

Abstracts

Teses de Doutorado

PANSONATO, Marcelo Petratti

Drivers of tree similarity, distribution and abundance in two environments of the Atlantic Rainforest

Abstract: Understanding the drivers of change in species distribution and abundance in tropical and subtropical forests is one of the central themes in plant ecology. One of the most consistent pattern of ecological communities is the decay of similarity with geographic distance - the distance decay. However, different abiotic and biotic conditions may affect the patterns of distance decay, species abundance, and species distribution. In this context, the coastal regions of the Atlantic Forest represent a study system well suited to investigate these issues. In these regions, there are two contrasting environments that occur contiguous throughout the entire latitudinal extension of the Atlantic Forest: the restinga forests, considered a recent and harsh environment to plant development and dense ombrophilous forests, considered an old and less restrictive environment. In this study, we first evaluated the changes in composition of tree species along the geographic space and the factors that determine these changes, then we investigated how species populations vary in their abundances and distributions in these environments. In the first chapter we studied the relative effects of geographic distance, climate and species dispersal ability in two environments (which present edaphic and geological age contrasts) on tree species similarities between different sites in the coastal region of the Atlantic Forest. We found that similarity in species composition varies greatly among the environment types and the effect of different factors considered can change not only between the environments, but also between the northern and southern biogeographic regions of the Atlantic Forest. Although we expected the recent and harsher environment to have a more homogeneous species composition, we found a lower species similarity in this environment than in the old and less restrictive environment. The dispersal ability of the species contributed to increase the similarity between sites that are far from each other, as shown by their interaction with geographic distance. However, this relationship was found in the most recent environment in the southern sector of the Atlantic Forest and in the oldest environment of the northern sector. Our main conclusion is that studies that use only climate data and infer the effect of dispersal on similarity based only on the effect of geographic distance can overestimate the effect of climate. In the second chapter, we investigated how tree species populations vary in their local and regional abundances, and in their range of distribution in both types of environment. We also analyze if some functional traits of these species are related to the observed patterns. We found that differences in patterns of species distribution and abundance occur at both local and regional scales. We found a striking effect of edaphic and geological age differences on several species populations. Many species that occur with low abundance and/or have restricted distribution in the old and less restrictive environment may occur with higher abundances in the recent and harsh environment. The effect of functional traits was more pronounced on regional abundance than on local species abundance. The trait value that best characterized the species that occur with greater abundances in the most restrictive environment was the small leaf area. In the older environment, greater dispersion ability was related to wider regional distributions. We conclude that the lower species richness - metric often used in the delimitation of areas to be conserved - found in the more restrictive environment does not mean that it should not be prioritized, since large species populations that are not abundant in the richest

environment can be found in these less diverse environments. Our study has revealed some patterns that bring new information about the drivers that structure tree communities and populations of in tropical and subtropical forests. The use of this study system made up of two contrasting but contiguous environments in the Atlantic Forest allowed us to verify that interspecific differences in the dispersal ability of tree species is an important process for floristic relationships and should be considered in future studies. Finally, the conservation of Atlantic Forest tree species will benefit if priority is also given to environments associated with the coastal plains.

MELITO, Melina Oliveira

Effects of forest fragmentation on biomass in tropical forests

Abstract: In spite tropical forests are the most important terrestrial global carbon sinks due to carbon storage in aboveground biomass, it is also the primary target of deforestation. The conversion of Tropical forests into anthropogenic areas might disrupt biological flux and also lead to severe microclimatic changes at forest edges. These combined effects can trigger profound changes in plant composition through both high mortality of fragmentation-sensitive species and proliferation of disturbed-adapted species which will ultimately impacts carbon storage. Thus, our main objective in this study was understand the role of human-induced disturbances in modulate the dimension of biomass loss at tropical forests. We applied a systematic literature review searching for empirical evidences that edge effects can drive biomass loss in tropical forests (Chapter 2). Our findings highlighted the gap of knowledge about the pattern and process related to biomass loss in tropical forests. To strengthen this understanding, we formulated a conceptual model linking landscape structure and patch-level attributes to severity of edge effects affecting aboveground biomass. Our model hypothesizes that habitat amount, isolation, time since edge creation, and the synergism between edge distance, patch size, and matrix type are the main drivers of biomass loss in anthropogenic tropical forests. We thus used a large plant dataset (18 503 trees ≥ 10 cm dbh) from 146 sites distributed across four Mexican and four Brazilian rainforest regions to test our conceptual model predictions, specifically the influence of forest cover, site isolation, edge distance, patch size and type of matrix on biomass (Chapter 3). We observed that carbon-rich sites presented species that are typical of old-growth forests (shade-tolerant, large-seeded, zoocoric) contrasting to carbon-poor sites composed by disturbed-adapted species (pioneer occupying the understory). Large shade-tolerant trees (≥ 40 cm dbh) were impacted severely by the combination of forest loss and edge effects. Edge distance, patch size, and the amount of open-matrix strongly influence small shade-tolerant trees (≤ 20 cm dbh). Although our results do not fully corroborate the initial predictions of the conceptual model, they support the idea that landscape composition interact with patch structure and ultimately impacts biomass stocks in fragmented tropical forests. Finally, we further investigated if the disturbance level of the region influences plant-structure responses to forest loss (Chapter 4). Biomass, but not plant density, was affected by forest loss in regions with intermediate disturbance levels, i.e. regions showing a combination of moderate deforestation (20-40% of remaining forest cover) disturbed during the past 30-60 years, high defaunation but harboring relictual populations of large-mammals, and areas mostly composed by heterogeneous matrices. In general, our findings highlight that both landscape composition and patch structure are the main drivers of biomass loss in Neotropical forests, and that the landscape context must be considered to obtain more reliable estimations of carbon emissions due to forest degradation. Landscape planning (e.g. restoration of forest cover) should be included in conservation strategies in order to sustain carbon storage. Moreover, we advocate that conservation initiatives will be less costly and more effective if implemented in areas under intermediate disturbance levels.

BERTONCELLO, Ricardo**Ecological restoration and structuring processes of plant communities**

Abstract: Interspecific interactions are considered to be important structuring forces in early successional vegetation. Whereas competition seems to prevail in less severe environments, facilitation tends to increase in importance in harsh environments. Hence, facilitation is expected to play an important role in degraded tropical areas with high irradiance, heat loads, and evapotranspiration, where conditions are far from optimum for most forest species. Moreover, in order to understand complex structuring process of high diverse tropical forests, ecologists have realized the need for simplification. A promising way to do that is through the use of functional traits, which can be measured for any species and compared in different systems and different locations around the world. However, in these conditions, little is known about the role of species interaction on the relation of functional traits and species performance. In this scenario, we planned a restoration project on the southeastern Brazilian coastal plain to compare growth and survival of tree seedlings planted at two densities (isolated or aggregated) in a factorial experiment with nutrient addition. In the first chapter we analyzed survival, height, ground level diameter, and crown projection of 4,132 saplings from 19 species that ranged along a successional gradient, over an 18-month period. We used mixed-effect models to analyze the relationship between species performance and treatments, and Akaike's information criterion (AIC) to select the models. The best model showed higher survival in aggregated plantations (indicating facilitation) for non-pioneer species. In contrast, we found lower diameter growth in aggregated plantation (indicating competition). Fertilizer addition did not affect survival in clusters, but, surprisingly, it had a negative effect on isolated plants of both pioneer and non-pioneer species. On the other hand, fertilizer addition had a positive effect on diameter and crown projection growth in aggregated plantations (reducing competition), especially for pioneer species. Thus, whether facilitation or competition was the predominant interaction depended on the response analyzed. We concluded that, as establishment of non-pioneer species in disturbed sites can be challenging, restoration designs could take advantage of higher survival rates in clusters and use resource addition to ameliorate growth and decrease competition for limited resources. In the second chapter we used the core simple-measurable traits to investigate whether functional traits were related to growth and survival and whether there was a difference in the effect of the functional traits on plant performance of isolated individuals or of individuals subjected to interaction with neighbors. Our main findings were that for pioneer species, the greater the specific leaf areas (SLA), the greater the survival rates, but, under aggregated conditions, the greater the SLA the lower the survival rates. However, functional traits only partially explained saplings performance in a restoration context and more research is needed to understand its role in predicting seedlings outcomes, especially considering the potential applicability of this methodological approach. The manipulative character of ecological restoration broadens perspectives to use experiments to generate and test new hypotheses in ecology and to refine restoration models.

ROCHA, Diogo Souza Bezerra**Plant diversity in Atlantic Forest in southern Bahia: an evaluation of the environmental effects on the composition and structure of the tree community**

Abstract: The Atlantic rainforest is distributed over a wide latitudinal range, including altitudinal gradients, with altitude representing an indirect interference variable in vegetation patterns as a function of the variability of abiotic conditions (e.g. decrease of temperature and the availability of nutrients in the soil and increased rainfall). Therefore, this study aimed to evaluate the variation of

environmental factors and to determine what are its effects on the composition and structure of the tree communities at different altitudes. The first chapter presents a literature review of the main patterns of changes in vegetation composition and structure in altitudinal gradients of tropical montane forest. Abiotic variability among different altitudes were mainly characterized by decrease the temperature, even at small distances, related to a reduced diversity and height of the forest with increasing altitude. The second chapter presents a description of the variability of microclimate, from data of temperature, precipitation, vapor pressure deficit recorded in two altitudinal quotas from three montane forests in northern Atlantic rainforest. The microclimate in the region was characterized by intense rainfall throughout the year without a marked seasonality and a temperature reduction with increasing altitude. In the third chapter, we present an analysis of the relative importance of environmental factors (climate, topography and edaphic composition) and space influencing the richness, diversity and species composition patterns of tree communities of these montane forests in northern Atlantic Rainforest. We found 519 species in 5680 individuals sampled. Increases of the number of individuals and decreases in species richness along an increase in elevation were recorded. The reduction of diversity in relation to altitude was observed when considered a same locality, which was probably explained by role of topographic factors on a smaller scale, which shape diversity in different ways in each locality.. The topography and soil factors were both important to determine changes in species composition The spatial structure had no effect on the species composition. The areas at 500 m altitude presented weather and species composition more similar among the mountains while the areas at 800m were more distinct regarding the same factors. In addition, we observed greatest differences in species composition between sites of the same mountain than between sites at the same altitude in different mountains.

JURINITZ, Cristiane Follmann

Population ecology of two tree species in forest fragments in Southeast Atlantic Plateau

Abstract: One of the greatest challenges of ecology is to understand and predict the fluctuations in the biological populations. When we consider the human intervention in this understanding, we can, at the same time, make predictions about the future of the populations and understand better their natural processes of regulation and control. In this work we carried out a study about the ecology of populations of two shade tolerant tree species (*Guapira opposita* (Vell.) Reitz, that occupies the canopy and *Rudgea jasminoides* (Cham.) Müll.Arg., that occupies the understory) to answer the question of how the structure, population dynamics and seedling performance respond to environmental heterogeneity caused by disturbances related with fragmentation and secondary succession. In the first chapter we tested if the population structure, measured by size distributions, is related to the size and/or to the successional stage of the fragment. From the conclusions generated in this first study, in the second chapter we evaluated if population dynamics parameters, such as asymptotic growth rate and vital rates explain the variation in density and structure. In the third chapter we tested if the seedling performance of these species is affected by canopy openness and litter depth, which are known promoters of environmental heterogeneity in secondary forest fragments. In order to achieve this goal we marked and followed by two years (2007- 2009) populations of both species in six secondary forest fragments of different successional stages in the Southeast Atlantic Plateau. Regarding the population structure, *Guapira* showed variation associated to the degree of forest structuring, while for *Rudgea* the fragment size was the most important explanatory variable, what lead us to hypothesize that *Rudgea* is in risk of local extinction in the medium fragments. Regarding the analysis of population dynamics, *Rudgea* showed a population doubling time in the medium fragments 4.5 times greater than in the large ones, what lead us to conclude that this risk of local extinction can be mitigated or even reversed. For *Guapira*, the rates did not differ between the successional stages, being predicted stable populations in both (955;8776;1).

The analysis of the effect of the canopy openness and the litter depth in the seedling performance showed the importance of the interaction between these factors and the relevance of considering the different seedling ontogenetic stages. Through a new approach, we demonstrated how important is to consider complementary studies (structure and dynamics) in order to really understand what happens at population level. Besides, we highlight the importance of studies with dynamics in order to elucidate the demographic mechanisms that occur in each population. This knowledge is a fundamental tool for planning more directional management and conservation actions.

Dissertações de Mestrado

BEL, Renan Lucas Siena Del

Tree recruitment in a restinga rainforest: Influence of functional neighborhood and soil

Abstract: While biological communities are complex systems in which numerous mechanisms act in different scales and different processes can generate the same pattern, one way to answer questions regarding the assembly of plant communities is to find correlations between environmental patterns indicative of underlying niche processes with the emerging patterns of a community. Because of that, it is essential to keep developing our understanding on how to represent the niche processes and how to better assess the community structure. In this dissertation we investigate how different environmental variables contribute to our understanding of niche processes. In particular, we are interested in how variables of biotic or abiotic nature interact and contribute to the pattern observed in the structure of the community, and whether the integration of these components is important in identifying the processes involved in community assembly. We use the spatially explicit leaf traits distribution of young (recruited in the last 10 years) individuals from a restinga in Ilha do Cardoso to represent the resulting pattern of the assembly processes, as well as data collected in 2009, to rebuild the neighborhood in which these individuals were recruited. We found that different combinations of biotic and abiotic variables explain different leaf traits distributions, but when we include the young individuals species as a random factor in our models, our results point for no correlation between environmental variables and leaf traits. Because of these conflicting results we infer that while both biotic and abiotic variables work together as predictors of the structure of the community, they do so via species distribution, which is in turn, correlated to an individual's leaf traits values. Thus, environmental variables are only informative when we have no information about the identity of the species. Based on our results, we propose that both types of variables (biotic and abiotic) must be used together when trying to assess the niche processes in a community, as both may be complementary and sometimes interact to form a more complete picture. Together our results open some lines of investigation that may further our knowledge over the mechanisms behind the tree community assembly and may inform future work in the field in order to achieve a better resolution in structure analyses.

SOUZA, Luanne Caires da Cruz

Facilitation and competition in coastal dunes: meta-analysis of determinants of plant interactions

Abstract: Plants established next to other plants may have their performance positively or negatively affected by their neighbors, which characterizes interactions of facilitation and competition,

respectively. Facilitation and competition, however, may occur simultaneously and understanding which one predominates in pairwise interactions under different ecological contexts is important to comprehend the structure of plant communities. According to the stress-gradient hypothesis (SGH), facilitation is expected to prevail in more severe environments, but the outcome of interactions may change depending on features of interacting individuals, such as life form and ontogenetic stages. As harsh conditions and high diversity of plant life-forms are characteristic of coastal dunes, the amount of studies about plant interactions has been rapidly increasing in these ecosystems, with apparent divergent conclusions. However, until now, there is not a systematic and quantitative synthesis about the factors affecting the net outcome of facilitation and competition in these ecosystems. We conducted a meta-analysis to investigate the effects of environmental stress and the simultaneous influence of plant life form and ontogenetic stage on the outcome of facilitation and competition in coastal dunes around the world. We used four performance measures to estimate the outcome of interactions: abundance, survival, growth, and reproduction. Contrary to what was expected by SGH, we found that negative impacts of neighbors on plant reproduction increase towards more arid conditions, but this effect was not observed for other performance measures. Our results also indicate that woody neighbors facilitate the survival of woody seedlings and the reproduction of herbs, while herbaceous neighbors facilitate the growth of other herbaceous plants. Overall, the outcome of plant interactions in coastal dunes depends on the performance variable measured and on both environmental conditions and plant features, indicating an interaction between these factors. Such interaction and different mechanisms underlying facilitation and competition should be more investigated in the future. The global scale of our meta-analysis supports generalization of important processes of succession and conservation in coastal dunes. Benefits of woody neighbors to the survival of woody seedlings corroborate the concept of successional feedbacks in the beach-inland physiognomic gradient, and our results reinforce the use of nurse plants in coastal dunes as a valuable tool to restoration of these endangered ecosystems.

SANO, Bruno

Relationship between functional traits and performance of native tree species in restoration planting

Abstract: In degraded environments, ecological restoration aims to accelerate the process of ecological succession. The most widely used technique for restoration of degraded environments is the planting of seedlings. The selection of species is crucial to the success of the restoration projects, because the species need to establish and grow under the harsh conditions of the environment. Using the approach of functional traits can be a promising tool to assist in the selection of species in restoration projects. In forest environments, there is evidence that functional traits affect the performance of the species, however, there are few studies conducted in areas undergoing restoration. In this study, the relationship between the functional leaf traits and the relative growth rate in height and in diameter at ground level of native tree species planted in a degraded area that is being restored was evaluated. To describe the relationship between the functional traits and the relative growth rate (RGR) of individuals, we used the approach of model selection based on linear mixed effects models (LMEM). The selection of models was performed using Akaike's Information Criterion (AIC). The functional traits showed no relationship with the relative growth rate in height and diameter of the individuals of the species, possibly due to differences in environmental conditions between forest environments and degraded environments. Despite not finding a relationship between the functional traits and the RGR, the most plausible model selected indicates that larger individuals at the beginning of monitoring have lower relative growth rates in height, that is, taller individuals have lower rates of growth in height. Considering that no relationship between the morphological functional traits and the relative growth rate in an area undergoing restoration was found, it is

reasonable to assume that this approach cannot be applied in all environments. Studies that assess functional traits of the leaf in the different stages of plant development in degraded environments can refine these analyses and help define whether the selection of species for restoration projects can be accomplished using the approach of functional characteristics.

PARMIGIANI, Renan

Functional diversity along a stress gradient: A case study in sand coastal vegetation

Abstract: Understanding processes underlying community assembly is one of the main questions in community ecology. The influence of processes such as environmental filtering and competition can be observed in patterns of functional diversity patterns in plant communities. Competition, through competitive exclusion, limits similarities in ecological strategies in a given community. Environmental filtering, on the other hand, constrains the species that can be established in a given community, restricting the functional diversity. One can reasonably predict that the influence of such processes changes across environmental gradients, where the environmental filtering will exert more influence in more stressful environments, whereas competition will exert more influence in less stressful places. This study aimed to understand the influence of environmental filtering and competition on functional diversity in a plant community across a stress gradient. We expected an inverse relationship between functional diversity and stress. The stress gradient studied occurs in the restinga of the Cardoso Island State Park (Cananeia, SP). We sampled 41 sites, in which we found 104 species of vascular plants. We measured three traits: life form, leaf area and leaf economic spectrum (LES). We represented the environmental filter using edaphic variables that represent restinga environmental restrictions. We used Grime's strategies classification (CSR), to extract the component related to competitiveness of each species, and therefore, calculated the competition community weighted mean (CWM) of each plot as proxy of competition. We built linear mixed models (LMM) to represent different hypothesis related to functional diversity and selected the best models by Akaike Criterion (AIC). We evaluated functional diversity through three response variables in the models: functional richness (FRic), functional dispersion (FDis) and CWM. In the model selection of CWM for each trait, FRic for life form and FRic for all traits were predicted by the environmental filtering. The FRic of LES, FRic of leaf area and all models of FDis had the null model as the most plausible, discarding the influence of competition and environmental filter in functional diversity. The fact that there is a concentration of abundance around certain strategies explains why there is no difference in functional dispersion. We infer that environmental filter restricts some strategies, reducing functional richness or displacing functional space of the communities. The absence of competition affecting functional diversity suggests that limiting similarity exerts little influence on community assembly in the studied gradient, or that the consequences of similarity limitation is compensated by other process.

ZIMBACK, Leticia Bolian

Which characteristics influence seed limitation in a tropical tree community?

Abstract: The seed limitation has been empirically investigated as an equalizing mechanism of the competitive differences between species that coexists in plant communities. In addition to the spatial limitation, the temporal variations of seed dispersal can also be important to the species coexistence. The aim of the study was to investigate the relation between spatial seed limitation and temporal seed limitation and the species characteristics that influence both limitations. In a coastal plain forest, the seed rain was sampled over 36 months in 40 traps (20 m²), 100 m distant from each other and from the forest edges. The generalized mixed-effect models approach was used to test the relation

between seed limitation and the average mass of the seeds, the dispersal syndrome, the trees local maximum height, and the adult trees distribution frequencies. The results show that the proportion of the analysed species spatial limited (90,3%) e temporal limited (70,9%) were high and the correlation between spatial seed limitation and temporal seed limitation were also high (Spearman = 0,8). To explain spatial seed limitation and temporal seed limitation were selected the average mass of seeds, the trees local maximum height and the adult trees distribution frequencies. Usually those relations indicate that species with larger seeds, lowest maximum tree height and lowest adult trees distribution frequencies are more limited spatially and temporally. Although these factors have been selected, there was a great variation in the effects of the species analysed. The study supports the fact that the spatial seed limitation mechanism is frequently found in tree communities and shows a temporal approach to the seed limitation study. The reduction of interspecific competitive interactions, due to the high seed limitation observed in the study, is opposed to widely accepted theories (Janzen-Connell) that indicates that the efficient seed dispersal mechanism are a strategy to minimize the intraspecific competition. The relative importance of dispersal mechanisms and seed limitation on mantaning diversity in trees communities should be studied to evaluate which situations or which species sets the coexistence is mediated by the absence of intraspecific or interspecific interactions.

NOVARA, Luisa

Disturbance effect on life strategies: evolutionary and ecological dynamics

Abstract: Disturbance events impact life strategy diversity in communities and life strategy evolution in populations. In the field of Ecology, disturbance occurrence is studied while an environmental factor that alters resource availability and populations abundance, causing competitive exclusion of less favorable life strategies depending on disturbance frequency and intensity. In the field of Evolutionary Biology, disturbance is evaluated as a pressure, depending on its spatial and temporal regularity, that determines the intensity of species' evolutionary response and, as a consequence, the adaptation towards the fittest life strategy. Although there is a separation between these two fields of knowledge, ecological dynamics influence evolutionary dynamics and the other way around. Studies that mix Ecology and Evolution are becoming more common, but few or none of them takes disturbance in consideration. Here, we use an individual-based model to generate contexts in which adaptation and competitive exclusion might act apart and together in order to understand how disturbance determines life strategies that occur in communities under ecological, evolutionary and eco-evolutionary dynamics. In the model, life strategy is an inheritable character defined for a trade-off between longevity and fecundity. Simulations from the evolutionary context were composed by one population under mutation acting, simulations from the ecological context by various species without mutation and simulations from the eco-evolutionary context by various species with mutation occurrence. We observed that disturbance was positively correlated with fecund individuals preponderance in all contexts but that disturbance effect on life strategy diversity varied between the different contexts. In the evolutionary and the eco-evolutionary contexts, life strategy diversity increased with disturbance raise, while in the ecological context diversity decreased. This result evidences the mutation role as a source of new life strategy variants when there is a high renovation of individuals given by raised mortality. Only in the eco-evolutionary context there was an interspecific heterogeneity peak on intermediate levels of disturbance. In this scenario, species reproductive isolation, in contrast to populations panmixy, allows species to differ in relation to its life strategies. In parallel to this, the constant input of new life strategy variants by mutation prevents the definite extinction of life strategies from the system. Therefore, when disturbance level is intermediate, productive species as well as long-lived ones are able to coexist. Given that the different contexts resulted in varied patterns of life strategies' relative frequency, this study

evidences the importance of studying disturbance effect on communities structure and dynamics unifying processes that are typically separated between Ecology and Evolution fields.

PEREIRA, Thiago Mitonori

Effects of nucleation on physiological responses of tree seedlings in an ecological restoration area

Abstract: Nucleation of seedlings is a technique for forest restoration in which is expected that the aggregated planting of seedlings increases the recruitment and establishment of species. This would occur because the growth of some species can provide better environmental conditions to neighboring plants. However, the aggregated planting can also intensify the competition for nutrients between plants. It is expected that the facilitating effects are greater for the non-pioneers species that are more sensitive to high light intensities and better competitors for nutrients. For pioneers that are tolerant to high irradiance and worst competitors, the nuclei must be unfavorable. The addition of nutrients can minimize the competition and then turn the nuclei more favorable, especially to the pioneer species. In order to evaluate the responses of seedlings to the nucleation and the addition of nutrients were measured the maximum photosynthetic efficiency (Fv/Fm) and the content of photosynthetic pigments. Foliar and soil temperatures were measured to assess the potential of nucleation to minimize extreme microclimates. The seedlings were planted in plots, each with a combination of type of planting in nucleus or line, and type of fertilizer applied, chemical fertilizer (NPK), topsoil or without fertilizer. The nuclei were composed of 13 seedlings of different species, 5 pioneers and 8 non-pioneer pioneers. The seedlings were separated from each other by distances of approximately 30 cm. Seedlings planted in lines were isolated from each other by 2 m. Seedlings planted in the nucleation system showed better conditions with greater Fv/Fm and chlorophyll a, b and total contents, indicating the facilitation effects of nucleation. Foliar and soil temperatures were lower in nuclei. Both pioneers and non-pioneers showed signals of photoinhibition, with values of Fv/Fm below of that considered as stress-free when were planted in both, lines or nuclei. Photoinhibition signals were higher for the group of non-pioneer with lower Fv/Fm values. Non-pioneers had lower ratio of chlorophyll a/b, evidencing their investment to absorb more light. However, the different effects of nuclei for pioneers and non-pioneer species were not conclusive, as well as the effects of the addition of nutrients. The present study provides evidence for the effect of facilitation in nuclei, adding more information to the beneficial effects of nucleation, providing aid for the recommendation of the use of this technique in projects of ecological restoration. No evidence that planting in nuclei is harmful to pioneer or non-pioneer were found, thus justifying the planting of mixed nuclei.

VENDRAMI, Juliana Lopes

Functional diversity in a restinga forest

Abstract: Understanding the processes underlying the origin and maintenance of species diversity in communities is a central goal in ecology. Among the numerous processes proposed to explain the organisms' diversity, we can highlight environmental filter and limiting similarity. Environmental filter operates by restricting the variation and distribution of organisms in a given environment, while the process of limiting similarity acts by pressing differentiation in the organisms' characteristics, because the coexistence of individuals depends on difference in resource utilization. The functional approach has been used to test the processes responsible for species coexistence and consists in the comparison of species functional similarities in a community through their traits. The combination of

different traits in an organism defines its ecological strategy and, therefore, their distribution on habitats. Restinga forests are suitable to test species coexistence hypotheses in communities, because it presents a well marked environmental gradient, which is defined by resource availability. Thus, this study aimed to evaluate: i) the effect of soil condition (drained and flooded) on functional traits and on ecological strategies of restinga trees species and, ii) the effect of functional traits on plant's habitat preference. We conducted this study in an area of high restinga at Cardoso Island (SP), which comprises two soil types: drained and flooded. We collected five functional traits (leaf area, specific leaf area, leaf thickness, leaf dry matter content and wood density) of 44 tree species. We selected 30 individuals of each species, 15 in each soil type. We used model selection for statistical analyses, being linear models to assess soil type effect on trait and ecological strategies variances and linear mixed models to assess ecological strategies mean values. We found soil effect on the coefficients of variation of leaf dry matter content (LDMC) and of specific leaf area (SLA), which was higher in the flooded soil. In the case of SLA coefficient of variance, the effect was only significant when we excluded the palms from analyses. We found no soil effect on the other functional traits and on ecological strategies variation, neither on ecological strategy type. As for the results, it was found that in the flooded soil, limiting similarity is the dominant process structuring this community. This result differs from those reported by other tropical forests researches. We found no effect of traits and ecological strategies on habitat species preference, with the exception of LDMC and SLA coefficients of variations. Again, for SLA coefficient of variation, the effect was only significant when we exclude *Euterpe edulis* (juçara palm) from analyses. This result reinforces the importance of phenotypic plasticity to define species occurrence in different habitats.

MELLO, Thayná Jeremias

Biological invasion in oceanic island: the case of *Leucaena leucocephala* (Leguminosae) in Fernando de Noronha

Abstract: Biological invasions are among the main causes of biodiversity loss on the planet. Isolated environments such as oceanic islands and disturbed environments are considered more prone to invasion. For plants, the invasion success may be related to advantages in competition with native species, which may occur through the production of allelopathic substances. Among the 100 most invasive species on the planet is the legume *Leucaena leucocephala*, which produces substances with putative allelopathic effects and is established on tropical oceanic islands worldwide. In Brazil, the invader was introduced on the island of Fernando de Noronha, where it occupies vast areas. Despite the relevance of this island for biodiversity conservation, important information for the management of the invasion, as its extension and determinants, do not exist. In this work we use experiments to investigate allelopathy as a mechanism associated with the invasion and to evaluate the effect of *L. leucocephala* on the establishment of *Erythrina velutina*, a native species common on the island, but often absent from invaded areas. We found no evidence of allelopathic effects of *L. leucocephala* in the germination of *E. velutina*, but the exotic reduced the growth and survival of the native. The negative effect is enhanced when *L. leucocephala* is associated with *Capparis flexuosa*, the only native species often found in heavily invaded areas. When alone, the effect of *C. flexuosa* on *E. velutina* varies from positive to neutral, indicating that the balance of interactions between native species is altered in the presence of an exotic. Additionally, we describe the current distribution of *L. leucocephala* and its expansion in the last 20 years in Fernando de Noronha. We also investigate the environmental and anthropic factors determining the invasion and the impact of *L. leucocephala* on the plant community. We found that *L. leucocephala* is widely distributed throughout the island, densely populating most places where it occurs. The area occupied by the species increased about 40% in the last 20 years, and there are no environmental restrictions for the establishment of exotic, although it is favored by farming. In invaded areas, the number of dominant native species decreased

by almost half and we observed a tendency towards homogenization of the community. It is likely that the high degree of human disturbance in Fernando de Noronha poses dispersal limitations and modifies the environments making them unsuitable to the establishment of natives. However, there are strong evidences that *L. leucocephala* is driving ecological changes on the island that influence in native species loss. Considering the biological importance of Fernando de Noronha, actions to control the expansion of exotic and to restore the invaded areas are urgent.

FREY, Gabriel Ponzoni

Phylogenetic structure and demography of trees in a coastal Brazilian white sand forest

Abstract: One of Ecology's biggest goals is to explain the patterns of species' diversity and to understand the processes that generate and maintain this diversity in natural communities. Classical competition theory predicts that two species will be able to coexist only when there is divergence in the use of resources, i.e., competition imposes a limiting similarity among species that allows co-occurrence of species with divergent ecological strategies. On the other hand, the physical environment may impose restrictions to the range of possible ecological strategies of species. Environments with limited resources or adverse conditions will allow the survival of species with more specific strategies, a process known as environmental filtering. These two processes will generate opposite effects on the structure of communities, as more similar or more different ecological strategies will be selected. There is still the possibility that both processes are occurring simultaneously, or neither are important for the community. In both cases, a neutral or random pattern is expected. Using the proportional contribution (elasticities) of the three demographic vital rates - survival, growth and fecundity - to the finite rate of increase of population as a mean of inferring the ecological strategy of trees in a community, we intended to answer the question: "What process is responsible for the structuring of tropical tree communities?". Data was collected in a Restinga forest 10.24 ha permanent plot. All individuals with more than 15cm of perimeter at breast height were marked, identified and had their diameters at breast height registered for two censuses. Elasticities of the three vital rates for 89 tree species were obtained with an Integral Projection Model (IPM). IPMs are modern tools more robust than classical matrix models, commonly used in demographic studies. We defined an ecological space in the triangle where ecological strategies are plotted according to elasticities of the three vital rates. We also generated a molecular phylogeny based on *rbcL* and *matK* chloroplast markers, and used it to obtain the phylogenetic distance between all pairs of species. We calculated the phylogenetic signal of ecological strategies using the correlation between ecological distances in the ecological space and phylogenetic distances. We assumed ecological strategies to be conserved in the phylogeny. Species could be classified into four demographic groups in ecological space, distributed mainly in a growth-survival axis. This is expected for trees. No phylogenetic signal was found for the ecological strategies. This can mean that either both processes are structuring this community, or neither is important. Our study uses a new methodological approach and presents new results that contradict recent literature, on which environmental filtering is repeatedly accounted as the main process structuring tropical communities. Confirmation of this pattern for other communities may bring further understanding of structuring of tropical communities.

ZANELATO, Daniela

Tree communities in restinga forests: the role of trade-offs and natural enemies in the regeneration niche

Abstract: The objective of the current research was to investigate if the existing patterns in the adult tree communities can be generated by differences in the aspect related to the regeneration niche of species. Our model of study were two restinga's forests located at the Cardoso Island, on the South coast of São Paulo state. The tall resting forest (TRF) is an older formation, geologically speaking, and it has closer canopies than the short resting forest (SRF). In the first chapter, we investigated if the abundance inversions of adult trees existing between the TRF and the SRF could be generated due to the differentiated performances of these species at the stage of the seedling, due to the action of the environmental light filter. We assumed as a hypothesis that the species show a worst performance in the stage of seedling in the forest where they are less abundant as adult, due to a trade-off between growth and survival. We expected that the mortality by pathogens was the main cause for the mortality of plants in the more shaded forest. We achieved a manipulative experiment in field with six tree species, in which one-month-old seedlings after germination were transplanted in the two forests and in the nursery. We followed the performance of the species in the two studied forests for nine months. There were no differences in the performance of the two species, except the survival of the *Clusia criuva* (in the expected way) and of the *Tapirira guianensis* (opposite to the expected way). Different from what was expected, the main cause of the mortality of all the species was the severe herbivory, and it was not possible to observe a conflict between the growth and the survival of them. In the second chapter, we investigated if the differences in the size of the seeds among the zoochoric tree species can generate differences in the patterns of the adult community and if those differences occur due to an action of the environment lighting filter or only by the differences of the dispersion capacity of the species. We followed the seed rain of the zoochoric tree species for four years in both forests and we could check that the active dispersion capacity of them is negatively related to the size of the seeds, as it can be predicted by both the hypothesis (environmental filter and dispersion capacity). Besides, the relationship between the average production of seeds and the size of the seeds presented a triangular pattern, as species with big seeds always provide low productions. We compared the seeds average sizes and the range of the seeds sizes of the individual plants and of the adult species in both forests (DAP_> 5 cm. We could verify that the TRF presents average size of seeds and range of the seeds's sizes that were bigger than in SRF. Furthermore, the SRF floristic composition is nested in the TRF composition. Therefore, we assumed as a hypothesis that the differences in the dispersal capacity of species, plus the age differences of the forests, are responsible for the distribution of the seeds sizes of the adult plants present in both forests. Finally, in chapter 3, we made a literature review about the role of the soil microorganisms in the specific site of the regeneration of the tropical tree species. We found studies that focus only on the action of the fungi as far in positive interactions (mycorrhizal fungi) as in negative ones (pathogenic fungi). We discussed the main factors and the characteristics associated to the mortality caused by the soil pathogens, as well as the relationship proposed by the pioneer studies which were not confirmed nor tested.

CARVALHO, Gabriel Martins de

Influence of stochastic processes on the structuring of community in tabuleiros forest, Bahia, Brazil

Abstract: One of the central objectives of plant ecology is understand the factors that favor the coexistence of large numbers of species in tropical forests. Previous studies have indicated that species substitution (beta diversity) may explain the high diversities (alfa) seen in these forests. Both determinist and stochastic processes can determine species distributions, thus affecting the substitution rates of species in those communities. Within this context, the present study evaluated variations in the composition and abundance of tree species, as well as their morphometric attributes (diameter and height), between two habitat types in Tabuleiro Forests. Tabuleiro Forests occur on

wide coastal plateaus cut by occasional valleys. Edaphic and light regime characteristics vary between these two topographic units, so that the tree communities in each would be expected to be different. A total of 1810 arboreal individuals of 349 morphospecies DAP > 5 cm were sampled in ten 0.1 ha sampling plots. Comparisons were made between the plateau and valley habitats in terms of their arboreal composition, structure and physiognomy. Additionally, the occurrence of possible indicator species in these habitats was examined. The most abundant species on the plateaus were *Manilkara multifida*, *Eugenia rostrata*, *Rinorea guianensis* and *Paypayrola blanchetiana*, while *Actinostemon verticillatus*, *E. rostrata*, *P. blanchetiana* and *Helicostylis tomentosa* were most abundant in valley sites. We observed a high turnover of species among the plots, even within the same habitats, without the occurrence of characteristic suites of species in any of them. No significant differences were observed between the two habitats in terms of total abundance, diameters, tree heights, or total basal areas. Only *Croton macrobothrys* among the 349 species sampled demonstrated any significant association with valley habitats. The species distribution patterns observed suggests that neutral mechanisms operate in structuring these communities, and that the bulk of the species observed showed no discernible niche differentiation along the environmental gradient analyzed. Differences were observed in the abundances of the species among the habitats, however, exclusive species of a certain habitat were not observed.

VAZ, Marcel Carita

Diversity of ecological strategies of the dominant tree species from a terra-firme forest in Central Amazonia

Abstract: Plants have several ways to solve their problems such as resource limitation, herbivory damage or water loss. How a plant solves one of these problems can be considered a tactic and all the tactics together constitutes an ecological strategy. The strategies are possible only because plants have a series of traits that directly affect ecological performance of these plants. These functional traits, therefore, reflect the ecological strategies of species. Based on this rationale, we described the 157 dominant tree species in a terra firme forest of Central Amazon according to thirteen functional traits (among leaf, vegetative and regenerative traits). Our goal was to simplify the ecology of tropical forests, so far focused on species identity. Since these forests have a lot of species that are in general very rare, the patterns of species composition of these communities are very complex and unclear. By shifting focus to diversity of strategies, instead identities, we unveiled an interesting pattern of dominance among the strategy types: Although there are eleven different types of strategies in the forest studied, 61% of the species were of only one type. In addition to a greater number of species, only one type responded by 52% of the tree biomass of the forest sampled, which indicates that this is the optimal strategy. However, as the dominance does not vary considerably between species, it is possible that the benefit generated by the use of the optimal strategy is offset by the number of species who also use this strategy. We conclude that the neutral pattern found in the distribution of dominances among species and the dominance pattern found among the types are mainly the result of peculiarities of the species set, in particular the large number of the two most common strategies. But how so many similar species can have been originated? To answer to this question, we tested three hypotheses: 1) the rate of speciation was greater than the rate of ecological divergence; 2) species converged recently or evolved parallelly; and 3) allometric relations or tradeoffs between traits restricted the diversity of strategies. We found evidences that partially support these three hypotheses. As phylogenetic diversity was lower than ecological diversity, it is possible that the species studied resulted from recent speciation, which is compatible with the refuge theory. According to this theory, several species would have originated in Pleistocene refuges during the glaciations, which might have enhanced rates of allopatric speciation that was not necessarily followed by ecological divergence. On the other hand, the positive effect of phylogenetic signal in

strategy diversity reveals that current species ancestors were ecologically more different from each other than current species are. This indicates that there was a recent convergence of strategies, which is consistent with the hypothesis of Lake Amazonas, which covered the area studied until the early Pleistocene. The large relative amount of silt in the soil of the studied area strengthens the suspect that the bed of this Lake should have provided a great ecological opportunity for species that were adapted to drier and poorer soils. Finally, we found evidence that only the diversity of strategies linked to leaf traits is severely limited by tradeoffs and allometric relations.

STUART, Julia

Do nitrogen fixing legumes facilitate other tree species in a Restinga Forest?

Abstract: Many studies have been proving the importance of positive interactions to the distribution and diversity of species in plant communities. Positive and negative interactions occur simultaneously and the net effect of a species on another is the product of these combined interactions. The objective of the present study was to evaluate if nitrogen fixing legumes facilitate other tree species in a nitrogen poor environment. We studied the effect of the presence of legumes on the density of species and individuals belonging to two different layers ($DBH > 1$ cm and $1 \leq DBH \leq 10$ cm) around them and also patterns of spatial association between the legumes and other tree species, using a null models approach. The results obtained were dependent on the legume species considered. In chapter 1, the legume *Balizia pedicellaris* (DC.) Barneby & J.W.Grimes presented higher species density around it, for both layers, although there was no effect on the density of individuals. The species *Ormosia arborea* Harms did not present effect on the density of species and individuals around it. For the first layer *Andira anthelmia* (Vell.) J. F. Macbr. did not show effect on the densities, but this species presented a negative effect on the density of species and individuals of the upper layer ($1 \leq DBH \leq 10$ cm), in opposition to our hypothesis. In chapter 2, the spatial association patterns were also distinct between the legume species that showed different species identity associated and different kinds of association (positive or negative). The results indicate that, in spite of belonging to the same functional group, the legumes influence the species around them differently, depending on their morphological and physiological characteristics, as the ability to fix nitrogen in some systems or even the ability to produce allelopathic compounds.

LACERDA, Victória Duarte

Structure and vegetation composition of a herbaceous-shrub mussununga in southern Bahia, Brazil

Abstract: Mussununga is a vegetation type present in the Atlantic Forest, occurring on tablelands in the north of Espírito Santo and southern Bahia. This vegetation occurs on patches of white sandy soil embedded within forest areas and retains physiognomies similar to restinga vegetation. This work was performed in a herbaceous/shrub Mussununga area in southern Bahia, Brazil. Part of this area was subjected to a disturbance in the past due to the cultivation of *Cocos nucifera* L., however the cultivation was abandoned. The aim of this study was to analyze the structure and composition of this plant community and evaluate the floristic relationships with other areas. The first chapter covers only the area with no evidence of recent disturbance. The structure and species composition of this area was described and a floristic analysis was performed to verify similarity patterns among 20 physiognomic similar areas occurring on white sand soils on the Atlantic Coast of Brazil. We found 76 species in 37 botanical families and the richest families were Fabaceae, Orchidaceae and Myrtaceae. The diversity was low ($h' = 2.53$ nats), however the area presented a large environmental

heterogeneity. Floristic analysis showed a strong spatial correlation and low correlation with environmental variables. In chapter 2, a portion of the area without evidence of recent disturbance was compared to a portion of disturbed area based on richness, diversity, composition and the distribution of functional groups. Richness and diversity were similar in both areas, however there was a remarkable difference in species composition. The most abundant species in both areas was *Renvoizea trinii* (Poaceae). The aggressive species *Pteridium arachnoideum* (Dennstaedtiaceae) increased considerably in the disturbed area. Functional groups showed significant differences in their mean coverage in each area.

MORAES, Adriana de Olinda

Effect of anthropized matrices on the epiphyte community of understory in forest fragments of Southern Bahia, Brazil

Abstract: The landscape mosaic of the southern state of Bahia consists of forest fragments, pasture areas and shaded cacao (*Theobroma cacao* L.) plantations (cabruca). The cacao agroforestry matrix is considered efficient to the conservation of several species compared to the other agricultural systems, because it preserves large trees of the original forest. Therefore, we investigated the influence of the both matrixes on the community of vascular epiphytes and hemiepiphytes richness and abundance in Wildlife Refuge - Una Biological Reserve (Revis-REBIO), Una, Bahia, Brazil. Eight plots (10 x10 m) were installed at the edge (5-10 m) and eight plots in the interior (100 m) of four fragments with cabruca matrix and four fragments with pasture matrix. A total area of 12.800 m² was sampled. All trees with circumference at breast height (CBH) \geq 5 cm the circumference were measured and the number of epiphytes and hemiepiphytes was counted up to three meters tall. We sampled 10.557 trees and 4.057 were phorophytes that housed 57 species of epiphytes and 30 of hemiepiphytes, distributed in 20 families. A total of 7984 individuals were sampled. The family with the highest number of species was Araceae (20 spp.) and the most abundant species was *Philodendron surinamense* (2.150 individuals). About matrix influence, the interior of fragments surrounded by a pasture matrix had the highest values of abundance and richness of epiphytes and hemiepiphytes. The abundance of epiphytes was significantly higher ($p < 0,001$) in the fragments with pasture matrix. Hemiepiphytes were also more abundant within fragments with pasture matrix. The fragments inserted into the pasture matrix had significantly ($p < 0,02$) more species than the fragments immersed in the cabruca matrix. For hemiepiphytes, the plots of the interior of the fragments had significantly ($p = 0,0007$) more species than the edge plots. The edge of fragments inserted in pasture matrix had a higher average number of trees than the interior and in plots inserted in the interior of fragments with cabruca matrix, there were a higher average number of trees than the edge. The largest circumferences and the largest number of phorophytes were in fragments with pasture matrix. Overall, in cabruca matrix fragments, the epiphytes and hemiepiphytes occurred on the phorophytes with the larger perimeter and on interior of pasture matrix fragments, the epiphytes occupied the trees with larger perimeter and hemiepiphytes occupied both the edge and interior, trees with the larger CBH. The sampling units were not grouped within the same condition. *Anetium citrifolium* was an indicator species of the interior of fragments in the pastures matrix.

SALLES, Maysa da Costa Lima

Linear edge effects of different ages on the composition and structure of the shrub-tree community in the Atlantic Forest

Abstract: Forest fragmentation reduces the total area covered by the forest and exposes the plant community to edge effects, even if the edge is a linear opening. Besides, environmental factors associated to disturbances, such as fragmentation and topographical features, are some of the factors that determine community change. Hence, the aim of this study consisted in evaluating the effects of linear edges with different ages (30 and 200 years) and the influence of environmental factors associated with them on the plant community of two forest layers of an Atlantic rainforest area located in the state of Rio de Janeiro, Brazil. Data concerning community structure and composition were compared between the different locations within the studied area, from which both slope and altitudinal interactions were evaluated. We suggested that the plant community of the Tinguá Reserve is under edge effects, but that these are less intense given that the impacts have been buffered by the formation, along the years, of a secondary vegetation layer, associated with an adjacent forest matrix and the absence of stochastic events. The older edge (200 years) had a lower richness and a different plant composition from the other locations. It suggests that the tree and shrub community may be under the influence of permanent damages from edge effects. The more recent edge (30 years) could be in a period of transition which the early successional trees, that reproduced immediately after the edge creation may reach the adult stage, near by the other tree species, and they constitute the upper stratum of the forest. The altitudinal and slope variables influence in some way the floristic composition, but other associated variables must be considered for a more precise evaluation.

PANNUTI, Márcia Ione da Rocha

Aspects of spatial pattern, habitat association and herbivory density-dependent of *Calophyllum brasiliense* Camb. (Clusiaceae) in restinga alta forest, Ilha do Cardoso, Cananéia. SP, Brazil

Abstract: Several theories, including different factors and mechanisms, have been postulated to explain the high tree species coexistence in tropics, which remains an unsolved question that continues to pose a challenge to plant ecologists. Population-level tree dynamics studies contribute to a better understanding of the processes acting on community-level. The aim of the present study was to investigate some aspects related to the dynamics of a common tree species, *Calophyllum brasiliense* Camb. (Clusiaceae), in a Restinga Alta forest in Ilha do Cardoso, Cananéia, SP. We investigated if seedling survival and fitness were related to density-dependent herbivory, tested if the species presented an association with soil habitats and characterized its spatial patterns distribution in the study area. In General Introduction (Chapter 1) we enumerated the main theories developed so far to explain high tropical diversity, which include many processes acting on the tree species dynamics. Traditionally, models focused on density-dependent factors were frequently contrasted with models based on habitat or niche partitioning, but we know nowadays that both are acting simultaneously to determine community structure. For this reason we described in general lines both models. We also discussed how detected spatial patterns of a species may give account for underlying processes responsible for the generated patterns and the need of experimental tests after such inferences. Additionally, we resumed Janzen-Connell model which embases next chapter and was also the starting point of this dissertation. We did a brief contextualization about Janzen-Connell model and reviewed main results of investigations of its effects in others study areas using alternatives methodologies. As the next two chapters were developed in the same study area and with the same species, we also included their descriptions in the general introduction. In order to test the Janzen-Connell model (Chapter 2), we designed an experiment to evaluate *C. brasiliense* seedlings survival and fitness under three treatments: protection against herbivory, distance from conspecific adults and tree parental density. We found that the distance and density-dependent effects did not act as predicted by the model for our study species. Despite the high herbivory damages it suffered,

its seedlings showed tolerance and compensatory growth responses. We proposed that pressure by host-specific herbivores seems to be widespread in the study area instead of aggregated around conpecific densities. Patterns detected also suggest that soil moisture is a better predictor for the species survival than herbivory. On chapter 3, therefore, we tested if density of this species presented any association with soil habitats, as suggested in chapter 2. We used an approach conjunct with the spatial distribution, permitting the inference of other underlying processes possibly related to the species dynamics besides the micro-habitat. We characterized the spatial distribution patterns using two complementary second-order point pattern statistics, K-Ripley and O-ring, and tested the habitat association using the torus translation procedure that incorporates spatial autocorrelation between conpecific stems. Besides detecting clumped distribution patterns, with variable critic scales with the analyzed size classes, we also detected a positive habitat association with temporally flooded soil (Neossolo), where its relative density was 30% greater comparing to others soils types. Adult stage was also positively associated with Neossolo and, in the other hand, was negatively associated with Espodossolo arênico, which is characterized by lower moisture soil levels. Young stage corresponded to only a quarter of all species stems and did not show any association with soils habitats. We suggest that flooding and anoxic conditions tolerance, as well as the occurrence of hidrocoy among its dispersion types, the main factors favorable to survival and fast ontogenetic development in these soil conditions. We used information about *C. brasiliense* ecology from other studies to infer or exclude possible related factors with its spatial distribution and the habitat association and Janzen-Connell tests to complement these supposed factors. On Final Considerations we synthesize all proposed and tested information about underlying processes acting on *C. brasiliense* dynamics and suggest that the clumped spatial pattern detected may be an interaction result of three main factors: (1) differential association with both temporally flooded and unflooded soils, (2) occurrence of three simultaneous and complementary seed dispersal agents (gravity, bats and water) and (3) high density-dependent intra-specific competition through ontogenetic stages. We finalize proposing a hypothetic scenario with testable predictions about the species spatial pattern detected to *C. brasiliense* in the study area. These results attribute to grouping acting effects of both abiotic and biotic processes the possible answer to complement our understanding about tree spatial patterns founded, as suggested by other studies in the tropics.

FARIA, Mariana Brando Balazs da Costa

Diversity and natural regeneration of trees in Restinga Forests in Ilha do Cardoso, Cananéia, SP, Brazil

Abstract: The goal of this dissertation was to analyze the natural regeneration dynamics of three restinga forests (Tall Restinga Forest TR; Tall Seasonal Swamp Restinga Forest TSR and Short Restinga Forest SR) with different edaphic conditions, floristic composition and structure in Ilha do Cardoso, Cananéia, SP. During a year, we attempted to understand the mechanisms that promote the floristic composition and structure variations in these three systems. For that, between February 2007 and January 2008 we accompanied the forests seed rain using 90 seed traps of 0,5 m² (30 in each forest; Chapter 1) and the seedlings community (tree species; 50 cm) using 270 plots of 1 m² (90 in each forest; Chapter 2). The natural regeneration dynamics was analyzed using the seed rain and the seedling dynamics (three census in 12 months) data, the individuals tree species with DAP 5 cm data and the environment data (canopy openness and organic matter - OM; Chapter 3). In relation to the seed rain, SR presented twice as many seeds as TR and TSR. On the other hand, TR and STR presented a significantly higher diversity than SR and also floristic composition and structure similarity. In respect to the dispersion syndrome, more than 95% of the seeds and species were animal dispersed, indicating the importance of zoochoric dispersal to the maintenance and structuring of these forests. The seeds species showed a higher correspondence with the adult community

adjacent to the seed traps, suggesting that diversity, floristic composition and structure similarities and differences among the forests seed rain are a reflection of the forests local adult community diversity, floristic composition and structure. Besides, as the seeds presented an aggregated and close to the parent tree pattern of deposition, we proposed that the forests species are limited mainly by safe sites for seed germination and not by dispersion. For the seedlings, we founded a higher diversity and richness per 3 m² in SR, the opposite of what we had expected since the Tall Restinga Forest is known to be a more complex vegetation, with higher values of richness and diversity for adult trees when compared to Short Restinga Forest. We proposed a hypothetical model of community structuring in which these forests are structured in different ways due to ecological filters, as light and nutrients availability and stochastic events, that limit germination and seedling, juveniles and adults establishment. We predicted, as well, that the diversity inversion between the seedlings and adults community is due to density-dependence factors that are responsible for the differentiated seedling establishment. In Chapter 3, we were able to test some parts of the hypothetical model of community structuring proposed in Chapter 2. We concluded that natural regeneration dynamics and biotic and abiotic filters really are important to the forests community structuring. SR presented a higher canopy openness (higher light availability) than TR and STR. Seedling recruitment, density and richness (in 3 m²) were positively related to the canopy openness. Nevertheless, TR and STR presented higher organic matter contents than SR, and the diversity was positively related to the canopy openness and the OM. Thus, light availability seems to be an important abiotic filter acting in the germination and in the seedling establishment, leading to higher values of recruitment, density and richness per 3 m² in the SR when compared to TR and STR. However, in the seedling/juvenile turn to adult the lower individuals density and the higher nutrients availability in TR and STR would benefit the species permanence, leading to the higher species diversity found in those forests.

CASTANHO, Camila de Toledo

Determinant factors of decomposition process in São Paulo State forests

Abstract: Composition is an important indicator of functional patterns of ecosystems, as it controls basic processes related to the availability of nutrients and to ecosystem productivity. Climatic and edaphic conditions and the quality of the litter and soil fauna as determining factors are of particular importance in the process of decomposition. The significance of each one of these varies with spatial and temporal scale. The objective of this work was to evaluate the importance of certain determining factors of decomposition in sites representing the main forest ecosystems of the state of São Paulo, Brazil. To accomplish this, two independent experiments were conducted. The first, denoted here as the "Exotics" experiment, was to examine the effects of the type of forest and the soil fauna on the decomposition of leaves of an exotic species (*Laurus nobilis* L.) in two humid forests (Restinga Forest of the Parque Estadual da Ilha do Cardoso e Atlantic Forest of the Parque Estadual Carlos Botelho) and a seasonal forest (Semideciduous Forest of the Estação Ecológica de Caetetus). The effects of these factors were tested above and belowground, to simulate the environment of decomposition among leaves and roots respectively. The type of forest had a significant effect over fauna above the surface, while below the surface, only fauna had significant effect. These results indicate that the hierarchy of determining factors in decomposition differs between leaves and roots. If on the one hand decomposition in leaves is much more susceptible to variation in climate than are roots, on the other hand changes in the soil fauna affect decomposition in both environments. Above the surface, fauna had a significant effect only in the Atlantic Forest, emphasizing the difference between two humid forests. Under the surface, and in the absence of fauna, the percentage of remaining biomass was very similar in the three forests. Notwithstanding differences in the forests, the presence of fauna was apparent, suggesting that there is a specific contribution of fauna in decomposition among roots in these forests. The Restinga Forest produced the most pronounced effect of fauna below the soil

surface. These results indicate that fauna is a factor of notable importance in the decomposition of roots, especially in humid sandy tropical forests. The other experiment, here called the "Native" experiment, was developed to evaluate the effects of the substrate and the forest type on the decomposition of leaves of four native species in sites of the four major forest types in São Paulo state. The experiment was conducted in the same three forest sites as the "Exotics" experiment, including the Cerradão da Estação Ecológica de Assis. A tree species was chosen in each forest type, the leaves of which were used as substrate for the litter bags. The type of forest and the substrate demonstrated a significantly greater effect on the quantity of remaining mass throughout the experiment. The majority of the species suffered greater losses in the Atlantic Forest, followed by the Restinga Forest, the Semideciduous Forest, and the Cerradão. These results suggest that the total associated precipitation and its distribution are important determinants in the process of decomposition. As such, the two most humid forests show, on average, decomposition rates twice as great as the two seasonal forests. The rest of the differences encountered between forest types can be explained by edaphic and biotic factors. With respect to the effect of the species, the greatest biomass losses were observed in *Esenbeckia leiocarpa* Engl., followed by *Copaifera langsdorfii* Desf., *Guapira opposita* Vell. and *Calophyllum brasiliensis* Camb. Chemical parameters only show significant negative correlation with decomposition rates when *G. opposita* is excluded from the analysis. In this case the percentage of lignin was the parameter that showed the greatest correlation ($r^2 = 0,59$). In spite of the general patterns presented above, the interaction between forest type and substrate showed some variation, principally related to the loss of mass of *C. langsdorfii* in its native habitat, the Cerradão. Comparing decomposition rates (k) found in the Semideciduous Forest and Cerradão, *C. langsdorfii* shows a decrease of 40% more in the Cerradão, while the other species show, on average rates 28% lower in the Cerradão than in the Semideciduous Forest. These results suggest a strict correlation between the decomposition community and the local litter. Understanding processes of decomposition, is of fundamental importance and includes recognizing the determining factors and the variation in the importance of these factors under different environmental conditions, as presented in this study. This is true not only for our understanding of the forest ecosystems of São Paulo, but also for management planning, restoration, and conservation.

Monografias (Iniciação Científica e trabalhos de conclusão de graduação)

AULER, Jennifer Prestes

Environmental heterogeneity and the spatial distribution of Amazonia's trees

Abstract: Niche and dispersal limitation are important coexistence mechanisms that can spatially structure tree communities. We aimed to verify the influence of environmental heterogeneity in the relative importance of those processes. We used data from ForestGEO plots with different environmental heterogeneity (Colombia-CO < Brazil-BR < Ecuador-EQ). We selected the most plausible of four concurrent spatial models: Randomness (CSR), Niche (NH), Dispersal Limitation (DL), and both (NH+DL). BR e EQ didn't diverge in the probability of model selection, having 85,6% and 83% of niche models selected (NH and NH+DL), while in CO only 57,5% were observed. The proportion of no model selected was four times higher in CO than in BR and EQ. We attribute these differences to CO's lesser environmental heterogeneity and conclude that it influences the relative importance of processes. Plots with a higher proportion of coexistence mechanisms are also significantly more diverse (BR and EQ > CO).

ROSA, Matheus Guthieris Bitencourt

Phylogenetic structure of seedling communities in Restinga forests with different environmental conditions

Abstract: Ecological communities often differ in species richness, composition and abundance, reflecting different assembly processes. Niche-determined processes and neutral processes may interact in the role of structuring different communities. Assessing the phylogenetic structure of communities should allow us to infer niche-related processes with respect to neutral processes, if the phylogenetic distances between co-occurring species reflects niche differences. On one hand, if species tolerance to abiotic conditions are phylogenetically conserved, intense environmental filtering is expected to promote community assemblages more phylogenetically related than chance. On the other hand, negative interactions between neighbouring species can limit niche similarity in local assembly, if species interactions, such as competition for limited resources, is stronger between species that share the niche of a common ancestor. In the stage of seedlings, competition may not be able to impose a non-random signal on the phylogenetic structure of the entire habitat, but it may drive the assembly of local neighbourhoods. We therefore intend to infer the relative importance of different assembly processes by comparing the phylogenetic structure of seedlings communities in different Restinga forest physiognomies from the Parque Estadual da Ilha do Cardoso (Restinga Alta Alagada - RAA, Restinga Alta Drenada - RAD e Restinga Baixa - RB), at the scale of the entire habitat and the scale of local neighbourhoods. We describe phylogenetic structure of the entire habitat and local neighborhoods by calculating the mean pairwise phylogenetic distances between co-occurring species, both weighted and unweighted by species abundances. At the scale of the entire habitat, we ask if species composition at each forest type differs from null expectations, we test this by comparing the observed MPD value for each Restinga forest with a null distribution of communities generated by drawing species by chance from an adult tree species pool. We found that different Restinga forests show random phylogenetic structure at this scale. And, at the scale of local neighbourhoods, we ask if the distribution of MPD per triad differs between Restinga forests physiognomies, by comparing the F statistics from a simple Analysis of Variance with the distribution of F generated by permutations of MPD between habitats. We then conducted a post-hoc test to evaluate the absolute differences between groups of neighbourhoods in different Restinga forest types. We found that the distribution of MPD per triad in Restinga Baixa differs from the distribution of both Restinga Alta forests, but the Restinga Alta Alagada (flooded habitat) and Restinga Alta Drenada (drained habitat) don't differ from each other. Our results therefore suggest that neutral processes are more important than niche processes to determine the assembly of seedlings communities at the entire habitat scale, however, niche-related processes, such as habitat filtering and competition may have a secondary role by determining local differences in the phylogenetic structure of neighbouring species.

MORETTO, Felipe Alexandre

Natural regeneration and seedling diversity in a coastal plain transition ecosystem - hillside

Abstract: The seedling community of coastal plains of Caraguatatuba county was studied in a fragment of 50 acres of Forest Transition Restinga - Hill. The study area has been described by means of 40 sets of three plots of 1m x1m totaling an area of 120m², with 23 sets were flooded condition and 17 in non-flooded conditions (drought). We obtained canopy opening with the help of Densiometer. In total 507 seedlings were identified, representing an average of 4.23 seedlings per

m2. It was possible to observe a high richness, with 82 different species. The most abundant species were *Calypthranthes sp* (107), *Myrta sp1* (82) and *Annona cf reticulata cf* (19). The family Myrtaceae showed the highest species richness, totaling 18 species. The flooded plots had on average 9.99 seedlings per 3m² and droughts 15.69 per 3m². The average number of species in the wetlands was 3.69 species per 3m² and in the dry plots was 6.11 seedlings per 3m². The predictions of this study were that the wetlands should contain fewer species and lower species richness compared to areas not flooded. For canopy opening was expected that more open areas possess greater number of seedlings and greater species richness. However after randomization of data was not possible to observe that wetlands had less wealth and fewer species ($p = .33$). Increasing the percentage of canopy openness did not significantly affect the number of seedlings ($p = 0.23$) or species richness ($p = .44$). Thus, the results indicate that environmental variables are not sufficient to explain the observed variation in abundance and species richness of seedlings in this ecosystem. However other factors may be limiting for seedling establishment. Among the possible factors, the human disturbance area for removal of palm (*Euterpe edulis*), the large number of paths traced in the region (trampling seedlings) and competition from herbaceous plants deserve more detailed studies in the future.

DIAS, Julia de Freitas

Survey of Seedling Production of Restinga Species in Nurseries State of São Paulo: Implications for ecological restoration

Resumo: To be viable to carry out restoration projects following the scientific statements and legislation is essential that there is availability of seedlings in nurseries with high species and genetic diversity. In order to evaluate the current availability of seedlings, production capacity and the main constraints to the production of a high diversity of restinga (white sand coastal vegetation) species, a study was conducted with nurseries producing seedlings of restinga species in the state of São Paulo. In total, 122 nurseries and 41 counties were contacted, resulting in only six nurseries producing seedlings from areas of restinga. The definition of the profile of resting seedlings production in these six nurseries was done through questionnaires technical and administrative. Among the main results of this survey, we can highlight the small number of seedlings of restinga species produced by the north coast nurseries, the difficulties in obtaining seeds mainly related to the process of seed collection, the disarticulation of the sectors involved in the production of seedlings of restinga species, the tiny share of the municipalities in seedling production and the perception of the producers of changes in the fruit phenology of the restinga species in their collection areas. This study highlights the current shortage of seedling of restinga species and should be useful as a tool to reveal the nurseries working in this ecosystem, and to improve the contact between them and the restoration planning groups.

PEREIRA, Thiago

Effects of light quality on seed germination of Myrtaceae species from restinga of Cardoso Island

Abstract: The Myrtaceae family is one of the most ecologically important families, mainly in the Atlantic forest, being the dominant family in diverse tropical forests. Specifically in "restinga" (coastal sandy plains) areas, Myrtaceae is noted for high species richness, being among the trees, often the most diverse. However there are few studies about the ecology and physiology of this family. Knowledge about the conditions for seed germination, in the case of Myrtaceae species, may increase

the success in producing of seedlings in nurseries for use in forest restoration The analysis of light requirements for germination of the Myrtaceae species provides data that can be useful both in evolutionary studies about the family Myrtaceae, as to indicate the correct phase of succession to use of these species of Myrtaceae occurring in the Ilha do Cardoso in restoration projects in tropical areas. The germination of seeds of three species, *Eugenia umbelliflora*, *Myrcia multiflora* and *Blepharocalyx salicifolius*, were analyzed in a white light treatment and in the control (dark). An analysis of seed germination under distinct Red/Far red ratios was also performed for the species *Eugenia umbelliflora*. The seeds of the three species germinated in the presence of light and in the dark, indicating that the seeds have great environmental plasticity about light and can occupy different habitats. *E. umbelliflora* and *B. salicifolius* probably have their germination controlled by phytochrome A (phyA), using a Very Low Fluence Response (VLFR). The species *M. multiflora* show a higher germination rate under white light, which could indicates positive photoblastic seeds, but this classification requires complementary studies. Tests at different levels of R / FR for *E. umbelliflora* reinforce that this species has wide environmental plasticity, with the ability to germinate both in treefall gaps and under the canopy.

PEREIRA, Nathália Helena Azevedo

Spatial distribution of terrestrial tank bromeliads in restinga: causes and consequences

Abstract: The plants' spatial distribution pattern is the result of biotic and abiotic factors, from space competition to nutrients, light and water availability. To analyze the factors that vary spatially, light incidence and edaphic characteristics for example, is key to comprehend the influence they could have over the space distribution of the vegetation species in natural environments. This study aimed to analyze the possible factors that determine the distribution of terrestrial bromeliads, a group of plants that is very abundant in restinga, dominating the herbaceous layer on large tracts. On the other hand, the presence of bromeliads in the herbaceous layer can hinder the establishment of arboreal species and affect the vegetation structure. Thus, the consequences of the presence of bromeliads over the vegetation structure were also analyzed in this study. The study was conducted in a patch of restinga forest, at the "Parque Estadual da Ilha do Cardoso", south coast of São Paulo state. Were sampled 5,76 ha, in 144 contiguous shares of 20 x 20m, in wich was registered the total number of rosettes of terrestrial bromeliads, as well as the percentage of coverage of the ground of each species. Were found seven terrestrial bromeliads species: *Bromelia antiacantha*, *Canistrum cyanthiforme*, *Nidularium innocentii*, *Nidularium procerum*, *Quesnelia arvensis*, *Vriesea carinata* e *Vriesea ensiformis*, and about 50% dos 5,76ha of the forest of restinga sampled were covered by bromeliads. The species that presented the greatest number of rosetas and the biggest coverage area were *N. procerum*, *N. innocentii* e *C. cyanthiforme*. The results indicate that the terrestrial bromeliads distribution is positively related with the canopy opening and that the growing of the percentage of thick sand between 5 and 20m underground is related to the decrease of the number of bromeliads per share. The variety of individual arboreal adults decreased with the rising of the number of rosetas on a share. It wasn't noticed any relationship between the presence of bromeliads and the abundance of adult arboreal species on the shares, what suggests that the bromeliad don't interfere the structure of the forests dossel and seems to be using other space than the occupied by the arboreal species.

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