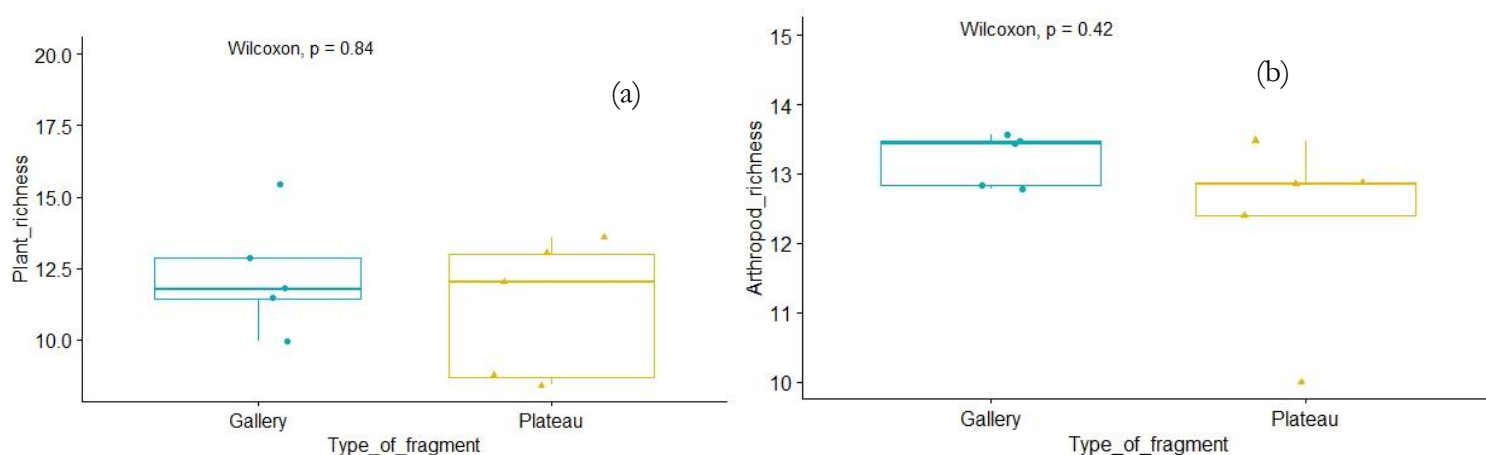


Figure 4: Boxplots of effect of the type of fragment on plant and arthropod richness.

Figure 4: (a) Boxplot and p-value of a Wilcoxon test with the type of fragment as group variable and plant specific richness as dependent variable. $p = 0.84$. Data: Annex 25 (b) Boxplot and p-value of a Wilcoxon test with the type of fragment as group variable and arthropod specific richness as dependent variable. $p = 0.42$. Data: Annex 26.

3.1.2. NETWORK

The modelling of networks fragments illustrating plant-arthropod interaction allowed us to compare the two types of fragments (gallery and plateau forest) in term of linkage density.

Wilcoxon's test performed on the linkage density did not show any significant difference (Figure 5).

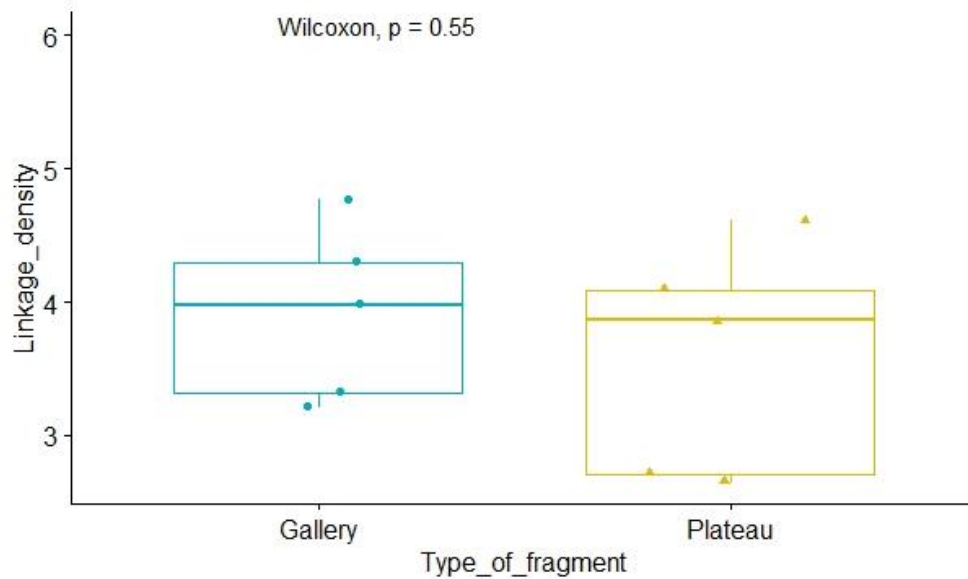


Figure 5: Boxplots of effect of the type of fragment on plant and arthropod richness.

Figure 5: Boxplot and p-value of a Wilcoxon test with the type of fragment as group variable and linkage density as dependent variable. $p=0.55$. Data: Annex 27

3.1.3. BETA DIVERSITY OF FRAGMENTS

In terms of plant specific richness, fragment P4 was the most dissimilar in comparison with the other fragments (except for fragment P5). Fragments P8 and P10 are the most similar among all the fragments. All the fragments have a dissimilarity of more than 50% (Figure 6 and Table 2). In terms of arthropods richness, all fragments also showed a high dissimilarity ($>81\%$). Fragment P7 has the highest average dissimilarity (Figure 7 and Table 3).

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
P1		84	93	100	84	86	83	74	78	73
P2			84	92	71	84	100	90	92	97
P3				100	90	100	100	92	93	93
P4					79	100	100	100	100	100
P5						95	94	88	90	85
P6							83	74	93	73
P7								78	91	84
P8									73	52
P9										72
P10										

Figure 6 Pairwise matrix of plant beta diversity.

Figure 6: Analysis to estimate the dissimilarity (in %) of fragments based on the plant specific richness calculated with Past326b software, the cells with the hottest colours representing the highest values of dissimilarity between fragments.

Table 2: Classification of fragments by plant dissimilarity.

	Mean (%) (n=10)
P8	80±0.142
P10	81±0.146
P1	84±0.086
P5	86±0.074
P9	87±0.098
P6	87±0.101
P2	88±0.081
P7	90±0.087
P3	94±0.055
P4	97±0.074

Table 2: According to their dissimilarity mean value in terms of plant specific richness, from the less dissimilar to the most dissimilar. The third column represents the standard deviation of the calculated averages. Data: Figure 6.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
P1		86	95	91	85	87	95	85	100	96
P2			96	92	85	90	100	88	100	100
P3				85	90	96	100	89	100	100
P4					87	97	100	92	100	97
P5						93	100	81	95	93
P6							95	93	89	89
P7								96	100	100
P8									95	97
P9										100
P10										

Figure 7 Pairwise matrix of arthropod beta diversity

Figure 7: Analysis to estimate the dissimilarity (in %) of fragments based on the arthropod specific richness calculated with Past326b software, the cells with the hottest colours representing the highest values of dissimilarity between fragments.

Table 3 Classification of fragments by arthropod dissimilarity.

	Mean (%) (n=10)
P5	90±0.061
P8	90±0.053
P1	91±0.055
P6	92±0.037
P2	93±0.061
P4	93±0.056
P3	95±0.056
P10	97±0.039
P9	98±0.040
P7	98±0.024

Table 3: According to their dissimilarity mean value in terms of arthropod specific richness, from the less dissimilar to the most dissimilar. The third column represents the standard deviation of the calculated averages. Data: Figure 7.

3.2. PLANT AND ARTHROPODS SPECIES IMPORTANCE

3.2.1. PLANT SPECIES

The most abundant plants in the whole sample are native species such as, *Croton floribundus* Spreng., *Acacia polyphylla* DC., *Piptadenia gonoacantha* Mart. and *Platypodium elegans* Vogel (Annex 16). In addition, species native to the Atlantic forest represent 72% of the identified species (Annex 16). We found plant species showing different levels of interactions with the identified arthropods. The species *Bauhinia longifolia* Bong., *Handroanthus impetiginosus* Mart., *Rollinia mucosa* Jacq. and *Triplaris gardneriana* Wedd. were the ones with the highest number of interactions (Table 4). Checking for abundance and if the species was native or exotic, we were to found that the number of such interactions are not related to abundance and nativity of the plant species. The Wilcoxon's test performed on the dependence of host strength on abundance of plant species was not significant (Figure 8(a)). Wilcoxon's test performed on the dependence of host strength on nativity of plant species were not significant (Figure 8(b)).

Table 4: The ten species with the higher host force interaction per individual.

Family	Species	Host strenght (Number of interaction/number of individual plant)	Nativity (Index of nativity)
FABACEAE	<i>Bauhinia longifolia</i>	4	1
BIGNONIACEAE	<i>Handroanthus impetiginosus</i>	4	1
ANNONACEAE	<i>Rollinia mucosa</i>	4	0
POLYGONACEAE	<i>Triplaris gardneriana</i>	4	1
URTICACEAE	<i>Cecropia pachystachya</i>	3.67	1
BIGNONIACEAE	<i>Tabebuia roseoalba</i>	3.67	1
LAMIACEAE	<i>Aegiphilla integrifolia</i>	3	1
CANNABACEAE	<i>Celtis iguanea</i>	3	0
BORAGINACEAE	<i>Cordia mixa</i>	3	1

Table 4: Also nativity information (1 means native from Atlantic forest and 0 not native).
Data: Annex 17.

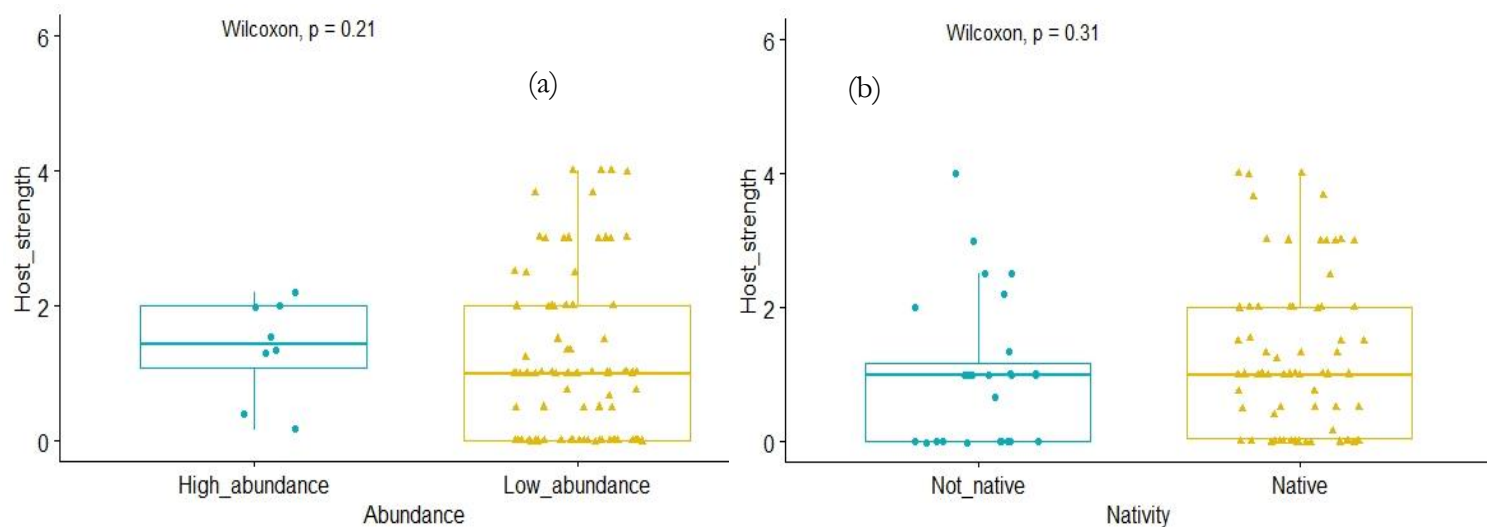


Figure 8: Boxplots of effect abundance and nativity on host strength.

Figure 8: (a) Boxplot and p-value of a Wilcoxon test with the level of abundance as group variable and host strength as dependent variable. $p = 0.21$. Data: Annex 27 (b) Boxplot and p-value of a Wilcoxon test with the factor “nativity” as group variable and host strength as dependent variable. $p = 0.31$. Data: Annex 29.

3.2.2. ARTHROPOD SPECIES

The separation of arthropods into morphospecies allowed us to illustrate the functional diversity of arthropods present within the fragments. Among the identified individuals, a high proportion of spiders and scale insects were found. Lepidopterans (caterpillars) and ants are present in a smaller proportion but represent a non-negligible part of the sample (Table 5).

Table 5: Functional diversity of morphospecies.

	Proportion (%)
Spiders	27
Lepidopterans (caterpillars)	11
Ants	14
Scale insects	25

Table 5: Proportion of 4 interest groups within the fragments, percentage of individuals identified in the interest group relative to the total number of individuals identified (310).
Data: Annex 2.

3.3. QUALITY FRAGMENTS INDICES ESTIMATION

3.3.1. SUMMARY OF THE INDICATORS MEASURING QUALITY OF FRAGMENTS

Fragments P3, P4 and P5 are the only fragments to have positive disturbance levels (Figure 9 (b)) and to have been fully restored (Table 6). Fragment P9 has the lowest level of disturbance and arthropods species richness (Figure 9(c),(d)) and appears to be the fragment that has suffered most from accidental fires over the last 30 years (Table 6). The fragments subject to fire and unrestored (Table 6) all have negative disturbance indices. There is little variation in the specific richness of arthropods between fragments (Figure 9(d)). Fragments P3, P7 and P9 have the lowest linkage density indices compared to the other fragments (Figure 9(a)).

The indicators made it possible to form the latent variables richness, network and disturbance, which according to the results of the model have a significant positive relationship with the quality variable (Figure 10 and Annex 22)

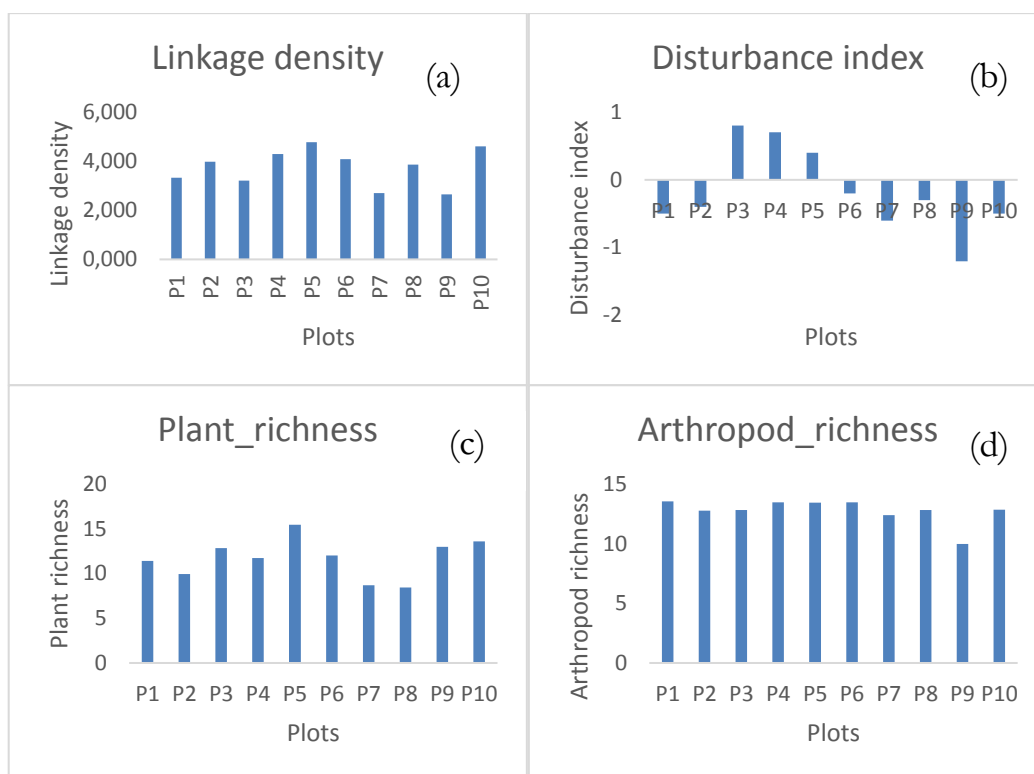


Figure 9: Indicators used for fragment quality.

Figure 9: Barplots representing the values of the indicators per plot, which will be used in the PLS-PM. (a) Linkage density. (b) Disturbance index. (c) Plant specific richness. (d) Arthropod specific richness. Data: Annex 18.

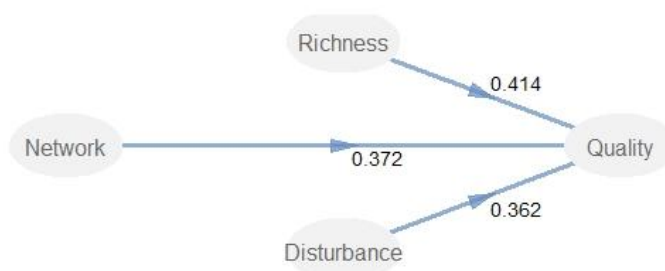


Figure 10: Weights of the variables in the determination of quality index.

Figure 10: Represents weights of each latent variable in the construction of the second latent variable Quality. Blue lines mean significant positive relation, negative relations would have been shown on red lines.

3.3.2. HISTORIC OF FRAGMENTS

Of the 5 gallery forest fragments, 3 fragments are identified as restored (P3, P4 and P5) and none has burnt in the last 30 years (Table 6). Of the 5 native fragments (P2, P6, P8, P9, P10), 3 fragments had experienced accidental fire episodes (P6, P9, P10)(Table 6).

Fragment type	Plot fragment number	Historic
Gallery forest	P1	No information available.
Gallery forest	P2	Native forest along the river, no fire for the past thirty years.
Gallery forest	P3	Forest completely restored after occupation of the land by sugar cane crops. No fire events.
Gallery forest	P4	Forest completely restored after occupation of the land by sugar cane crops. No fire events.
Gallery forest	P5	Forest completely restored after occupation of the land by sugar cane crops. No fire events.
Plateau forest	P6	Native forest with regular fire in the last 30 years, recent fire burnt the entire fragment (2017-2018).
Plateau forest	P7	No information available.
Plateau forest	P8	Native forest.
Plateau forest	P9	Native forest with regular fire in the last 30 years.
Plateau forest	P10	Native forest with fire in the past but not recently, partial deforestation.

Table 6 Information on the history of the fragments collected from a specialist in the agricultural areas of the region.

3.3.3. INDEX QUALITY OF FRAGMENTS

Fragments P7 and P9 are the fragments with the lowest quality index, fragments P4 and P5 are the fragments with the highest quality index (Figure 11). The two fragments with the best indices (P4 and P5) are two fragments planted in the last 30 years (Table 6). The fragment with the worst index (P9) is native and regularly submits to forest fires (Table 6). The separation of the fragments into three clusters allowed us to separate the fragments into three levels of quality (

Figure 12). It shows the proximity of the planted fragments (P3, P4 and P5) with the highest quality. Fragments P9 and P7 appear to be the closest with a of low fragment quality.

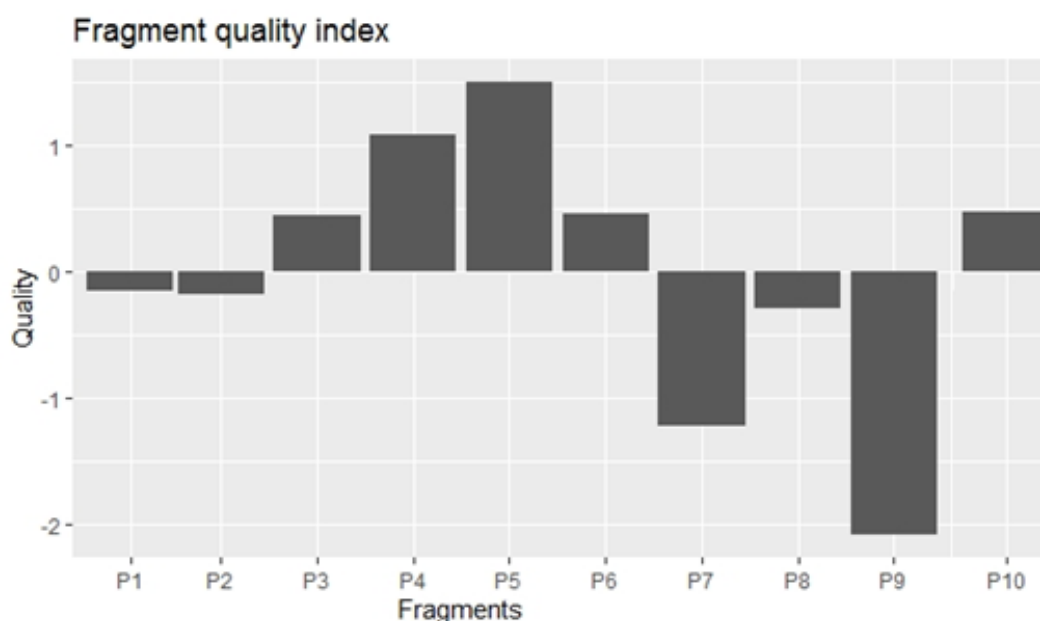


Figure 11 Boxplot of the fragment quality indices calculated via the plspr package.

Figure 11: Data: Annex 23.

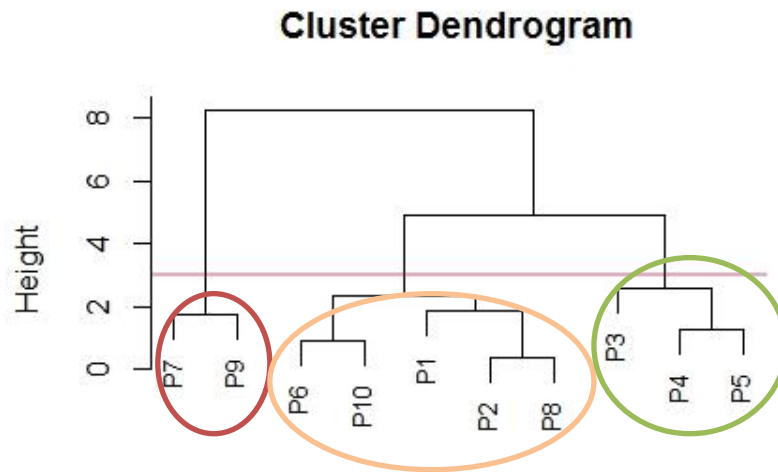


Figure 12: Plots grouped by quality index.

Figure 12: Cluster dendrogram representing results of cluster analyses on scores obtained for the latent variable Quality, in the plspm package, cluster separation have been effected at $k=3$, the three groups representing three levels of quality of fragment, from left the smaller quality to right the higher quality.

4. DISCUSSION

4.1. COMPARISON BETWEEN GALLERY AND PLATEAU FOREST AND AMONG FRAGMENTS

4.1.1. GALLERY VS PLATEAU

We hypothesized that gallery forest fragments would harbour greater plant diversity and less disturbed fragments in comparison with plateau areas. However, the plateau fragments and gallery forests do not seem to present any significant difference in terms of plants and arthropods richness (Figure 4), but in fact they were found to differ in terms of disturbance and historic aspects (Figure 9(b), Table 6).

Factors other than the type of fragments could be considered to explain differences in biodiversity. For example, the studied forest fragments have varying levels of connectivity among each other, and many of them may be isolated from each other. This difference in connectivity with other natural areas generally has an impact on biodiversity since species exchanges are increased when natural areas are linked to others by ecological corridors (MacDonald, 2003), which would increase arthropods movement and in case of plants seed dispersal. In the case studied here, we suggest that it would be interesting to measure connectivity and species dispersal among fragments of each fragment with the surrounding fragments to link its connectivity with their species richness.

4.1.2. BETA DIVERSITY

Although we did not find differences in species richness between gallery and plateau forest, we found great levels of dissimilarity between the studied fragments (Figure 6, Figure 7). The strong dissimilarity between all the fragments seems to show that each fragment is unique in terms of biodiversity, not only in terms of plant but also in terms of arthropod. This strong dissimilarity shows that it is important to protect each type of fragment because it hosts a specific biodiversity that is unique from the point of view of species richness.

We have also seen that the management of the fragments is very variable, some were native, and others were restored (Table 6). Fragment P4 has a very strong dissimilarity in terms of the specific richness of plant species (Table 2). As it is a replanted fragment, we can hypothesise that the choice of species did not consider the species present in the surrounding fragments, increasing diversity of plants at the region scale. As the fragments all have strong dissimilarity indices, we made the hypothesis that the different levels of management create this high level of complementarity on the scale of the region. This confirms the results of a study of (Rother *et al.*, 2019) which has shown that the conservation of the biodiversity of plant species requires the conservation of existing the highest number of native and restored forest fragments.

It has long been shown that the larger the sampling area, the more precise the measurement of biodiversity is (Arrhenius, 1921). It would be interesting to carry out identifications of the flora and arthropods over the entire surface of the fragments, which was not possible in view of the duration of the training period and the conditions, which imposed certain limitations to the sampling approach adopted here and to identification of the sampled arthropods. Finally, since the width of a natural area having an impact on its biodiversity (Metzger *et al.*, 1997), it would also be interesting to consider the impact of the total surface area of the fragments when comparing its real patterns of biodiversity.

4.2. PLANT AND ARTHROPODS SPECIES IMPORTANCE

4.2.1. PLANT SPECIES

The most abundant plants in all the fragments (*Croton floribundus*, *Acacia polyphylla*, *Piptadenia gonoacantha* and *Platypodium elegans*), (Table 4) are native species of the Atlantic forest (Ramos *et al.*, 2007). Despite drastic fragmentation, native species still remain as the most abundant species in the studied fragments. In a study on the distribution of species in one of the last important mature semideciduous forests in the west of the state of São Paulo state (Durigan *et al.*, 2000), the floristic distribution is different from that of the fragments we studied. *Metrodorea nigra* A.St.-Hil., the most frequent species in their study was identified only once in our study. On the other hand, *Acacia polyphylla*, which is highly present in the fragments we studied, is one of the least frequent species in their study (Durigan *et al.*, 2000). It has been shown that the distribution of species in the Atlantic forest is subject to spatial and environmental variables (Maçaneiro *et al.*, 2016) which could, allied with historical exploitation of the fragments, explain this difference in floristic distribution. Abundance and nativity do not seem to have an impact on the number of plant species interactions

with arthropods (Figure 8). We expected to find a stronger interaction of arthropods with native plants, as shown in the study of (Cook-Patton & Agrawal, 2014) for old field communities. However, this study also shows that exotic species, when included in a native and non-invasive ecosystem, can bring new arthropod functionalities not existing in the ecosystem, which diversify plant-arthropod interactions (Cook-Patton & Agrawal, 2014). As exotic plants sampled are not invasive among the fragments, this could explain why no difference between native and exotic plants is observed.

The most abundant species are more likely to interact with arthropods in a given environment (Montoya *et al.*, 2006). However, we have considered the abundance of these species at the entire scale of the study, and at the scale of a fragment, other plant species may be more abundant. This could explain that the most abundant species at the scale of the whole study are not necessarily the species with the most interactions. This confirms the idea that each fragment is unique, so the importance of species should be considered at the fragment level.

4.2.2. ARTHROPOD SPECIES

The characterization of the morphospecies present in the fragments shows that these fragments harbor a great diversity of arthropod species, with different functionalities (Table 5).

The role of spiders in pest control is still little studied (Sunderland & Samu, 2000) but based on our data (showing a high presence of such taxon in forest fragments surrounding crops), we could encourage the setting up of studies on the subject.

Ants have variable impacts on phytophagous insects, but generalist species have been shown to have a strong impact on the biocontrol of phytophagous insects (Way & Khoo, 1992). A thesis on the larvae of *Diatraea saccharalis*, a major pest of sugarcane, showed an impact of certain genera of predatory ants on their regulation ((Capiolo, 1994), as cited in (Rossi & Fowler, 2004)). In addition, research is currently being carried out by a UNESP PhD student on the impact of ants on sugarcane pests. Comparison between the species present in fragments and in sugar cane crops is an important biocontrol issue.

Lepidoptera and scale insects are phytophagous insects that can cause significant crop damage (García Morales *et al.*, 2016 ; Borror & DeLong, 1969). Their presence in the fragments is interesting as a source of food for predators. The more a natural environment hosts prey, the more food it will be able to provide to predators, being able to hunt in the surrounding crops, also known as the principle of alternative prey (Landis *et al.*, 2003). Their presence within the fragments might show the potential of the forest fragments as a refuge for predators of the surrounding culture crops.

Seasonality is known to be an important factor to consider in arthropod sampling, its importance has for example been shown in the study of ant diversity in a dry tropical forest in Brazil (Neves *et al.*, 2010). It would be interesting to reproduce the protocol of this study during the summer season, to consider the differences in temperature and humidity with the winter season.

4.3. QUALITY FRAGMENTS INDICES ESTIMATION

We provide evidence that each fragment is unique and therefore important to preserve. This finding led us to attempt to characterize each of them to assess their quality. The indicators selected seem to be interesting elements to represent the quality of the studied fragments. Indeed, they seem to translate the quality of the network in the same sense in view of the preliminary results of the model (Figure 10). The repetition of the protocol on other fragments will make it possible to ensure the validity of the variables constructed using the indicators.

4.3.1. RICHNESS

A greater diversity of arthropods is expected in areas with higher plant diversity, as shown by several studies on the dependence of arthropod diversity on plant diversity (Siemann *et al.*, 1998 ; Haddad *et al.*, 2009). Plant richness has also been shown to increase stability (Haddad *et al.*, 2011). The measure of correlation between arthropod and plant species diversity did not show a significant correlation (2.3.1.1). It can therefore be presumed that the absence of repetition of arthropod sampling and the impossibility to identify all the collected species does not allow to show the real richness in arthropods and therefore the correlation with the richness of plant species. In order to guarantee the stability of an ecosystem, a minimum number of species is necessary, and the maintenance of stability under changing conditions requires more stable species (Loreau, 2001), we therefore believe that this richness index should be retained in the evaluation of the quality of the fragments. As discussed in the section about beta diversity (2.3.1.4), the fragments are unique from the point of view of specific richness, with a possible link to their management history, which further justifies the use of this variable.

4.3.2. NETWORK STABILITY

Fragments with a lower linkage density index (P3, P7 and P9(Figure 9(a))) may be less complex and therefore less stable (Montoya *et al.*, 2006). The study by (Losapio *et al.*, 2015) shows that plant and arthropod communities develop more and more connections along the successional gradients of plant communities. One might therefore expect a higher density of connections for native forest fragments, being older than planted fragments. Fragment P3 is a plantation but the other two planted fragments do not show lower levels of stability (Figure 9(a)). The interaction networks are very complex to study and their response to disturbance remains subject to much controversy (Montoya *et al.*, 2006), and we do not have the necessary elements on all the fragments to explain the differences in link density between the fragments. In any case, this variable is important because studying interaction networks as a complement to diversity enable to better target the conservation required to guarantee the maintenance of ecosystem services provided by an ecosystem (Harvey *et al.*, 2017).

4.3.3. DISTURBANCE

Three of the five fragments close to the rivers have been completely restored in the last 30 years (Table 6), which shows that the forestry code updated in 2012 has allowed the restoration of new fragments along the rivers. Disturbance measurements show a negative index for the non-restored fragments, due to the presence of lianas and invasive grasses (Figure 9(b)). Based on the testimonies of the Jaboticabal forest area specialist, we hypothesize that the fragments of unrestored forest (mainly plateau) are not maintained or controlled, and that some trees may have been cut down. Tree felling and fragmentation favours the invasion of lianas (Campbell *et al.*, 2018), but also invasive herbs. A study on the invasion of grasses (including *Panicum maximum*, named *Urochloa maxima* Jacq. in the study) in dry forests in Bolivia was conducted by (Veldman *et al.*, 2009). In this study, *Panicum maximum* dominates forest areas disturbed by roads. This is consistent with our observations, as *Panicum maximum* is mainly present in the edges of the fragments. This could explain the disturbance of the unrestored fragments.

The 3 restored fragments have not been burnt since they were planted (Table 6). It could be hypothesized that since these fragments have been completely restored and the presence of lianas and invasive grasses is minimal, accidental fires are less likely to propagate in this type of fragments. The study of (Veldman *et al.*, 2009), for example, shows that *Panicum maximum* is an important fuel for forest fires. We assume that lianas may also represent fuel for accidental fires, but we have not found any study on the subject.

A second hypothesis is that the fragments least disturbed by invasive grasses and lianas are less susceptible to fires that spread via sugarcane fields.

As the aim of the index is also to promote the restoration of forest fragments, we feel it is important to retain this index in the model. A statistical comparison considering the fire event history of each fragment would therefore be interesting to specify the disturbance index of each fragment.

4.3.4. MANAGEMENT OF FRAGMENTS ADVICES

The actual model does not make it possible to assert what is the ideal management of the fragments to be put in place to guarantee the quality of the network regarding ecosystem services. However, the preliminary results of network quality show a positive index for replanted fragments, so we could encourage the replanting of forests in open areas. Measures to limit the spread of lianas and invasive species could also be put in place, to decrease disturbance of the fragments. Clustering enable to separate the fragments into three levels (

Figure 12) of fragment quality, we could presume that first group (fragment P9 and P7) are the fragments which precise the most of restoration management.

5. CONCLUSION

The comparison of the gallery and plateau type fragments did not show a clear difference between the two types of fragments, but it did show that each fragment is unique and that many variables have to be taken into account to characterise these fragments. This study has allowed us to begin to shed light on the interactions that take place within the fragments. It is a preliminary study whose methodology can be repeated at different seasons and over larger areas to complement the data already collected. The principle of evaluating the quality of the fragments could be used with a stronger model based on more repetitions. Current conditions have limited the possibilities of identifying the arthropods present within the fragments. In the future, a more precise description of the species present will make possible to consider the interactions between arthropods and to measure the impact of predators and parasitoid on the phytophagous species within the fragments. The value of the fragments in pest control can thus be assessed. In addition, the results could be cross-referenced with the future results of the university's studies on the diversity of arthropods present in the crops surrounding the forest fragments.

As farmers are the owners of the forest fragments, it is important to measure the benefits they can derive from these fragments to justify their conservation. The quality of the fragments related to biodiversity and plant-arthropod interactions can thus be coupled with other indices related to the ecosystem services rendered, such as the role of the fragments in the presence of predators and parasitoid of pest species in the surrounding crops. In more global questions, the carbon storage capacity and the prevention of soil erosion could also be considered.

As explained (Montoya *et al.*, 2006), the interest of this type of study is to link the theory of ecology with conservation practices and the work of field ecologists.

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7. LIST OF ABBREVIATIONS

Partial least square path modelling (PLS-PM)

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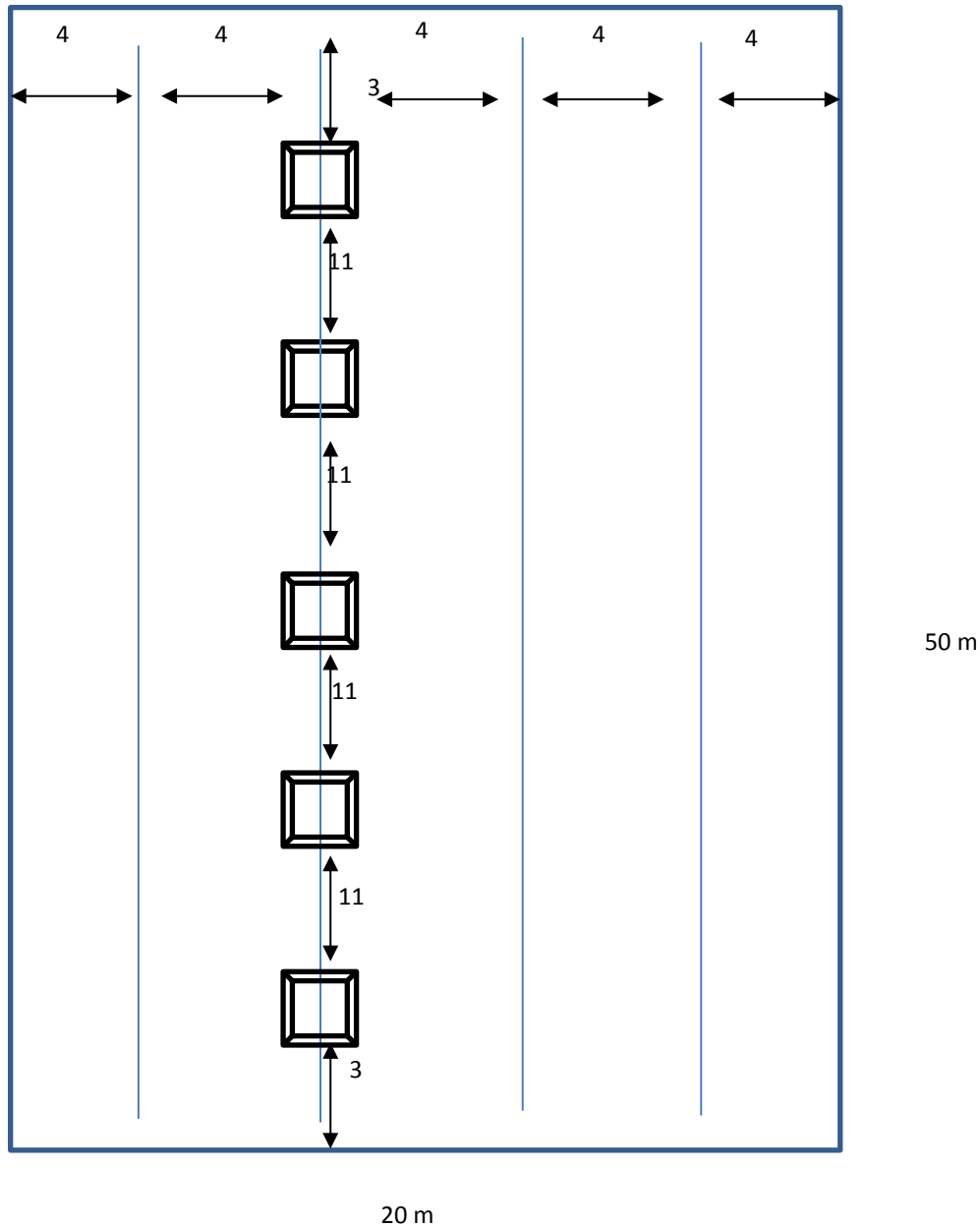
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ANNEX 1: DESIGNED EXPERIMENTATION

Annex 1: Designed experimentation of each plot with an example of subplots positioning along a transect



ANNEX 2: LIST OF PLANT AND ARTHROPOD MORPHOSPECIES WITH FUNCTIONAL GROUP IDENTIFICATION

Annex 2: List of morphospecies with their order, family, subfamily, functional group, plant host and the code of the plant containing the plot number.

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Piptocarpha sellowii</i>	P1S1Id2	Aranea	Thomisidae		Thomisidae sp. 6	Predator
<i>Piptocarpha sellowii</i>	P1S1Id2	Aranea	Lycosidae		Lycosidae sp. 1	Predator
<i>Dalbergia frutescens</i>	P1S1Id3	Diptera	Tachinidae		Tachinidae sp. 1	Parasitoid
<i>Acacia polyphylla</i>	P1S1Id4	Aranea	Lycosidae		Lycosidae sp. 2	Predator
<i>Acacia polyphylla</i>	P1S1Id4	Aranea			Aranea sp. 1	Predator
<i>Acacia polyphylla</i>	P1S1Id4	Lepidoptera	Geometridae		Geometridae sp. 1	Phytophagous
<i>Parodiolysa micrantha</i>	P1S1Id5	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Celtis fluminensis</i>	P1S2Id3	Hemiptera	Tingidae		Tingidae sp. 5	Phytophagous
<i>Platypodium elegans</i>	P1S2Id5	Aranea	Salticidae		Salticidae sp. 1	Predator
<i>Platypodium elegans</i>	P1S2Id5	Aranea	Araneidae		Araneidae sp. 1	Predator
<i>Piptadenia gonoacantha</i>	P1S3Id1	Hemiptera	Coccidae	Ceroplaste	Ceroplastes cirripediformis	Phytophagous
<i>Cedrela fissilis</i>	P1S3Id3	Hemiptera	Tingidae		Tingidae sp. 2	Phytophagous
<i>Machaerium stipitatum</i>	P1S4Id4	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Guarea macrophylla</i>	P1S4Id5	Aranea			Aranea sp. 22	Predator
<i>Platypodium elegans</i>	P1S5Id2	Lepidoptera			Lepidoptera sp. 1	Phytophagous
<i>Platypodium elegans</i>	P1S5Id2	Hemiptera	Pseudococcidae	Ferrisia	Ferrisia sp. 1	Phytophagous
<i>Copaifera langsdorffii</i>	P1S5Id3	Hemiptera	Coccidae		Coccidae sp. 1	Phytophagous
<i>Celtis fluminensis</i>	P1S5Id4	Hemiptera	Tingidae		Tingidae sp. 4	Phytophagous
<i>Celtis fluminensis</i>	P1S5Id4	Hymenoptera	Ichneumonidae		Ichneumonidae sp. 1	Parasitoid
<i>Celtis fluminensis</i>	P1S5Id4	Hemiptera	Tingidae		Tingidae sp. 1	Phytophagous
<i>Platypodium elegans</i>	P2S1Id2	Aranea	Gnaphosidae		Gnaphosidae sp. 1	Predator
<i>Platypodium elegans</i>	P2S1Id2	Hemiptera	Coccidae		Coccidae sp. 3	Phytophagous
<i>Platypodium elegans</i>	P2S1Id2	Lepidoptera			Lepidoptera sp. 1	Phytophagous
<i>Platypodium elegans</i>	P2S1Id2	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 1	Omnivore
<i>Platypodium elegans</i>	P2S1Id3	Hymenoptera	Formicidae	Camponotus	Camponotus sp. 1	Omnivore
<i>Platypodium elegans</i>	P2S1Id3	Lepidoptera			Lepidoptera sp. 3	Phytophagous
<i>Platypodium elegans</i>	P2S1Id3	Hemiptera	Coccidae		Coccidae sp. 2	Phytophagous
<i>Panicum maximum</i>	P2S2Id1	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 1	Omnivore
<i>Panicum maximum</i>	P2S2Id1	Hemiptera	Diaspididae		Diaspididae sp. 3	Phytophagous
<i>Cecropia pachystachya</i>	P2S2Id4	Aranea	Corinnidae		Corinnidae sp. 3	Predator
<i>Cecropia pachystachya</i>	P2S2Id4	Hemiptera	Fulgoridae		Fulgoridae sp. 1	Phytophagous
<i>Cecropia pachystachya</i>	P2S2Id4	Hymenoptera	Formicidae	Azteca	Azteca sp. 1	Omnivore
<i>Acacia polyphylla</i>	P2S2Id6	Pseudoscorpionida			Pseudoscorpionida sp. 1	Predator
<i>Platypodium elegans</i>	P2S2Id7	Aranea	Corinnidae		Corinnidae sp. 2	Predator
<i>Platypodium elegans</i>	P2S2Id7	Diptera	Tephritidae		Tephritidae sp. 1	Phytophagous
<i>Platypodium elegans</i>	P2S2Id7	Coleoptera	Curculionidae		Curculionidae sp. 1	Phytophagous
<i>Platypodium elegans</i>	P2S2Id7	Aranea	Corinnidae		Corinnidae sp. 3	Predator
<i>Smilax fluminensis</i>	P2S2Id8	Lepidoptera	Noctuidae		Noctuidae sp. 1	Phytophagous
<i>Smilax fluminensis</i>	P2S2Id8	Aranea	Corinnidae		Corinnidae sp. 2	Predator
<i>Acacia polyphylla</i>	P2S3Id1	Lepidoptera			Lepidoptera sp. 2	Phytophagous

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Senegalia tucumanensis</i>	P2S3Id2	Aranea	Corinnidae		Corinnidae sp. 2	Predator
<i>Senegalia tucumanensis</i>	P2S3Id2	Hymenoptera	Ichneumonidae		Ichneumonidae sp. 1	Parasitoid
<i>Guarea guidonia</i>	P2S3Id4	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Guarea guidonia</i>	P2S3Id4	Hemiptera		Auchenorrhyncha sp. 1	Phytophageous	
<i>Guarea guidonia</i>	P2S3Id4	Hemiptera	Diaspididae		Diaspididae sp.1	Phytophageous
<i>Guarea guidonia</i>	P2S3Id4	Hemiptera	Cicadellidae		Cicadellidae sp. 5	Phytophageous
<i>Oeceoclades maculata</i>	P2S3Id5	Lepidoptera	Erebidae		Erebidae sp. 2	Phytophageous
<i>Acacia polyphylla</i>	P2S4Id1	Hemiptera	Coreidae ?		Coreidae ? sp. 1	Phytophageous
<i>Acacia polyphylla</i>	P2S4Id1	Hemiptera	Largidae	Largus	Largidae sp. 1	Phytophageous
<i>Acacia polyphylla</i>	P2S4Id1	Hemiptera	Diaspididae		Diaspididae sp.2	Phytophageous
<i>Senegalia tucumanensis</i>	P2S4Id2	Hemiptera	Pseudococcidae		Pseudococcidae sp. 1	Phytophageous
<i>Senegalia tucumanensis</i>	P2S4Id2	Coleoptera	Chrysomelidae ?		Chrysomelidae ? sp. 3	Phytophageous
<i>Acacia polyphylla</i>	P2S4Id3	Hemiptera	Diaspididae		Diaspididae sp.2	Phytophageous
<i>Guarea guidonia</i>	P2S4Id4	Hemiptera	Diaspididae		Diaspididae sp.1	Phytophageous
<i>Senegalia tucumanensis</i>	P2S5Id2	Aranea	Araneidae		Araneidae sp. 2	Predator
<i>Senegalia tucumanensis</i>	P2S5Id2	Hemiptera	Monophlebidae ?		Monophlebidae ? sp. 1	Phytophageous
<i>Guarea guidonia</i>	P2S5Id3	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 2	Omnivore
<i>Guarea guidonia</i>	P2S5Id3	Aranea	Thomisidae		Thomisidae sp. 5	Predator
<i>Guarea guidonia</i>	P2S5Id3	Hemiptera	Diaspididae		Diaspididae sp.1	Phytophageous
<i>Guarea guidonia</i>	P2S5Id3	Aranea	Corinnidae		Corinnidae sp. 2	Predator
<i>Annona dolabripetala</i>	P3S2Id2	Hemiptera	Membracidae		Membracidae sp. 1	Phytophageous
<i>Annona dolabripetala</i>	P3S2Id2	Hemiptera	Aphididae		Aphididae sp. 1	Phytophageous
<i>Acacia polyphylla</i>	P3S2Id5	Hemiptera	Reduviidae		Reduviidae sp. 1	Predator
<i>Cordia mixa</i>	P3S3Id1	Aranea			Aranea sp. 2	Predator
<i>Cordia mixa</i>	P3S3Id1	Hemiptera	Reduviidae		Reduviidae sp. 2	Predator
<i>Cordia mixa</i>	P3S3Id1	Hemiptera	Coccidae	Ceroplastes	Ceroplastes sp. 1	Phytophageous
<i>Magonia glabrata</i>	P3S3Id2	Aranea	Thomisidae		Thomisidae sp. 1	Predator
<i>Nectandra megapota</i>	P3S3Id3	Aranea	Thomisidae		Thomisidae sp. 2	Predator
<i>Morus alba</i>	P3S3Id4	Coleoptera	Chrysomelidae		Chrysomelidae sp. 1	Phytophageous
<i>Morus alba</i>	P3S3Id4	Aranea	Thomisidae		Thomisidae sp. 2	Predator
<i>Morus alba</i>	P3S3Id4	Diptera	Muscidae		Muscidae sp. 1	Omnivore
<i>Morus alba</i>	P3S3Id4	Orthoptera			Orthoptera sp. 1	Phytophageous
<i>Annona dolabripetala</i>	P3S4Id1	Aranea			Aranea sp. 3	Predator
<i>Morus alba</i>	P3S4Id4	Aranea			Aranea sp. 4	Predator
<i>Morus alba</i>	P3S4Id4	Aranea			Aranea sp. 6	Predator
<i>Morus alba</i>	P3S4Id4	Aranea			Aranea sp. 7	Predator
<i>Morus alba</i>	P3S4Id4	Aranea			Aranea sp. 8	Predator
<i>Morus alba</i>	P3S5Id2	Hemiptera	Cicadellidae		Cicadellidae sp. 1	Phytophageous
<i>Mangifera indica</i>	P3S5Id3	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Mangifera indica</i>	P3S5Id3	Coleoptera	Chrysomelidae		Chrysomelidae sp. 1	Phytophageous

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Mangifera indica</i>	P3S5Id3	Aranea			Aranea sp. 9	Predator
<i>Morus alba</i>	P3S5Id4	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Morus alba</i>	P3S5Id4	Hemiptera	Reduviidae		Reduviidae sp. 3	Predator
<i>Tabebuia roseoalba</i>	P4S1Id1	Aranea	Thomisidae		Thomisidae sp. 3	Predator
<i>Heliocarpus popayanensis</i>	P4S1Id3	Mesostigmata	Phytoseiidae		Phytoseiidae sp. 1	Predator
<i>Heliocarpus popayanensis</i>	P4S1Id3	Aranea			Aranea sp. 21	Predator
<i>Heliocarpus popayanensis</i>	P4S1Id3	Hymenoptera	Formicidae	Brachymyrmex	Brachymyrmex sp. 3	Omnivore
<i>Heliocarpus popayanensis</i>	P4S1Id3	Hemiptera	Coccidae	Ceroplaste	Ceroplastes rusci	Phytophagous
<i>Heliocarpus popayanensis</i>	P4S1Id3	Hymenoptera	Formicidae	Brachymyrmex	Brachymyrmex sp. 1	Omnivore
<i>Ocotea spixiana</i>	P4S1Id4	Hymenoptera	Formicidae	Brachymyrmex	Brachymyrmex sp. 2	Omnivore
<i>Handroanthus impetiginosus</i>	P4S2Id1	Hemiptera	Reduviidae		Reduviidae sp. 2	Predator
<i>Handroanthus impetiginosus</i>	P4S2Id1	Aranea	Theridiidae		Theridiidae sp. 3	Predator
<i>Handroanthus impetiginosus</i>	P4S2Id1	Aranea			Aranea sp. 10	Predator
<i>Handroanthus impetiginosus</i>	P4S2Id2	Neuroptera	Chrysopidae		Chrysopidae sp. 1	Predator
<i>Handroanthus impetiginosus</i>	P4S2Id2	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Handroanthus impetiginosus</i>	P4S2Id2	Hemiptera	Reduviidae		Reduviidae sp. 2	Predator
<i>Handroanthus impetiginosus</i>	P4S2Id2	Hymenoptera	Formicidae	Cephalotes	Cephalotes sp. 1	Omnivore
<i>Handroanthus impetiginosus</i>	P4S2Id2	Hymenoptera	Formicidae	Brachymyrmex	Brachymyrmex sp. 3	Omnivore
<i>Tabebuia roseoalba</i>	P4S2Id3	Hemiptera	Psyllidae		Psyllidae sp. 1	Phytophagous
<i>Tabebuia roseoalba</i>	P4S2Id3	Hemiptera	Reduviidae		Reduviidae sp. 4	Predator
<i>Tabebuia roseoalba</i>	P4S2Id3	Hemiptera	Reduviidae		Reduviidae sp. 5	Predator
<i>Handroanthus chrysotrichus</i>	P4S2Id4	Hemiptera	Coccidae	Ceroplaste	Ceroplastes cirripediformis	Phytophagous
<i>Handroanthus chrysotrichus</i>	P4S2Id4	Neuroptera	Chrysopidae		Chrysopidae sp. 2	Predator
<i>Eugenia pitanga</i>	P4S3Id1	Hemiptera	Diaspididae		Diaspididae sp. 7	Phytophagous
<i>Eugenia pitanga</i>	P4S3Id1	Aranea	Thomisidae		Thomisidae sp.4	Predator
<i>Eugenia pitanga</i>	P4S3Id1	Aranea	Thomisidae		Thomisidae sp. 5	Predator
<i>Eugenia pitanga</i>	P4S3Id1	Aranea			Aranea sp. 5	Predator
<i>Tabebuia roseoalba</i>	P4S3Id2	Aranea	Lycosidae		Lycosidae sp.1	Predator
<i>Tabebuia roseoalba</i>	P4S3Id2	Hemiptera	Pseudococcidae		Pseudococcidae sp. 2	Phytophagous
<i>Tabebuia roseoalba</i>	P4S3Id2	Hemiptera	Coreidae	Leptoglossus	Leptoglossus zonatus	Phytophagous
<i>Tabebuia roseoalba</i>	P4S3Id2	Aranea	Salticidae		Salticidae sp. 2	Predator
<i>Tabebuia roseoalba</i>	P4S3Id3	Aranea			Aranea sp. 5	Predator
<i>Tabebuia roseoalba</i>	P4S3Id3	Neuroptera	Chrysopidae		Chrysopidae sp. 3	Predator
<i>Tabebuia roseoalba</i>	P4S3Id3	Hemiptera	Cicadellidae		Cicadellidae sp. 2	Phytophagous
<i>Jacaranda cuspidifolia</i>	P4S3Id4	Neuroptera	Chrysopidae		Chrysopidae sp. 2	Predator
<i>Jacaranda cuspidifolia</i>	P4S3Id4	Aranea			Aranea sp. 4	Predator

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Jacaranda cuspidifolia</i>	P4S3Id4	Aranea			Aranea sp. 11	Predator
<i>Cecropia pachystachya</i>	P4S4Id1	Lepidoptera			Lepidoptera sp. 4	Phytophagous
<i>Cecropia pachystachya</i>	P4S4Id1	Hymenoptera	Formicidae	Azteca	Azteca sp. 1	Omnivore
<i>Cecropia pachystachya</i>	P4S4Id1	Hemiptera	Cicadellidae		Cicadellidae sp. 1	Phytophagous
<i>Calophyllum brasiliense</i>	P4S4Id2	Hemiptera	Coccidae	Pseudokermes	Pseudokermes vitreus	Phytophagous
<i>Calophyllum brasiliense</i>	P4S4Id2	Aranea	Theridiidae		Theridiidae sp. 2	Predator
<i>Calophyllum brasiliense</i>	P4S4Id2	Hymenoptera	Formicidae	Dorymyrmex	Dorymyrmex brunneus	Omnivore
<i>Calophyllum brasiliense</i>	P4S4Id2	Hemiptera	Aphididae		Aphididae sp. 2	Phytophagous
<i>Croton urucurana</i>	P4S4Id3	Hemiptera	Pentatomidae		Pentatomidae sp. 1	Phytophagous
<i>Croton urucurana</i>	P4S4Id3	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 4	Omnivore
<i>Bauhinia longifolia</i>	P4S4Id4	Hemiptera	Coccidae		Coccidae sp. 4	Phytophagous
<i>Bauhinia longifolia</i>	P4S4Id4	Aranea	Thomisidae		Thomisidae sp. 5	Predator
<i>Bauhinia longifolia</i>	P4S4Id4	Hemiptera	Pseudococcidae		Pseudococcidae sp. 3	Phytophagous
<i>Bauhinia longifolia</i>	P4S4Id4	Hemiptera	Pseudococcidae	Nipaecoccus	Nipaecoccus sp. 1	Phytophagous
<i>Calophyllum brasiliense</i>	P4S5Id3	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Calophyllum brasiliense</i>	P4S5Id3	Aranea	Theridiidae		Theridiidae sp. 2	Predator
<i>Calophyllum brasiliense</i>	P4S5Id5	Aranea			Aranea sp. 12	Predator
<i>Calophyllum brasiliense</i>	P4S5Id5	Hemiptera	Pseudococcidae	Ferrisia	Ferrisia sp. 2	Phytophagous
<i>Calophyllum brasiliense</i>	P4S5Id5	Hemiptera	Aphididae		Aphididae sp. 2	Phytophagous
<i>Calophyllum brasiliense</i>	P4S5Id5	Hymenoptera	Formicidae	Brachymyrmex	Brachymyrmex sp. 5	Omnivore
<i>Eucalyptus sp.</i>	P4S5Id6	Mesostigmata	Phytoseiidae		Phytoseiidae sp. 2	Predator
<i>Heliocharpus popayanensis</i>	P5S1Id1	Lepidoptera	Geometridae		Geometridae sp. 2	Phytophagous
<i>Heliocharpus popayanensis</i>	P5S1Id1	Hemiptera	Coccidae		Coccidae sp. 5	Phytophagous
<i>Platypodium elegans</i>	P5S1Id2	Hemiptera	Diaspididae		Diaspididae sp. 4	Phytophagous
<i>Heliocharpus popayanensis</i>	P5S1Id3	Hymenoptera	Formicidae	Brachymyrmex	Brachymyrmex sp. 6	Omnivore
<i>Heliocharpus popayanensis</i>	P5S1Id3	Araneae	Corinnidae		Corinnidae sp. 1	Predator
<i>Heliocharpus popayanensis</i>	P5S1Id3	Araneae	Thomisidae		Thomisidae sp. 6	Predator
<i>Heliocharpus popayanensis</i>	P5S1Id3	Hemiptera	Pseudococcidae		Pseudococcidae sp. 4	Phytophagous
<i>Heliocharpus popayanensis</i>	P5S1Id4	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 4	Omnivore
<i>Acroceras zizanioides</i>	P5S1Id6	Hymenoptera	Formicidae	Monomorium	Monomorium sp. 1	Omnivore
<i>Acroceras zizanioides</i>	P5S1Id6	Hymenoptera	Formicidae	Camponotus	Camponotus sp. 1	Omnivore
<i>Croton floribundus</i>	P5S2Id1	Araneae	Corinnidae		Corinnidae sp. 2	Predator
<i>Croton floribundus</i>	P5S2Id1	Araneae	Thomisidae		Thomisidae sp. 5	Predator
<i>Mangifera indica</i>	P5S2Id3	Hymenoptera	Formicidae		Myrmicinae sp. 1	Omnivore
<i>Mangifera indica</i>	P5S2Id3	Araneae	Salticidae		Salticidae sp. 6	Predator
<i>Cecropia pachystachya</i>	P5S2Id4	Thysanoptera			Thysanoptera sp. 1	Omnivore

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Cecropia pachystachya</i>	P5S2Id4	Araneae			Aranea sp. 13	Predator
<i>Cecropia pachystachya</i>	P5S2Id4	Araneae	Thomisidae		Thomisidae sp. 1	Predator
<i>Cecropia pachystachya</i>	P5S2Id4	Hemiptera	Pseudococcidae		Pseudococcidae sp. 5	Phytophageous
<i>Cecropia pachystachya</i>	P5S2Id4	Hymenoptera	Formicidae	Monomorium	Monomorium sp. 1	Omnivore
<i>Hyptis sp.</i>	P5S2Id7	Hemiptera	Pseudococcidae		Pseudococcidae sp. 6	Phytophageous
<i>Tabernaemontana catharinensis</i>	P5S3Id6	Hemiptera	Reduviidae		Reduviidae sp. 2	Predator
<i>Tabernaemontana catharinensis</i>	P5S3Id6	Hemiptera	Coccidae	Ceroplaste	Ceroplastes cirripediformis	Phytophageous
<i>Ocbroma pyramidale</i>	P5S3Id7	Lepidoptera	Geometridae		Geometridae sp. 3	Phytophageous
<i>Cariniana legalis</i>	P5S3Id8	Hymenoptera	Formicidae	Pheidole	Pheidole sp. 2	Omnivore
<i>Eugenia pitanga</i>	P5S4Id1	Araneae	Corinnidae		Corinnidae sp. 1	Predator
<i>Syzygium cumini</i>	P5S4Id3	Hymenoptera	Formicidae	Monomorium	Monomorium sp. 1	Omnivore
<i>Syzygium cumini</i>	P5S4Id3	Coleoptera	Chrysomeloidae	Charidotella	Charidotella sp. 1	Phytophageous
<i>Acacia polyphylla</i>	P5S4Id4	Hymenoptera	Formicidae	Pheidole	Pheidole sp. 3	Omnivore
<i>Acacia polyphylla</i>	P5S4Id4	Hemiptera	Coccidae	Ceroplastes	Ceroplastes glometarus	Phytophageous
<i>Rollinia mucosa</i>	P5S5Id2	Araneae			Aranea sp. 20	Predator
<i>Rollinia mucosa</i>	P5S5Id2	Hemiptera	Coccidae	Parasaissetia	Parasaissetia nigra	Phytophageous
<i>Rollinia mucosa</i>	P5S5Id2	Hemiptera	Coccinellidae		Coccinellidae sp. 1	Predator
<i>Rollinia mucosa</i>	P5S5Id2	Hymenoptera	Ichneumonidae		Ichneumonidae sp. 1	Parasitoid
<i>Bauhinia variegata</i>	P5S5Id3	Hymenoptera	Formicidae	Myrmelachista	Myrmelachista sp. 1	Omnivore
<i>Bauhinia variegata</i>	P5S5Id3	Hemiptera	Cicadellidae		Cicadellidae sp. 6	Phytophageous
<i>Croton floribundus</i>	P6S1Id1	Lepidoptera			Lepidoptera sp. 5	Phytophageous
<i>Croton floribundus</i>	P6S1Id1	Hemiptera	Diaspididae		Diaspididae sp. 11	Phytophageous
<i>Croton floribundus</i>	P6S2Id1	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 1	Phytophageous
<i>Croton floribundus</i>	P6S2Id2	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 1	Phytophageous
<i>Allophylus edulis</i>	P6S2Id3	Hemiptera	Diaspididae		Diaspididae sp. 9	Phytophageous
<i>Myracrodruon urundeuva</i>	P6S2Id4	Hemiptera	Ortheziidae		Ortheziidae sp. 1	Phytophageous
<i>Myracrodruon urundeuva</i>	P6S2Id4	Hymenoptera	Ichneumonidae		Ichneumonidae sp. 1	Parasitoid
<i>Myracrodruon urundeuva</i>	P6S2Id4	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 2	Phytophageous
<i>Serjania lethalis</i>	P6S2Id6	Aranea			Aranea sp. 16	Predator
<i>Undetermined liana sp2</i>	P6S2Id7	Aranea			Aranea sp. 14	Predator
<i>Platycyamus regnelii</i>	P6S3Id1	Aranea	Araneidae	Micrathena	Micrathena sp. 3	Predator
<i>Platycyamus regnelii</i>	P6S3Id1	Hemiptera	Pseudococcidae	Nipaecoccus	Nipaecoccus sp. 3	Phytophageous
<i>Platycyamus regnelii</i>	P6S3Id1	Hemiptera	Pseudococcidae		Pseudococcidae sp. 8	Phytophageous
<i>Albizia nipoides</i>	P6S3Id2	Lepidoptera	Lycaenidae		Lycaenidae sp. 1	Phytophageous
<i>Albizia nipoides</i>	P6S3Id2	Lepidoptera	Elachistidae		Elachistidae sp. 1	Phytophageous

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Croton floribundus</i>	P6S3Id3	Hymenoptera	Formicidae	Azteca	Azteca sp. 2	Omnivore
<i>Triplaris gardneriana</i>	P6S3Id4	Hymenoptera	Formicidae	Crematogaster	Crematogaster sp. 1	Omnivore
<i>Triplaris gardneriana</i>	P6S3Id4	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Triplaris gardneriana</i>	P6S3Id4	Lepidoptera	Geometridae		Geometridae sp. 4	Phytophagous
<i>Triplaris gardneriana</i>	P6S3Id4	Hemiptera	Coccidae		Coccidae sp. 7	Phytophagous
<i>Piptadenia gonoacantha</i>	P6S4Id2	Hemiptera	Pseudococcidae		Pseudococcidae sp. 9	Phytophagous
<i>Inga striata</i>	P6S4Id3	Lepidoptera	Elachistidae		Elachistidae sp. 2	Phytophagous
<i>Inga striata</i>	P6S4Id3	Lepidoptera	Lycanidae		Lycanidae sp. 1	Phytophagous
<i>Croton floribundus</i>	P6S4Id4	Aranea	Araneidae		Araneidae sp. 3	Predator
<i>Croton floribundus</i>	P6S4Id4	Hymenoptera	Formicidae		Formicinae sp. 1	Omnivore
<i>Croton floribundus</i>	P6S5Id3	Hemiptera	Pseudococcidae	Ferrisia	Ferrisia sp. 3	Phytophagous
<i>Allophylus edulis</i>	P6S5Id4	Aranea	Gnaphosidae		Gnaphosidae sp. 2	Predator
<i>Allophylus edulis</i>	P6S5Id4	Hemiptera	Tingidae		Tingidae sp. 2	Phytophagous
<i>Croton floribundus</i>	P7S1Id1	Hymenoptera	Formicidae	Azteca	Azteca sp. 2	Omnivore
<i>Croton floribundus</i>	P7S1Id1	Hemiptera	Tingidae		Tingidae sp. 5	Phytophagous
<i>Croton floribundus</i>	P7S1Id2	Hymenoptera	Ceraphronidae		Ceraphronidae sp. 1	Parasitoid
<i>Croton floribundus</i>	P7S1Id4	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 5	Omnivore
<i>Croton floribundus</i>	P7S1Id4	Hymenoptera	Formicidae	Azteca	Azteca sp. 2	Omnivore
<i>Croton floribundus</i>	P7S2Id1	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 5	Omnivore
<i>Croton floribundus</i>	P7S2Id1	Lepidoptera	Crambidae		Crambidae sp. 1	Phytophagous
<i>Croton floribundus</i>	P7S2Id1	Lepidoptera	Elastichidae		Elastichidae sp. 3	Phytophagous
<i>Machaerium acutifolium</i>	P7S2Id2	Hemiptera	Cicadellidae		Cicadellidae sp. 3	Phytophagous
<i>Machaerium acutifolium</i>	P7S2Id2	Hemiptera	Pseudococcidae		Pseudococcidae sp. 10	Phytophagous
<i>Machaerium acutifolium</i>	P7S2Id2	Aranea			Aranea sp. 17	Predator
<i>Croton floribundus</i>	P7S3Id2	Coleoptera			Coleoptera sp. 1	Fongivore
<i>Croton floribundus</i>	P7S3Id2	Mesostigmata	Phytoseiidae		Phytoseiidae sp. 3	Predator
<i>Aegiphilla integrifolia</i>	P7S4Id2	Hemiptera	Coccidae	Ceroplastes	Ceroplastes sp. 2	Phytophagous
<i>Aegiphilla integrifolia</i>	P7S4Id2	Hemiptera	Aphididae		Aphididae sp. 3	Phytophagous
<i>Aegiphilla integrifolia</i>	P7S4Id2	Lepidoptera	Geometridae		Geometridae sp. 5	Phytophagous
<i>Cupania vernalis</i>	P7S5Id1	Hymenoptera	Formicidae	Pheidole	Pheidole sp. 4	Omnivore
<i>Cupania vernalis</i>	P7S5Id1	Hemiptera	Diaspididae		Diaspididae sp. 10	Phytophagous
<i>Cupania vernalis</i>	P7S5Id3	Hemiptera	Diaspididae		Diaspididae sp. 8	Phytophagous
<i>Cupania vernalis</i>	P7S5Id3	Hemiptera	Diaspididae		Diaspididae sp. 11	Phytophagous
<i>Trema micrantha</i>	P8S1Id2	Lepidoptera	Erebidae		Erebidae sp. 1	Phytophagous
<i>Trema micrantha</i>	P8S1Id3	Aranea	Araneidae		Araneidae sp. 4	Predator
<i>Trema micrantha</i>	P8S1Id3	Hemiptera	Membracidae		Membracidae sp. 2	Phytophagous
<i>Trema micrantha</i>	P8S1Id3	Hemiptera	Cicadellidae		Cicadellidae sp. 4	Phytophagous
<i>Acacia polyphylla</i>	P8S2Id1	Lepidoptera	Pyralidae		Pyralidae sp. 1	Phytophagous

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Acacia polyphylla</i>	P8S2Id1	Hemiptera	Coccidae	Ceroplastes	Ceroplastes glometarus	Phytophagous
<i>Acacia polyphylla</i>	P8S2Id1	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 2	Omnivore
<i>Acacia polyphylla</i>	P8S2Id1	Aranea			Aranea sp. 17	Predator
<i>Manibot grabami</i>	P8S2Id3	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 2	Omnivore
<i>Manibot grabami</i>	P8S2Id3	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 1	Omnivore
<i>Croton floribundus</i>	P8S2Id4	Hymenoptera	Formicidae	Pseudomyrmex	Pseudomyrmex sp. 2	Omnivore
<i>Trema micrantha</i>	P8S3Id1	Aranea	Salticidae		Salticidae sp. 4	Predator
<i>Piptadenia gonoacantha</i>	P8S3Id2	Lepidoptera	Pyralidae		Pyralidae sp. 1	Phytophagous
<i>Piptadenia gonoacantha</i>	P8S3Id2	Hymenoptera	Braconidae		Braconidae sp. 1	Parasitoid
<i>Piptadenia gonoacantha</i>	P8S3Id2	Aranea	Salticidae		Salticidae sp. 3	Predator
<i>Piptadenia gonoacantha</i>	P8S3Id2	Lepidoptera	Drepanidae		Drepanidae sp. 1	Phytophagous
<i>Piptadenia gonoacantha</i>	P8S3Id2	Lepidoptera			Lepidoptera sp. 6	Phytophagous
<i>Croton floribundus</i>	P8S3Id3	Aranea			Aranea sp. 18	Predator
<i>Croton floribundus</i>	P8S3Id3	Hemiptera	Diaspididae		Diaspididae sp. 4	Phytophagous
<i>Croton floribundus</i>	P8S3Id3	Hemiptera	Coccidae	Ceroplastes	Ceroplastes cirripediformis	Phytophagous
<i>Manibot grabami</i>	P8S3Id4	Hemiptera	Pseudococcidae	Ferrisia	Ferrisia sp. 1	Phytophagous
<i>Manibot grabami</i>	P8S3Id4	Hemiptera	Coccidae	Ceroplastes	Ceroplastes sp. 1	Phytophagous
<i>Manibot grabami</i>	P8S3Id4	Hemiptera	Diaspididae		Diaspididae sp. 4	Phytophagous
<i>Manibot grabami</i>	P8S3Id4	Aranea	Araneidae	Micrathena	Micrathena sp.2	Predator
<i>Undetermined liana sp1</i>	P8S4Id1	Hemiptera	Coccidae		Coccidae sp. 8	Phytophagous
<i>Acacia polyphylla</i>	P8S4Id2	Hemiptera	Coccidae	Ceroplastes	Ceroplastes glometarus	Phytophagous
<i>Acacia polyphylla</i>	P8S4Id2	Lepidoptera			Lepidoptera sp. 7	Phytophagous
<i>Acacia polyphylla</i>	P8S4Id2	Hymenoptera	Formicidae	Ectatomma	Ectatomma sp. 1	Omnivore
<i>Acacia polyphylla</i>	P8S4Id2	Lepidoptera	Erebidae		Erebidae sp. 1	Phytophagous
<i>Acacia polyphylla</i>	P8S4Id2	Lepidoptera			Lepidoptera sp. 8	Phytophagous
<i>Myrcia fençliana</i>	P8S4Id3	Aranea	Theridiidae		Theridiidae sp. 2	Predator
<i>Myrcia fençliana</i>	P8S4Id4	Coleoptera	Chrysomelidae		Chrysomelidae sp. 2	Predator
<i>Celtis iguanea</i>	P8S4Id5	Hemiptera	Reduviidae		Reduviidae sp. 6	Predator
<i>Celtis iguanea</i>	P8S4Id5	Hemiptera	Pseudococcidae		Pseudococcidae sp. 13	Phytophagous
<i>Celtis iguanea</i>	P8S4Id5	Hymenoptera	Ichneumonidae		Ichneumonidae sp. 1	Parasitoid
<i>Croton floribundus</i>	P8S5Id1	Hemiptera	Pseudococcidae		Pseudococcidae sp. 12	Phytophagous
<i>Croton floribundus</i>	P8S5Id1	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Croton floribundus</i>	P8S5Id1	Hemiptera	Cicadellidae		Cicadellidae sp. 7	Phytophagous
<i>Acacia polyphylla</i>	P8S5Id2	Hemiptera	Coccidae	Ceroplastes	Ceroplastes glometarus	Phytophagous
<i>Acacia polyphylla</i>	P8S5Id2	Hymenoptera	Formicidae	Ectatomma	Ectatomma sp. 1	Omnivore
<i>Croton floribundus</i>	P8S5Id3	Hemiptera	Pseudococcidae		Pseudococcidae sp. 11	Phytophagous
<i>Croton floribundus</i>	P8S5Id3	Aranea	Corinnidae		Corinnidae sp. 1	Predator
<i>Astronium graveolens</i>	P9S1Id2	Hemiptera	Ortheziidae		Ortheziidae sp. 1	Phytophagous

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Astronium graveolens</i>	P9S1Id2	Hemiptera	Diaspididae		Diaspididae sp. 6	Phytophagous
<i>Vochysia tucanorum</i>	P9S1Id3	Hemiptera	Coccidae		Coccidae sp. 7	Phytophagous
<i>Endlicheria paniculata</i>	P9S1Id4	Hemiptera	Coccidae		Coccidae sp. 7	Phytophagous
<i>Acacia polyphylla</i>	P9S2Id1	Hemiptera	Coccidae	Ceroplaste	Ceroplastes glometarus	Phytophagous
<i>Acacia polyphylla</i>	P9S2Id1	Hemiptera	Tingidae		Tingidae sp. 3	Phytophagous
<i>Acacia polyphylla</i>	P9S2Id1	Hemiptera			Hemiptera sp. 1	Predator
<i>Piptadenia gonoacantha</i>	P9S2Id3	Hemiptera			Hemiptera sp. 1	Predator
<i>Acacia polyphylla</i>	P9S3Id1	Hemiptera			Hemiptera sp. 1	Predator
<i>Celtis iguanea</i>	P9S4Id1	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 1	Phytophagous
<i>Celtis iguanea</i>	P9S4Id1	Hemiptera	Coccidae		Coccidae sp. 6	Phytophagous
<i>Acacia polyphylla</i>	P9S4Id3	Hemiptera	Tingidae		Tingidae sp. 3	Phytophagous
<i>Acacia polyphylla</i>	P9S5Id2	Hemiptera	Reduviidae		Reduviidae sp. 8	Predator
<i>Ceiba speciosa</i>	P9S5Id3	Hemiptera	Reduviidae		Reduviidae sp. 7	Predator
<i>Astronium graveolens</i>	P10S1Id1	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 2	Phytophagous
<i>Acacia polyphylla</i>	P10S1Id2	Lepidoptera	Nymphalidae		Nymphalidae sp. 1	Phytophagous
<i>Luebea paniculata</i>	P10S1Id4	Aranea	Salticidae	Pachomius	Pachomius sp.1	Predator
<i>Fridericia sp.</i>	P10S1Id5	Aranea	Araneidae	Micrathena	Micrathena sp. 1	Predator
<i>Fridericia sp.</i>	P10S1Id6	Blattodea			Blattodea sp. 1	Omnivore
<i>Fridericia sp.</i>	P10S1Id6	Aranea	Araneidae	Micrathena	Micrathena sp. 1	Predator
<i>Fridericia sp.</i>	P10S1Id6	Hemiptera	Pseudococcidae		Pseudococcidae sp. 15	Phytophagous
<i>Allophylus edulis</i>	P10S2Id1	Hemiptera	Pseudococcidae	Nipaecoccus	Nipaecoccus sp. 3	Phytophagous
<i>Piptadenia gonoacantha</i>	P10S2Id2	Hymenoptera	Mutillidae		Mutillidae sp. 1	Omnivore
<i>Piptadenia gonoacantha</i>	P10S2Id2	Aranea	Thomisidae		Thomisidae sp. 6	Predator
<i>Piptadenia gonoacantha</i>	P10S2Id2	Lepidoptera	Pyralidae		Pyralidae sp. 2	Phytophagous
<i>Piptadenia gonoacantha</i>	P10S2Id3	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 2	Phytophagous
<i>Celtis iguanea</i>	P10S2Id4	Lepidoptera	Crambidae		Crambidae sp. 2	Phytophagous
<i>Celtis iguanea</i>	P10S2Id4	Aranea			Aranea sp. 19	Predator
<i>Celtis iguanea</i>	P10S2Id4	Hemiptera	Pseudococcidae	Nipaecoccus	Nipaecoccus sp. 3	Phytophagous
<i>Celtis iguanea</i>	P10S2Id4	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 2	Phytophagous
<i>Allophylus edulis</i>	P10S3Id1	Hymenoptera	Formicidae	Camponotus	Camponotus sp. 2	Omnivore
<i>Piptadenia gonoacantha</i>	P10S3Id2	Hymenoptera	Formicidae	Crematogaster	Crematogaster sp. 1	Omnivore
<i>Piptadenia gonoacantha</i>	P10S3Id2	Hemiptera	Monophlebidae		Monophlebidae sp. 3	Phytophagous
<i>Machaerium brasiliense</i>	P10S3Id3	Lepidoptera	Noctuidae		Noctuidae sp. 3	Phytophagous
<i>Machaerium brasiliense</i>	P10S3Id3	Lepidoptera	Noctuidae		Noctuidae sp. 4	Phytophagous
<i>Piptadenia gonoacantha</i>	P10S3Id4	Aranea	Theridiidae		Theridiidae sp. 3	Predator
<i>Piptadenia gonoacantha</i>	P10S3Id4	Aranea	Salticidae		Salticidae sp.5	Predator
<i>Machaerium brasiliense</i>	P10S4Id1	Hemiptera	Diaspididae		Diaspididae sp. 5	Phytophagous
<i>Cariniana estrellensis</i>	P10S4Id4	Coleoptera	Chrysomelidae	Charidotella	Charidotella sp. 2	Phytophagous
<i>Cordia superba</i>	P10S5Id1	Aranea	Theridiidae		Theridiidae sp. 1	Predator

Plant_species	Id_plant	Order	Family	Subfamily	Morphospecies	Functional group
<i>Cordia superba</i>	P10S5Id1	Formicidae	Formicinae		Formicinae sp. 11	Omnivore
<i>Cordia superba</i>	P10S5Id1	Aranea	Oxyopidae		Oxyopidae sp. 1	Predator
<i>Trema micrantha</i>	P10S5Id2	Lepidoptera	Crambidae		Crambidae sp. 3	Phytophageous
<i>Trema micrantha</i>	P10S5Id2	Hemiptera	Pseudococcidae	Pseudococcus	Pseudococcus sp. 2	Phytophageous
<i>Trema micrantha</i>	P10S5Id2	Hemiptera	Cicadellidae		Cicadellidae sp. 6	Phytophageous
<i>Amaioua intermedia</i>	P10S5Id3	Hemiptera	Monophlebidae		Monophlebidae sp. 2	Phytophageous
<i>Serjania lethalis</i>	P10S5Id5	Hemiptera	Pseudococcidae		Pseudococcidae sp. 14	Phytophageous

ANNEX 3: DISTURBANCE INDICES RESULTS

Annex 3: Indexes of canopy cover, percentage of invasive grasses and percentage cover of lianas. Estimation were made visually. The sum of them give the disturbance index for each plot.

	Canopy	Invasive grasses	Lianas	Sum
P1	0.3	0	-0.8	-0.5
P2	0.4	-0.3	-0.5	-0.4
P3	0.9	-0.1	0	0.8
P4	0.8	-0.1	0	0.7
P5	0.8	-0.3	-0.1	0.4
P6	0.4	-0.3	-0.3	-0.2
P7	0.3	0	-0.9	-0.6
P8	0.4	-0.3	-0.4	-0.3
P9	0.2	-0.5	-0.9	-1.2
P10	0.4	-0.1	-0.8	-0.5

ANNEX 4-5: RICHNESS ESTIMATION

Annex 4: Individual rarefaction estimation for plant richness calculated with Past326b, with values in bold as the values used to define the specific richness of the fragments

Samp size	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.920	1.913	1.924	1.931	1.975	1.931	1.789	1.883	1.942	1.957
3	2.770	2.747	2.782	2.798	2.926	2.800	2.443	2.664	2.830	2.872
4	3.557	3.509	3.584	3.608	3.854	3.614	3.009	3.354	3.670	3.749
5	4.291	4.207	4.338	4.364	4.759	4.378	3.518	3.967	4.466	4.589
6	4.977	4.845	5.053	5.074	5.642	5.097	3.990	4.512	5.222	5.396
7	5.621	5.431	5.734	5.740	6.504	5.777	4.434	4.999	5.944	6.170
8	6.229	5.970	6.389	6.369	7.347	6.422	4.858	5.436	6.633	6.914
9	6.804	6.466	7.021	6.963	8.169	7.035	5.265	5.830	7.296	7.630
10	7.351	6.924	7.636	7.527	8.973	7.620	5.658	6.187	7.933	8.320
11	7.873	7.349	8.238	8.065	9.758	8.180	6.037	6.513	8.550	8.985
12	8.374	7.744	8.830	8.579	10.526	8.717	6.404	6.812	9.148	9.627
13	8.855	8.113	9.414	9.073	11.277	9.235	6.759	7.089	9.730	10.248
14	9.318	8.459	9.993	9.551	12.012	9.735	7.104	7.347	10.298	10.849
15	9.766	8.785	10.569	10.013	12.730	10.219	7.439	7.589	10.855	11.430
16	10.200	9.094	11.142	10.463	13.434	10.688	7.765	7.818	11.403	11.995
17	10.622	9.389	11.714	10.903	14.123	11.143	8.083	8.035	11.942	12.543
18	11.032	9.673	12.286	11.335	14.798	11.585	8.395	8.242	12.474	13.076
19	11.432	9.947	12.857	11.759	15.459	12.016	8.700	8.440	13.000	13.594
20	11.822	10.215	13.429	12.178	16.107	12.435	9.000	8.632		14.099
21	12.204	10.478	14.000	12.591	16.742	12.842		8.818		14.592
22	12.577	10.739		13.000	17.364	13.239		9.000		15.073
23	12.943	11.000			17.975	13.625				15.542
24	13.302				18.574	14.000				16.000
25	13.654				19.162					
26	14.000				19.740					
27					20.306					
28					20.863					
29					21.409					
30					21.946					
31					22.473					
32					22.991					
33					23.500					
34					24.000					

Annex 5: Individual rarefaction estimation for arthropod richness calculated with Past326b, with values in bold as the values used to define the specific richness of the fragments

Samp size	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	1.995	1.985	1.986	1.994	1.993	1.994	1.979	1.987	1.945	1.985
3	2.986	2.954	2.958	2.983	2.980	2.983	2.938	2.960	2.838	2.955
4	3.971	3.910	3.916	3.966	3.960	3.966	3.877	3.920	3.681	3.912
5	4.952	4.851	4.861	4.943	4.934	4.943	4.798	4.868	4.478	4.856
6	5.929	5.779	5.793	5.914	5.902	5.915	5.702	5.803	5.231	5.787
7	6.900	6.694	6.713	6.880	6.864	6.880	6.589	6.725	5.942	6.707
8	7.867	7.597	7.620	7.840	7.820	7.840	7.460	7.635	6.615	7.615
9	8.829	8.487	8.516	8.794	8.771	8.795	8.316	8.533	7.253	8.513
10	9.786	9.366	9.400	9.743	9.716	9.744	9.158	9.419	7.857	9.401
11	10.738	10.234	10.273	10.686	10.656	10.687	9.987	10.293	8.431	10.280
12	11.686	11.091	11.135	11.623	11.590	11.624	10.804	11.156	8.978	11.149
13	12.629	11.937	11.987	12.554	12.519	12.556	11.609	12.007	9.500	12.010
14	13.567	12.773	12.828	13.480	13.444	13.482	12.404	12.848	10.000	12.864
15	14.500	13.600	13.660	14.400	14.364	14.402	13.189	13.677		13.709
16	15.429	14.417	14.482	15.314	15.279	15.316	13.965	14.495		14.548
17	16.352	15.226	15.295	16.223	16.190	16.225	14.733	15.303		15.380
18	17.271	16.026	16.100	17.126	17.096	17.128	15.495	16.101		16.205
19	18.186	16.817	16.895	18.023	17.999	18.026	16.250	16.888		17.025
20	19.095	17.601	17.683	18.914	18.897	18.917	17.000	17.665		17.839
21	20.000	18.377	18.463	19.800	19.791	19.803		18.433		18.647
22		19.146	19.236	20.680	20.682	20.684		19.190		19.450
23		19.907	20.002	21.554	21.570	21.558		19.938		20.249
24		20.662	20.760	22.423	22.454	22.427		20.677		21.042
25		21.410	21.513	23.286	23.335	23.291		21.407		21.832
26		22.152	22.259	24.143	24.212	24.148		22.128		22.617
27		22.888	23.000	24.994	25.087	25.000		22.840		23.397
28		23.619		25.840	25.959			23.544		24.174
29		24.343		26.680	26.829			24.239		24.947
30		25.063		27.514	27.696			24.926		25.716
31		25.777		28.343	28.561			25.606		26.481
32		26.486		29.166	29.423			26.277		27.242
33		27.190		29.983	30.284			26.941		28.000
34		27.890		30.794	31.143			27.597		
35		28.586		31.600	32.000			28.246		
36		29.277		32.400				28.888		
37		29.963		33.194				29.524		
38		30.646		33.983				30.152		
39		31.325		34.766				30.774		
40		32.000		35.543				31.390		
41				36.314				32.000		
42				37.080						
43				37.840						
44				38.594						
45				39.343						
46				40.086						
47				40.823						
48				41.554						
49				42.280						
50				43.000						

ANNEX 6-15: MATRICES USED FOR NETWORKS CONSTRUCTION

Annex 6: Matrices for plant-arthropod trophic level interaction of P1 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	2	1	0	0
<i>Cedrela fissilis</i>	0	1	0	0
<i>Celtis fluminensis</i>	0	3	1	0
<i>Copaifera langsdorffii</i>	0	1	0	0
<i>Dalbergia frutescens</i>	0	0	1	0
<i>Guarea macrophylla</i>	1	0	0	0
<i>Machaerium stipitatum</i>	1	0	0	0
<i>Parodiolyra micrantha</i>	1	0	0	0
<i>Piptadenia gonoacantha</i>	0	1	0	0
<i>Piptocarpha sellowii</i>	2	0	0	0
<i>Platypodium elegans</i>	2	2	0	0

Annex 7: Matrices of plant-arthropod trophic level interaction of P2 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	1	5	0	0
<i>Cecropia pachystachya</i>	1	1	0	1
<i>Guarea guidonia</i>	3	5	0	1
<i>Ocotea maculata</i>	0	1	0	0
<i>Panicum maximum</i>	0	1	0	1
<i>Platypodium elegans</i>	3	6	0	2
<i>Senegalia tucumanensis</i>	2	3	1	0
<i>Smilax fluminensis</i>	1	1	0	0

Annex 8: Matrices of plant-arthropod trophic level interaction of P3 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	1	0	0	0
<i>Annona dolabrpetala</i>	1	2	0	0
<i>Cordia mixta</i>	2	1	0	0
<i>Magonia glabrata</i>	1	0	0	0
<i>Mangifera indica</i>	2	1	0	0
<i>Morus alba</i>	7	3	0	1
<i>Nectandra megapota</i>	1	0	0	0

Annex 9: Matrices of plant-arthropod trophic level interaction of P4 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Bauhinia longifolia</i>	1	3	0	0
<i>Calophyllum brasiliense</i>	4	4	0	2
<i>Cecropia pachystachya</i>	0	2	0	1
<i>Croton urucurana</i>	0	1	0	1
<i>Eucalyptus sp.</i>	1	0	0	0
<i>Eugenia pitanga</i>	3	1	0	0
<i>Handroanthus impetiginosus</i>	7	1	0	2
<i>Heliocarpus popayanensis</i>	2	1	0	2
<i>Jacaranda cuspidifolia</i>	3	0	0	0
<i>Ocotea spixiana</i>	0	0	0	1
<i>Tabebuia roseoalba</i>	7	4	0	0

Annex 10: Matrices of plant-arthropod trophic level interaction of P5 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	0	1	0	1
<i>Acroceras zizanioides</i>	0	0	0	1
<i>Bauhinia variegata</i>	0	1	0	1
<i>Cariniana legalis</i>	0	0	0	1
<i>Cecropia pachystachya</i>	2	1	0	2
<i>Croton floribundus</i>	2	0	0	0
<i>Eugenia pitanga</i>	1	0	0	0
<i>Heliocarpus popayanensis</i>	2	3	0	2
<i>Hyptis sp.</i>	0	1	0	0
<i>Mangifera indica</i>	1	0	0	1
<i>Ochroma pyramidale</i>	0	1	0	0
<i>Platipodium elegans</i>	0	1	0	0
<i>Rollinia mucosa</i>	2	1	1	0
<i>Syzygium cumini</i>	0	1	0	1
<i>Tabernaemontana catharinensis</i>	0	1	0	0

Annex 11: Matrices of plant-arthropod trophic level interaction of P6 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Albizia nipoides</i>	0	2	0	0
<i>Allophylus edulis</i>	1	2	0	0
<i>Croton floribundus</i>	2	5	0	2
<i>Inga striata</i>	0	2	0	0
<i>Myracrodruon urundeuva</i>	0	2	1	0
<i>Piptadenia gonoacantha</i>	0	1	0	0
<i>Platycamus regnellii</i>	1	2	0	0
<i>Serjania lethalis</i>	1	0	0	0
<i>Triplaris gardneriana</i>	1	2	0	1
<i>Undetermined liana sp2</i>	1	0	0	0

Annex 12: Matrices of plant-arthropod trophic level interaction of P7 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Aegiphilla integrifolia</i>	0	3	0	0
<i>Croton floribundus</i>	1	3	1	4
<i>Cupania vernalis</i>	0	3	0	1
<i>Machaerium acutifolium</i>	1	2	0	0

Annex 13: Matrices of plant-arthropod trophic level interaction of P8 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	1	7	0	3
<i>Celtis iguanea</i>	1	1	1	0
<i>Croton floribundus</i>	3	5	0	1
<i>Manihot grabami</i>	1	3	0	2
<i>Myrcia feniziana</i>	2	0	0	0
<i>Piptadenia gonoacantha</i>	1	3	1	0
<i>Trema micrantha</i>	2	3	0	0
<i>Undetermined liana sp1</i>	0	1	0	0

Annex 14: Matrices of plant-arthropod trophic level interaction of P9 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	3	3	0	0
<i>Astronium graveolens</i>	0	2	0	0
<i>Ceiba speciosa</i>	1	0	0	0
<i>Celtis iguanea</i>	0	2	0	0
<i>Endlicheria paniculata</i>	0	1	0	0
<i>Piptadenia gonoacantha</i>	1	0	0	0
<i>Vochysia tucanorum</i>	0	1	0	0

Annex 15: Matrices of plant-arthropod trophic level interaction of P10 fragment

	Predator	Phytophageous	Parasitoid	Omnivore
<i>Acacia polyphylla</i>	0	1	0	0
<i>Allophylus edulis</i>	0	1	0	1
<i>Amaioua intermedia</i>	0	1	0	0
<i>Astronium graveolens</i>	0	1	0	0
<i>Cariniana estrellensis</i>	0	1	0	0
<i>Celtis iguanea</i>	1	3	0	0
<i>Cordia superba</i>	2	0	0	1
<i>Fridericia sp.</i>	2	1	0	1
<i>Luehea paniculata</i>	1	0	0	0
<i>Machaerium brasiliense</i>	0	3	0	0
<i>Piptadenia gonoacantha</i>	3	3	0	2
<i>Serjania lethalis</i>	0	1	0	0
<i>Trema micrantha</i>	0	3	0	0

ANNEX 16: LIST OF PLANT IDENTIFIED IN THE FRAGMENTS

Annex 16: List of plant species identified with family affiliation, nativity information (1 means native from Atlantic forest and 0 not native), abundance measured as the number of plants of the species identified, interaction as the number of arthropod interacting with the species and strength interaction as the interaction divided by the abundance.

Family	Species	Nativity (Index of nativity)	Abundance (Number of plants)	Interaction (Number of arthropod)	Host strength (Index of host strength)
FABACEAE	<i>Acacia polyphylla</i>	1	20	31	1.6
POACEAE	<i>Acroceras ziganioides</i>	0	3	2	0.7
LAMIACEAE	<i>Aegiphilla integrifolia</i>	1	1	3	3.0
FABACEAE	<i>Albizia nipoides</i>	1	2	2	1.0
EUPHORBACEAE	<i>Alchornea sidifolia</i>	1	2	0	0.0
SAPINDACEAE	<i>Allophylus edulis</i>	1	4	5	1.3
RUBIACEAE	<i>Amaioua intermedia</i>	1	1	1	1.0
ANNONACEAE	<i>Annona dolabripetala</i>	1	4	3	0.8
APOCYNACEAE	<i>Aspidosperma sp.</i>	0	1	0	0.0
ANACARDIACEAE	<i>Astronium graveolens</i>	1	4	3	0.8
FABACEAE	<i>Bauhinia longifolia</i>	1	1	4	4.0
FABACEAE	<i>Bauhinia variegata</i>	0	2	2	1.0
MALVACEAE	<i>Bombacopsis glabra</i>	0	1	0	0.0
MELIACEAE	<i>Cabralea canjerana</i>	1	1	0	0.0
LAMIACEAE	<i>Callicarpa reevesii</i>	0	1	0	0.0
CALOPHYLLACEAE	<i>Callophyllum brasiliense</i>	1	5	10	2.0
SOLANACEAE	<i>Capsicum bacatum</i>	0	4	0	0.0
LECYTHIDACEAE	<i>Cariniana estrellensis</i>	1	1	1	1.0
LECYTHIDACEAE	<i>Cariniana legalis</i>	1	2	1	0.5
SALICACEAE	<i>Casearia sylvestris</i>	1	1	0	0.0
URTICACEAE	<i>Cecropia pachystachya</i>	1	3	11	3.7
MELIACEAE	<i>Cedrela fissilis</i>	1	1	1	1.0
MALVACEAE	<i>Ceiba speciosa</i>	1	1	1	1.0
CANNABACEAE	<i>Celtis fluminensis</i>	1	2	5	2.5
CANNABACEAE	<i>Celtis iguanea</i>	1	3	9	3.0
ASTERACEAE	<i>Chaptalia nutans</i>	0	4	0	0.0
ASTERACEAE	<i>Chrysolaena platensis</i>	0	1	0	0.0
FABACEAE	<i>Copaifera langsdorffii</i>	1	1	1	1.0
BORAGINACEAE	<i>Cordia mixta</i>	0	1	3	3.0
BORAGINACEAE	<i>Cordia superba</i>	1	1	3	3.0
EUPHORBIACEAE	<i>Croton floribundus</i>	1	23	30	1.3
EUPHORBIACEAE	<i>Croton urucurana</i>	1	1	2	2.0

Family	Species	Nativity (Index of nativity)	Abundance (Number of plants)	Interaction (Number of arthropod)	Host strength (Index of host strength)
SAPINDACEAE	<i>Cupania vernalis</i>	1	3	4	1.3
FABACEAE	<i>Dalbergia frutescens</i>	1	1	1	1.0
LAURACEAE	<i>Endlicheria paniculata</i>	1	2	1	0.5
MYRTACEAE	<i>Eucalyptus sp.</i>	0	1	1	1.0
MYRTACEAE	<i>Eugenia pitanga</i>	0	2	5	2.5
BIGNONIACEAE	<i>Fridericia sp.</i>	0	3	4	1.3
MELIACEAE	<i>Guarea guidonia</i>	1	3	9	3.0
MELIACEAE	<i>Guarea macrophylla</i>	1	1	1	1.0
BIGNONIACEAE	<i>Handroanthus chrysotrichus</i>	1	1	2	2.0
BIGNONIACEAE	<i>Handroanthus impetiginosus</i>	1	2	8	4.0
MALVACEAE	<i>Heliocharis popayanensis</i>	1	4	12	3.0
FABACEAE	<i>Holocalyx balansae</i>	1	1	0	0.0
LAMIACEAE	<i>Hyptis sp.</i>	0	1	1	1.0
FABACEAE	<i>Inga striata</i>	1	1	2	2.0
FABACEAE	<i>Jacaranda cuspidifolia</i>	1	1	3	3.0
VERBENACEAE	<i>Lantana camara</i>	1	1	0	0.0
MALVACEAE	<i>Luehea candicans</i>	1	1	0	0.0
MALVACEAE	<i>Luehea divaricata</i>	1	1	0	0.0
MALVACEAE	<i>Luehea paniculata</i>	1	2	1	0.5
FABACEAE	<i>Machaerium aculeatum</i>	1	1	0	0.0
FABACEAE	<i>Machaerium acutifolium</i>	1	2	3	1.5
FABACEAE	<i>Machaerium brasiliense</i>	1	2	3	1.5
FABACEAE	<i>Machaerium stipitatum</i>	1	1	1	1.0
SAPINDACEAE	<i>Magonia glabrata</i>	0	1	1	1.0
ANACARDIACEAE	<i>Mangifera indica</i>	0	2	5	2.5
EUPHORBIACEAE	<i>Manihot grabami</i>	1	3	6	2.0
SAPINDACEAE	<i>Matayba elaeganooides</i>	1	1	0	0.0
RUTACEAE	<i>Metrodorea nigra</i>	1	1	0	0.0
MORACEAE	<i>Morus alba</i>	0	5	11	2.2
MUNTINGIACEAE	<i>Muntingia calabura</i>	0	1	0	0.0
ANACARDIACEAE	<i>Myracrodruon urundeuva</i>	1	2	3	1.5
MYRTACEAE	<i>Myrcia feniziana</i>	1	2	2	1.0
MYRTACEAE	<i>Myrcia rostrata</i>	0	1	0	0.0
LAURACEAE	<i>Nectandra megapotamica</i>	1	1	1	1.0
MALVACEAE	<i>Ochroma pyramidale</i>	0	1	1	1.0

Family	Species	Nativity (Index of nativity)	Abundance (Number of plants)	Interaction (Number of arthropod)	Host strength (Index of host strength)
LAURACEAE	<i>Ocotea corymbosa</i>	1	1	0	0.0
LAURACEAE	<i>Ocotea spixiana</i>	0	1	1	1.0
ORCHIDACEAE	<i>Oeceoclades maculata</i>	1	2	1	0.5
POACEAE	<i>Olyra latifolia</i>	0	2	0	0.0
POACEAE	<i>Panicum maximum</i>	0	2	2	1.0
POACEAE	<i>Parodiolyra micrantha</i>	1	6	1	0.2
PIPERACEAE	<i>Piper aduncum</i>	1	1	0	0.0
FABACEAE	<i>Piptadenia gonoacantha</i>	1	12	16	1.3
ASTERACEAE	<i>Piptocarpha sellowii</i>	1	2	2	1.0
NYCTAGINACEAE	<i>Pisonia ambigua</i>	1	1	0	0.0
FABACEAE	<i>Platycamus regnellii</i>	1	1	3	3.0
FABACEAE	<i>Platymenia reticulata</i>	1	1	0	0.0
FABACEAE	<i>Platypodium elegans</i>	1	8	16	2.0
ANNONACEAE	<i>Rollinia mucosa</i>	0	1	4	4.0
FABACEAE	<i>Senegalia tucumanensis</i>	0	3	6	2.0
FABACEAE	<i>Senna pendula</i>	1	1	0	0.0
SAPINDACEAE	<i>Serjania lethalis</i>	1	4	2	0.5
SMILACACEAE	<i>Smilax fluminensis</i>	1	5	2	0.4
MYRTACEAE	<i>Syzygium cumini</i>	1	1	2	2.0
BIGNONIACEAE	<i>Tabebuia roseoalba</i>	1	3	11	3.7
APOCYNACEAE	<i>Tabernaemontana catharinensis</i>	1	2	2	1.0
CANNABACEAE	<i>Trema micrantha</i>	1	4	8	2.0
MELIACEAE	<i>Trichilia birta</i>	1	2	0	0.0
POLYGONACEAE	<i>Triplaris gardneriana</i>	1	1	4	4.0
/	<i>Undetermined liana sp1</i>	0	1	1	1.0
/	<i>Undetermined liana sp2</i>	0	1	1	1.0
SAPINDACEAE	<i>Urvillea laevis</i>	1	1	0	0.0
VOCHYSIACEAE	<i>Vochysia tucanorum</i>	1	1	1	1.0
OLACACEAE	<i>Ximenia americana</i>	1	1	0	0.0
RUTACEAE	<i>Zanthoxylum sp.</i>	0	1	0	0.0

ANNEX 17: ARTHROPODS FUNCTIONAL DIVERSITY

Annex 17: Table of number of individuals of 4 interest groups within the fragments, allowing the calculation of the percentage of individuals identified in the interest group relative to the total number of individuals identified (310).

	Individuals (Number of individuals)
Spiders	85
Lepidopterans (caterpillars)	34
Ants	42
Scale insects	77
Total individual identified	310

ANNEX 18: INDICATORS OF LATENT VARIABLES

Annex 18: Indicators of latent variables used in the plspm model

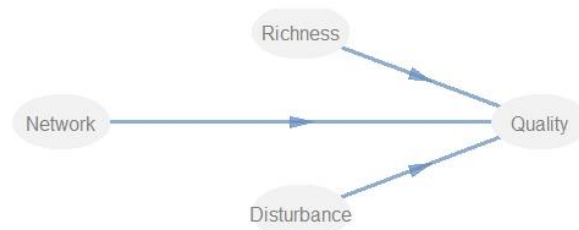
	Disturbance_index	Plant_richness	Arthropods_richness	Linkage_density
P1	-0.5	11.432	13.567	3.322
P2	-0.4	9.947	12.773	3.973
P3	0.8	12.857	12.828	3.207
P4	0.7	11.759	13.48	4.291
P5	0.4	15.459	13.444	4.771
P6	-0.2	12.016	13.482	4.087
P7	-0.6	8.7	12.404	2.702
P8	-0.3	8.44	12.848	3.864
P9	-1.2	13	10	2.650
P10	-0.5	13.594	12.864	4.609

ANNEX 19-21: PARTIAL LEAST SQUARE MODELLING CONSTRUCTION

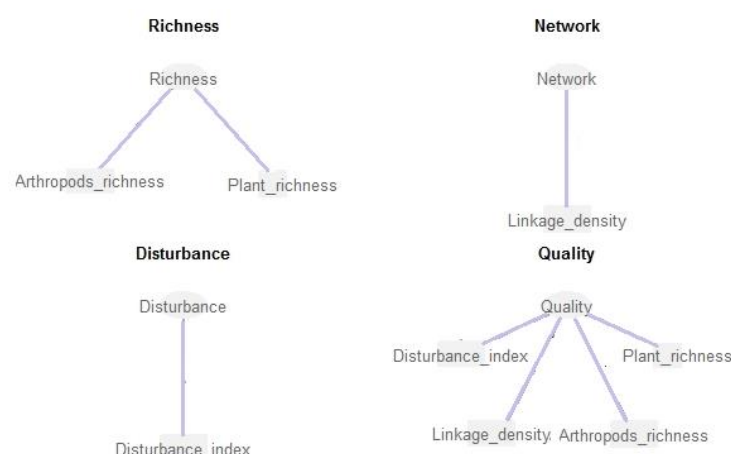
The PLS-PM is based on the construction of two sub-models: the internal model and the external model. The internal model indicates the links between the latent variables (**Erreur ! Source du renvoi introuvable.** Latent variables are variables that are estimated by groups of indicators. The relationship between these groups of indicators and the latent variables is defined by the external model (Annex 20).

We set up a higher order construct based on the repeated indicators approach to associate a secondary latent variable (Fragment quality) with the latent variables created (Richness, Network, Disturbance).

Annex 19: A priori internal model assumptions.



Annex 20: A priori external model assumptions.



The *plspm* package then calculates the model parameters to estimate the quality of the fragments. These parameters are calculated in several steps. First the initial weight of each indicator in the formation of the latent variables. Then the internal model is considered to recalculate the scores of the latent variables. The external weights can then be calculated in two ways: reflective or formative. Here the latent variables are formed by their indicators (Annex 18), so the formative mode was used to calculate the weights of each indicators, also called loadings.

ANNEX 21-23: RESULTS OF PLSPM PACKAGE

PLS models normally require a minimum number of samples, which corresponds to 10 times the number of links forming the model (Hair *et al.*, 2011). The duration of the internship did not allow such a large amount of field work to be carried out to have a sufficient data set for the construction of this model. Therefore, we present the results of the model in the Appendix section.

However, we still chose to build the model to show a method that could be used in future studies to assess the quality of forest fragments.

To check the structural assessment, the R^2 , the redundancy and the Goodness-of-Fit are calculated to measure the performance of the model (Sanchez, 2013), (Annex 21).

Annex 21: Indices obtained from the structural model assessment with the *plspm* package (a) Goodness-of-Fit (GoF) (b) R^2 determination coefficients (c) Redundancy

GOODNESS-OF-FIT
[1] 0.7382

(a)

SUMMARY INNER MODEL

	Type	R2	Block_Community	Mean_Redundancy	AVE
Richness	Exogenous	0	0.501	0.000	0.501
Network	Exogenous	0	1.000	0.000	1.000
Disturbance	Exogenous	0	1.000	0.000	1.000
Quality	Endogenous	1	0.567	0.567	0.567

(b)

(c)

Annex 22: Results of the inner model testing statistical representation of data by latent variables. P-value obtained for Richness, Network and Disturbance are significative (***) $p(H_0) < 0.001$.

INNER MODEL				
\$Quality	Estimate	Std. Error	t value	Pr(> t)
Richness	4.15e-01	1.41e-04	2.95e+03	1.03e-19
Network	3.72e-01	1.14e-04	3.27e+03	5.55e-20
Disturbance	3.62e-01	1.04e-04	3.48e+03	3.83e-20

Results of the structural model assessment show a strong model (Annex 21) and results of the inner model show the significance of the variables (Annex 22), but as we said more repetitions will be necessary to validate the model statistically.

Annex 23: Parameters obtained via the PLS-PM modelling, giving us scores of latent variables calculated for each plot and final quality fragment scores used to compare fragments.

```
> head(smp_pls$scores, n = 10)
```

	Richness	Network	Disturbance	Quality
P1	0.633	-0.600	-0.5366	-0.155
P2	-0.407	0.318	-0.3689	-0.184
P3	0.315	-0.761	1.6434	0.442
P4	0.633	0.765	1.4757	1.082
P5	1.457	1.443	0.9726	1.493
P6	0.694	0.479	-0.0335	0.454
P7	-1.019	-1.473	-0.7043	-1.226
P8	-0.689	0.163	-0.2012	-0.298
P9	-2.133	-1.547	-1.7105	-2.080
P10	0.517	1.214	-0.5366	0.472

ANNEX 24: TEST OF CORRELATION BETWEEN PLANT AND ARTHROPOD RICHNESS

Annex 24: Results of the Kendall's correlation test between plant diversity (X) and arthropod diversity (Y)
p-value=0.8618.

```
kendall's rank correlation tau

data: x and y
T = 24, p-value = 0.8618
alternative hypothesis: true tau is not equal to 0
sample estimates:
tau
0.06666667
```

ANNEX 25-29: DATA USED FOR THE WILCOXON TESTS

Annex 25: Data used for the construction of the boxplot of a Wilcoxon test with the type of fragment as group variable and plant specific richness as dependent variable.

Type of fragment	Plant richness
Gallery	11,432
Gallery	9,947
Gallery	12,857
Gallery	11,759
Gallery	15,459
Plateau	12,016
Plateau	8,700
Plateau	8,440
Plateau	13,000
Plateau	13,594

Annex 26: Data used for the construction of the boxplot of a Wilcoxon test with the type of fragment as group variable and arthropod specific richness as dependent variable.

Type of fragment	Arthropod richness
Gallery	13.567
Gallery	12.773
Gallery	12.828
Gallery	13.480
Gallery	13.444
Plateau	13.482
Plateau	12.404
Plateau	12.848
Plateau	10.000
Plateau	12.864

Annex 27: Data used for the construction of the boxplot of a Wilcoxon test with the type of fragment as group variable and linkage density as dependent variable.

Type of fragment	Linkage density
Gallery	3.322
Gallery	3.973
Gallery	3.207
Gallery	4.291
Gallery	4.771
Plateau	4.087
Plateau	2.702
Plateau	3.864
Plateau	2.650
Plateau	4.609

Annex 28: Data used for the construction of the boxplot of the Wilcoxon test with the level of abundance as group variable and host strength as dependent variable.

Host strength	Abundance	Host strength	Abundance	Host strength	Abundance
1.55	High_abundance	3	Low_abundance	0	Low_abundance
0.666666667	Low_abundance	1.304347826	High_abundance	0	Low_abundance
3	Low_abundance	2	Low_abundance	2.2	High_abundance
1	Low_abundance	1.333333333	Low_abundance	0	Low_abundance
0	Low_abundance	1	Low_abundance	1.5	Low_abundance
1.25	Low_abundance	0.5	Low_abundance	1	Low_abundance
1	Low_abundance	1	Low_abundance	0	Low_abundance
0.75	Low_abundance	2.5	Low_abundance	1	Low_abundance
0	Low_abundance	1.333333333	Low_abundance	1	Low_abundance
0.75	Low_abundance	3	Low_abundance	0	Low_abundance
4	Low_abundance	1	Low_abundance	1	Low_abundance
1	Low_abundance	2	Low_abundance	0.5	Low_abundance
0	Low_abundance	4	Low_abundance	0	Low_abundance
0	Low_abundance	3	Low_abundance	1	Low_abundance
0	Low_abundance	0	Low_abundance	0.166666667	High_abundance
2	High_abundance	1	Low_abundance	0	Low_abundance
0	Low_abundance	2	Low_abundance	1.333333333	High_abundance
1	Low_abundance	3	Low_abundance	1	Low_abundance
0.5	Low_abundance	0	Low_abundance	0	Low_abundance
0	Low_abundance	0	Low_abundance	3	Low_abundance
3.666666667	Low_abundance	0	Low_abundance	0	Low_abundance
1	Low_abundance	0.5	Low_abundance	2	High_abundance
1	Low_abundance	0	Low_abundance	4	Low_abundance
2.5	Low_abundance	1.5	Low_abundance	2	Low_abundance
3	Low_abundance	1.5	Low_abundance	0	Low_abundance
0	Low_abundance	1	Low_abundance	0.5	Low_abundance
0	Low_abundance	1	Low_abundance	0.4	High_abundance
1	Low_abundance	2.5	Low_abundance	2	Low_abundance
3	Low_abundance	2	Low_abundance	3.666666667	Low_abundance
1	Low_abundance	1	Low_abundance	0	Low_abundance
2	Low_abundance	0	Low_abundance	4	Low_abundance
0	Low_abundance	1	Low_abundance	1	Low_abundance
0	Low_abundance				

Annex 29: Data used for the construction of the boxplot of the Wilcoxon test with the nativity as group variable and host strength as dependent variable.

Nativity	Host strength	Nativity	Host strength	Nativity	Host strength	Nativity	Host strength
Not_native	0.667	Native	1.55	Native	1	Native	0
Not_native	0	Native	3	Native	2	Native	3
Not_native	1	Native	1	Native	4	Native	0
Not_native	0	Native	0	Native	3	Native	2
Not_native	0	Native	1.25	Native	0	Native	0
Not_native	0	Native	1	Native	2	Native	0.5
Not_native	0	Native	0.75	Native	3	Native	0.4
Not_native	0	Native	0.75	Native	0	Native	2
Not_native	3	Native	4	Native	0	Native	3.667
Not_native	1	Native	0	Native	0	Native	1
Not_native	2.5	Native	2	Native	0.5	Native	2
Not_native	1.333	Native	1	Native	0	Native	0
Not_native	1	Native	0.5	Native	1.5	Native	4
Not_native	1	Native	0	Native	1.5	Native	0
Not_native	2.5	Native	3.667	Native	1	Native	1
Not_native	2.2	Native	1	Native	2	Native	0
Not_native	0	Native	1	Native	0		
Not_native	0	Native	2.5	Native	0		
Not_native	1	Native	3	Native	1.5		
Not_native	1	Native	1	Native	1		
Not_native	0	Native	3	Native	1		
Not_native	1	Native	1.304	Native	0		
Not_native	4	Native	2	Native	0.5		
Not_native	2	Native	1.33	Native	0.167		
Not_native	1	Native	1	Native	0		
Not_native	1	Native	0.5	Native	1.33		
Not_native	0	Native	3	Native	1		