



I Seminário Científico do Programa de Pós-Graduação em Biodiversidade e Evolução – PPGBE

DEFESA DE DOUTORADO

Filogenia do complexo *Erythrolamprus reginae* e filogeografia de *E. reginae* (Serpentes, Dipsadidae, Xenodontinae)

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PPGBE Pós-graduação em Biodiversidade e Evolução

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MUG MUSEU GOELDI



29 de Novembro de 2019
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Auditório Paulo Cavalcante
Campus de Pesquisa
Av. Perimetral, 1901
Belém, Pará

Museu Paraense Emílio Goeldi
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I Seminário do Programa de Pós- Graduação em Biodiversidade e Evolução - PPGBE

29 de Novembro de 2019

09:00 – 17:00

Abstracts

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Terra Firme, Belém, Pará

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Conservation status of frugivorous butterflies in forest areas in the Brazilian Amazon

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In the tropics the threat of butterflies with extinction is still poorly studied. Some authors have drawn attention to the fact that the guild of tropical frugivorous butterflies undergoes changes in both diversity and composition as a result of forest fragmentation and land use changes, leading also to the extinction of butterfly species. The justification of the work was based on previous research that evaluated the extinction vulnerability and conservation status of frugivorous butterflies in the Belem Endemism area. That study detected 26 species with some degree of threat and 32 species of frugivorous butterflies over 40 without registration. This research asks the following questions: How are frugivorous butterfly species geographically distributed in the Brazilian Amazon? How are the networks of interaction between butterflies and their host plants structured? To what extent is host dependency a factor of vulnerability to Amazonian butterflies? Which species of frugivorous butterflies are vulnerable in the Brazilian Amazon? And the general objective is to describe the guild of frugivorous butterflies of the Amazon and to identify the conservation status of species in the Brazilian Amazon. The study will consist of analysis of material deposited in collections and analysis of material from previous standardized collections or performed during the research period. Complementary information from the literature will also be added to the database. As preliminary results so far national databases were consulted, literature was reviewed and collections were made. A python script has been developed to convert and plot large numbers of coordinates of various formats into a single format. It was created due to the unavailability of tools that convert grid coordinate numbers. The script is currently being optimized to be available to other users. So far, based on the data obtained, 23421 individuals were recorded, distributed in 175 species, belonging to 4 subfamilies; Biblidinae, Charaxinae, Nymphalinae and Satyrinae. The most abundant species were *Tigridia acesa* with 4284 individuals, followed by *Taygetis cleopatra*, with 2473 individuals, the others were collected in 82 municipalities covering all nine states of the Brazilian Amazon. Among the difficulties encountered so far, obtaining data from international collections is the most serious, as most of these are not available electronically, requiring in-person visit.

Seasonal dynamics of regeneration in savanna areas in the state of Pará, Brazil

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Natural regeneration deals with the early stages of the establishment and development of plant species responsible for the future of the forest, occurring according to the means that allow the entry and establishment of new individuals and species through soil seed bank, seed rain, seedling bank and seed dispersion. Regeneration is considered an ecological indicator to estimate the functioning of natural ecosystems or in restoration, since they represent the dynamics of arrival, establishment and persistence of the species. Precipitation and temperature are factors that influence the growth of regenerating species in the savanna. The hypothesis to be tested is that the rainy season is responsible for the richness of species. The objective of the research is to evaluate the floristic and structural dynamics of natural regeneration in two climatic periods (rainy and less rainy period) in sections of cerrado through the characterization of the composition and floristic structure and their forms of life and correlate the richness of species with climatic data of precipitation and temperature. The study will be conducted in an area of savanna in Itapuá, in the city of Vigia, northeast of the state of Pará, Brazil under geographical coordinates (0° 48' 59,6"; S 48° 5' 6,8" W) in the microregion of Salgado 93 km from the state capital in the period November 2019 to November 2020. The data collection will be from November 2019 to November 2020 in 50 plots of 20 m x 20 m. The floristic composition will be evaluated through the distribution of individuals in families, genera and species and the identification of species *in loco* will be done by a parobotanist of the Museum Emilio Goeldi. Families will be classified according to APG IV (2016). For structure analysis the Shannon-Wiener diversity index (H') shall be calculated, equability (J'), Sorenson's similarity index (S') and Relative Density (DR), Relative Frequency (FR), Relative Dominance (pain), Coverage Value Index (VC) and the Value of Importance Index (VI). Precipitation (mm) and Temperature (°C) data will be obtained from the Meteorological Database for Education and Research (BDMPEP) of the National Institute of Meteorology (INMet) by the website <http://www.inmet.gov.br> and then calculated monthly and annual averages. To correlate species richness and precipitation and temperature data a Bray-Curtis dissimilarity matrix will be developed using the floristic composition and structure of the rainiest and least rainy period, the grouping is expressed through a dendrogram using the method of binding by the weighted average. The cofenetic correlation coefficient shall be used as a measure of dendrogram fidelity to the original matrix.

Phylogeography *Siphlophis compressus* (Daudin, 1803) (Dipsadidae: Xenodontinae: Pseudoboini)

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The diversity of species whose distribution ranges from the Amazon Forest to the Atlantic Forest, but are absent in the dry biomes between them, is important evidence of a past connection between the two forests. A phylogeographic study of the species occurring in both the Amazon and the Atlantic Forest is not only an opportunity to understand patterns of population distribution within species, but also a chance to better understand the Amazon-Atlantic Forest connection itself. *Siphlophis compressus* is an interesting species to analyze, as it is distributed along the Amazon and Atlantic Forest, but it is also the only species of its genus to have this distribution. The rest of the species of this genus are restricted to the Amazon Forest or the Atlantic Forest. The main objectives of this study are to investigate the evolutionary patterns of *Siphlophis compressus*, as well as to analyze its genetic variability, to verify if there is genetic divergence within *S. compressus* lineages, and to better understand the Amazon-Atlantic Forest connections. To infer the phylogenetic relations between the lineages, concatenated trees were made based on four mitochondrial and three nuclear genes. Subsequently, population analyses will be performed to verify the population structure of the group using the Median-Joining Network method, together with summary statistics analysis. Demographic history will be inferred based on approximate Bayesian computational analysis. The concatenated gene tree showed a clear distinction between *Siphlophis* species from the Amazon and from the Atlantic Forest, also exhibiting *S. compressus* as more closely related to the Atlantic Forest species. Demographic history analysis will be made to further investigation.

Identification of potential corridors for jaguars in Mosaico Gurupi, Amazon region of Maranhão state, Brazil

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The effects of habitat loss and fragmentation are a major threat to the maintenance of biodiversity, and the landscape connectivity a central concern in ecology and conservation. Corridors are valuable tool for promoting connectivity because they allow individuals to move between habitat patches. The success of animal dispersal through corridors depends on the behavioral response of the focal species to the landscape physical structure. The jaguar is considered a focal species for planning reserves and large eco-regions since its survival requirements encompass multiple factors that are essential for maintaining an ecologically healthy environment. The present study aims to identify corridors between forest patches in the Gurupi Mosaic, using the jaguar as a focal species. The Gurupi Mosaic embraces the protected areas formed by Gurupi Biological Reserve and Awá-guajá, Carú, Alto Turiaçu, Araribóia and Rio Pindaré Indigenous Land, which hold 70% of the remaining Amazonian forest cover of Maranhão state. The study landscape have high level of fragmentation and habitat loss, and the remaining patches of forest are in pasture and agriculture matrix. The analysis about jaguar's corridors in Gurupi Mosaic was developed with the Circuitscape computer program, which uses the theory of circuits to model connectivity. The model highlights in landscape the areas with the low resistance, the most permeable, and also the high resistances, attributed to the barriers of movement. Four target points were selected from the shortest distances between Gurupi Biological Reserve, Araribóia, Rio Pindaré and Carú Indigenous Land forests. The resistance matrix was generated from the sum of layers with biotic and abiotic attributes of the landscape, which pixel value is proportional to the resistance offers to jaguar movement. The circuits model developed for Gurupi Mosaic resulted in low flow intensity among isolated forest patches as consequence of resistance attributes to jaguar's movement, such the extensive pasture and agriculture areas. The BR 222 highway with high vehicle flow also represents a barrier to jaguar's movement cause by crash risk and high human density. The results suggest the landscape interventions to improve the connectivity between fragments in order to enable the jaguar's movements among the isolated forest patches in the Gurupi Mosaic.

Taxonomic review and phylogenetic analysis of genus *Oxyepoecus* Santschi, 1926 (Formicidae: Myrmicinae: Solenopsidini)

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Among the current recognized subfamilies for ants, Myrmicinae is the biggest and most diverse, with a high number of cryptic species and many homoplastic characters, representing a taxonomic challenge. *Oxyepoecus* Santschi, 1926, a genus of this subfamily (Solenopsidini tribe), is formed by 21 gathered species for presenting eleven antennal segments and three segments forming the apical club, clypeus with four teeth, propodeum with teeth, and sculptured mesosoma at least in the propodeum. This genus is distributed in the Neotropical region; it can be found exclusively in South America, (Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay and Peru). The biology of these species is poorly known. They are rarely collected and recorded in forested and opened environments. It is suggested that they live on the ground and forage in the leaf litter. Although *Oxyepoecus* has been the subject of two taxonomic reviews that contributed to the taxonomic knowledge and natural history of the genus, questions remain about species identity, with several specimens in collections that do not fit in any current descriptions. The phylogenetic relationships between species of the *Oxyepoecus* genus are also unknown, as its relationships with other genera of the Solenopsidini tribe. Therefore, this work proposes a taxonomic and phylogenetic study of the genus *Oxyepoecus* based on morphological characters. The identification, differentiation, survey, and the selection of morphological characters relevant to the taxonomy and systematics of *Oxyepoecus* species was performed with the Stereo Microscope and Scanning Electron Microscopy (SEM) images. We examined adult workers, reproductive castes and immature specimens, from the entomological collection of the Museu Paraense Emílio Goeldi, donations and borrowed material from other nine institutions. We have examined representative type specimens of 19 species, and about 400 specimens of 20 species are being analyzed, 17 of which are already described in the literature and we proposed three possible new species. Species recognized as new are being described and all known species of the genus will be redescribed. New diagnoses will be proposed and evolutionary hypotheses will be proposed based on the theoretical and methodological principles of phylogenetic systematics.

Functional structuring of the rotifer community and its relationship with environmental predictors in an amazon lotic ecosystem

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Functional trait is defined as any measurable morphological, physiological or phenological trait at the individual level. Such study provides insights into how species contribute to ecosystem processes and also provide a better understanding of trophic interactions and how communities respond to important environmental gradients. The rotifer community plays an important ecological role in lake food networks because they have a fast turnover rate and metabolism. The functional structure of communities may vary over time, so long-term studies provide information on community trends or variability that is not detected in spatial or short-term studies. Given the above, we investigate the variation of rotifer community functional diversity in a temporal and seasonal gradient and its relationship with environmental predictors. Samples were taken in the Guamá river, Belém, biweekly from October 2017 to June 2019, through horizontal trawls with conical plankton net. Simultaneously, water samples were collected for chlorophyll-a analysis. From these data the Trophic State Index was estimated. Rainfall data were compiled from the National Institute of Meteorology database, tidal height data provided by the Brazilian Navy. We sought to gather the functional characteristics that incorporate ecological aspects of the community and describe the response of organisms to environmental conditions, namely: biomass, feeding mode, feeding habit, predator flight and habitat. The following indices were estimated: functional richness (FRic), functional uniformity (FEve), functional divergence, quadratic entropy of Rao and CWM, both calculated using the R studio software. The assumptions of normality were tested by the Shapiro-Wilk test. The data presented normal distribution, being applied the T Test to verify the seasonal difference and among the tidal levels ($\alpha \leq 0,05$), such analyzes were performed in Past 3.1 software. To evaluate the relationship between environmental variables and functional characteristics, a joint test of the Fourth-Corner and RLQ methods in the R studio environment was performed. The h-test revealed no significant temporal difference in the calculated indices, while the t-test indicated no difference between tidal and seasonal levels, except for FEve which was significantly higher in the rainy season ($t = 0.015$). There is no relationship between environmental variables and functional characteristics.

Effects of açai (*Euterpe oleracea* Mart.) management on the regeneration of a floodplain forest of the amazon estuary

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Rainforests are globally responsible for maintaining biodiversity, providing essential ecosystem services (e.g. carbon sequestration and storage, climate regulation, maintaining soil fertility) and supporting livelihoods for millions of people in the tropics. However, the provision of these ecosystem services has been threatened as the ability of forests to regenerate following disturbances has been depleted. In this project we will test the following hypothesis: the intensification of açai management alters the natural regeneration of plant communities, interfering with the mechanisms of regeneration. Being this interference expressed through the impoverishment of the taxonomic and functional compositions of the species found in the bank and in the seed rain. This study is being conducted in the Ilha Combu, Belém, Brazil. 20 plots (20 x 20 m) containing different intensities of açai management (0 to 675 açai clumps per hectare) were selected. In each plot all woody plants with chest level circumference \geq 15 cm were measured, their heights inferred and were identified. Seed bank and rain are being collected every two months (during one year). All seeds will be identified, quantified and will have dispersion syndrome, growth form (i.e. weed, shrub, tree), mass and size (height, width and thickness) obtained / measured. Subsequently, the seeds will be planted in suspended nurseries in order to quantify their germination rate, being weekly quantified and taxonomically identified. From the composition of the bank and seed rain we intend to examine the abundance, richness and species diversity. Five sub-samples of the soil will also be collected to compose a sample composed by plot (collected up to 20 cm deep). The edaphic variables obtained will be: organic matter, density, particle size composition, humidity, P, pH, Ca, Mg, Na, K, Al, H, S, CTC and V. To evaluate the contribution of the type mechanism of regeneration on the frequency of recruitment and to know the relationship between the predictor variables (açai management, flood and edaphic characteristics) and the response variables (taxonomic and functional data of the bank and seed rain) will be performed GLM tests (Generalized Linear Models). Therefore, understanding how anthropogenic disturbances affect one of the world's most endangered rainforests is an urgent scientific challenge in the context of sustainability.

Comparative phylogeography of two gladiator frogs (*Boana boans* and *Boana wavrini*) widespread across Amazonia (Amphibia: Anura: Hylidae)

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The high diversity and endemism of vertebrates in Amazonia, combined with the complex geological and climatic histories of region, stimulated naturalists and researchers to explain this concentration of taxa and to investigate how it was shaped over time in Amazonia. Several mechanisms have been proposed in order to explain the origins of diversity in the region, resulting in a plethora of different biogeographic hypotheses and speciation models. The first and most widely discussed model evoked the hypothesis that rivers may limit the distributions of Amazonian taxa. Several studies have shown that Amazonian rivers can act as barriers to gene flow and be major promoters of allopatric speciation. Frequently, however, the influence of rivers as barriers is associated with populations of *terra firme* species. On the other hand, taxa with life cycles closely associated to river channels or floodplains tend not to have rivers as barriers, since these rivers may actually act as facilitators of gene flow. Amazonian floodplains (*várzeas* and *igapós*) are highly dynamic habitats, and species in these environments tend to have better dispersal abilities when compared to *terra firme* species. We will use genetic data from up to four loci (two mitochondrial: 16S and COI; two nuclear: RAG1 and POMC) and broad geographic sampling to analyze genetic structure for two closely distributed and closely related Amazonian gladiator frog taxa [*Boana boans* (Linnaeus, 1758) and *Boana wavrini* (Parker, 1936)]—both have ecological requirements that are closely associated with rivers and floodplains. Preliminary phylogenetic analyses (MAFFT alignment + RAxML phylogenetic inference) suggest that both species are monophyletic, but lack strong phylogenetic structure within them—a pattern concordant with other riverine species. Future analyses include summary statistics of genetic diversity (F_{st} and N_m), genealogical haplotype networks (haploviewer); time of divergence between populations (BEAST 2); and haplotype sharing (structure).

Morphological variability of *Tayassu pecari* (Artiodactyla, Tayassuidae) from the Xingu-Iriri Interfluvium

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Tayassuidae is the only family of Suiforme in the New World, being one of the first immigrant mammals during the Great American Biotic Interchange (GABI). It includes three species: *Pecari tajacu* Linnaeus, 1758, *Tayassu pecari* (Link, 1795), both distributed from south North America throughout South America to northern Argentina, and *Catagonus wagneri* (Rusconi, 1930), restricted to the Chaco region. Tayassuids are susceptible to intense selective forces resulting from climate variability, availability of food resources, anthropic impacts from hunting and habitat loss, or even competition with each other due to their ecological similarities and extensive area of sympatry, mainly between *P. tajacu* and *T. pecari* in the Neotropical region. Morphological variation can occur in intraspecific and interspecific levels: e.g., significant differences in mandibular skull dimensions found between *P. tajacu* populations from rainforests and drier environments and adaptations in the mandible-skull morphology observed between *P. tajacu* and *T. pecari* due to particular eating habits and biomechanical or phylogenetic constraints. Processes such as natural selection, neutral evolution and migration are evolutionary mechanisms acting on variation and are the basis for the morphological, functional and ecological adaptation of organisms within their populations or biological communities. These adaptations refer to properties of living beings that make them able to survive and reproduce in nature, making these variations have high adaptive value. The study area “Terra do Meio” is located on the Xingu River and Iriri interfluvium, in the state of Pará and is composed of a mosaic of Conservation Units and Indigenous Lands that form a continuum of protected areas that create the Biodiversity Corridor of Xingu Basin. Although it includes several protected areas, it is under numerous threats, such as deforestation, burning, road construction, agriculture and logging. To understand the morphology of *Tayassu pecari* in the Xingu-Iriri interfluvium and compare with populations from other localities based on literature, geometric and linear morphometry will be performed, including qualitative analyses of skulls of 203 adult specimens present in the Mammal collection of the Museu Paraense Emílio Goeldi (MPEG). Also, the diet of these specimens will be investigated through the analysis of diet-related patterns through tooth microwear, using a scanning electron microscope.

Embryonic and fetal morphology in the agouti (*Dasyprocta fuliginosa*)

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In mammals the gestational period is composed of two phases: embryonic and fetal, being the embryonic phase the most critical for the conceptus survival. The study of these phases allows the understanding and comparison of strategies adopted by different species to maximize their maternal and neonatal survival. In addition, this information provides greater understanding of their evolutionary relationships and provides information for their conservation. In this study, we used a sample of 96 embryos/fetuses of 53 wild agouti (*Dasyprocta fuliginosa*) obtained by collaborative methods with local hunters in the Amazon over a period of 17 years to describe the development of the external morphology of this neotropical rodent. We performed biometric measurements of the embryos/fetuses, measuring the values of weight, linear and dorsal length of the body. We used linear length measurements to estimate the age of each fetus based on a 104-day gestation. We characterize fetuses according to the following morphological characters: presence of dermis, eyelid formation, eyelid fusion, genitalia, external ear formation, presence of hair, tactile hair and nails, limb formation and presence of teeth. Finally, we applied logistic regressions to estimate the likelihood of morphological characters throughout fetal development. The fetuses presented an average of 9.65 ± 4.21 cm in linear length. All fetuses with a linear length of > 11.7 cm presented open eyelids. The presence of dermis was identified in all specimens analyzed. All fetuses over 4.8 cm - about 68.73 days of development - already had tactile hair. On the other hand, the appearance of body covering hair occurs at 96.88 days of gestation. The genitalia and eyelid fusion were differentiated in 4.8 cm fetuses. Teething is the most delayed feature in agoutis, appearing after 99 days of fetal development. In-depth studies on the fetal development of other wild mammals, especially caviomorph rodents, may point to similarities between the developmental biology of wild mammals, their kinship relationships, and conservation implications.

Evolution of anatomical characters in Arthrostylidiinae (Poaceae, Bambusoideae, Bambuseae)

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The tribe Bambuseae (Poaceae: Bambusoideae), or woody bamboos, is composed of bamboo species with culms strongly lignified. Woody bamboos are of significant importance due to their economic, ecological and cultural applicability. In the New World, Bambuseae is divided into three subtribes: Arthrostylidiinae, Chusqueinae and Guaduinae, and comprises 345 species within 21 genera. Due to the long flowering cycles that can last up to 120 years, woody bamboo specimens in herbaria usually do not have reproductive structures. For this reason, vegetative characters are commonly used in the taxonomy and identification of species, including those of anatomical nature. Anatomical investigations aiming to seek for alternative characters for the taxonomy of bamboos have increased in recent years. However, most of these studies have focused on the foliage leaf blade anatomy, whereas little attention has been directed to other vegetative structures, such as culms, pseudopetioles, and leaf culms. In this context, we characterize the anatomical and micromorphological structure of vegetative organs (foliage leaf blade, leaf sheath, pseudopetioles, culm, culm leaf blade and culm sheath) of species belonging to Neotropical bamboos subtribes, with emphasis on the Arthrostylidiinae. We aim to contribute to the taxonomy and better understanding of the evolution of anatomical characters in the Neotropical bamboo clades. So far, anatomy of the culm of 21 species of Arthrostylidiinae was analyzed; as well as investigations on the leaf blade, which has been increasingly important in the group systematics. Anatomy of pseudopetioles and leaf culms, in the light of the taxonomy of the group, also reveals new insights for the understanding of the evolution of Neotropical bamboos.

Butterflies fruit-feeding as indicators of natural regeneration after burning

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Habitat can be affected in many ways: natural disturbances, such as thunderstorms, floods, droughts and interspecific interactions, as well as events linked to clearing, burning and other anthropogenic disturbances. Some studies indicate that butterflies are ideal for studying present and future impacts of global warming, and understanding the interaction effects of environmental change, especially climate and landscape change. Although fruit-feeding butterflies are a well studied taxonomic group, there is still little research about populations, especially including population recovery during a natural regeneration process after burning. The aim of this study is to use fruit-feeding butterflies as indicators of natural regeneration after burning. The Gurupi Biological Reserve is the largest remaining fragment of the Amazon Rainforest in Maranhão, it is the only conservation unit of its kind in this state, and is part of a region that is currently being severely degraded by anthropic action, such as deforestation for agriculture, illegal wood extractivism, and recently went through fire. Sampling is being done with attractive decaying fruit traps with Van Someren-Rydon model containing fermented banana baits. At each sampling point, traps were inserted 1.5 m above the ground; 16 sampling points were set at each trail: in the northern region of Reserve two trails in an unburned area and one trail in a burned area, in the southern region two trails in burned areas and one in an unburned area. We used plots of 20 x 20 meters around the traps. Vegetation structure variables were removed in order to evaluate evidence of natural regeneration. Additionally, caterpillars were collected through active search. For the estimation of species richness, the Jackknife1 and Chao 2 estimators will be used in EstimateS ver. 8.2, to verify which vegetation structure variables have influence on the richness and abundance of fruit-feeding butterflies. Pearson correlation and Similarity Analysis (ANOSIM) will be done to evaluate the difference of composition of butterflies fruit-feeding for both treatments. Fruit-feeding butterflies and vegetation structure variables were collected in the years 2013 and 2014 (before burning), 62 species of butterflies fruit-feeding, distributed in 11 tribes, 27 genera, with a total of 378 individuals. The most collected species was *Colobura dirce* (Linnaeus, 1758) belonging to the Nymphalinae subfamily.

Phylogeography and taxonomic revision of *Micrurus ibiboboca* Merrem, 1820 (Serpentes, Elapidae)

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Micrurus Wagler (1824) includes about 80 taxa distributed from the southeastern United States to southern South America. Based on the color pattern, tail length and hemipenis morphology, four groups are currently recognized. *Micrurus ibiboboca* belongs to the group that presents triad coloration and short and bilobate hemipenis. *M. ibiboboca* was described at the mouth of the Belmonte River, Bahia, Brazil, and can be characterized by the presence of a white muzzle, which extends from the anterior frontal edge(dorsally in the preocular and supraocular) to the first three supralabial regions. This species has a tricky and puzzling taxonomic history. It was described as *Elaps ibiboboca* and *Elaps marcgravii*, both based on the same type material, causing uncertainties about their type locality. The distribution of *M. ibiboboca* extends along the Brazilian coast, from the state of Maranhão to Rio de Janeiro, occupying areas of Atlantic Forest and Caatinga. Given their large distribution and large number of morpho-types recognized based on staining pattern and morphological characters, we hypothesized that there may be other unrecognized and undescribed evolutionary units. Using specimens and tissue samples deposited in scientific collections, this thesis aims to propose a phylogeographic hypothesis for *Micrurus ibiboboca*, identifying potential cryptic lineages and testing the hypothesis of group diversification. In addition to phylogeographic analysis using mitochondrial and nuclear genes, morphological analysis will also be performed with meristic and morphometric characters, design and color patterns, hemipenis and skull.

Phylogeography of *Uranoscodon superciliosus* (Linnaeus, 1758) (Squamata, Tropiduridae)

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Amazonia is a highly diverse biome and its biodiversity is not restricted to a period or event. Many hypotheses have been proposed to explain it, including the rivers as barriers, refuge theory and marine transgressions. According to the literature, these hypotheses could explain the evolutionary scenario of some Amazonian lizard species, such as *Kentropyx calcarata*, *Chatogekko amazonicus* and *Plica umbra*, all delimited by rivers. However, these species are commonly found in dryland forests and none phylogeographic studies have focused on lizards related to floodplains. *Uranoscodon superciliosus* is closely related to watercourses, commonly found on floodplains, but rarely observed away from water in primary and secondary forests. It is a widely distributed species throughout the Amazonia. By combining molecular data of mitochondrial (mitochondrial: 12S, 16S and ND4) and nuclear genes (RAG1, PRLR and KIF24) of 178 tissue samples, and linear morphometric and scales counts of 200 adult specimens, we aim to investigate the phylogeography of *U. superciliosus*, searching for geographic structure and divergence time between lineages. The dataset of each gene will be concatenated and a Maximum Likelihood and Bayesian inference will be performed, as well as a population analyses and divergence time estimation, with a molecular clock calibrated to 2% substitution/million of year. Two Discriminant Function Analysis (DFA) (separating males and females) will be performed to check the congruence between the groups previously defined in the phylogenetic results. Size effect will be removed using a Principal Component Analysis (PCA), using the residues from that in the DFA. The preliminary phylogeny (based only in ND4) revealed a strongly supported division between the population from the interfluve Tapajós-Madeira and populations from Tocantins-Xingu, Xingu-Tapajós.

The influence of natural and experimental factors on the structure and floristic of natural plant regeneration in dryland and flooded forests in eastern Amazon

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Understanding how natural communities are structured has been one of the largest challenges for ecology. The aim of the thesis is to test the differences in species composition of the natural regeneration community in relation to drought, distance, substrate type and soil physicochemical composition. To answer this objective the thesis was structured in three chapters: the first deals with the comparison of the natural regeneration of the dryland forest in an experiment of water exclusion; in the second is made the comparison of the natural regeneration in dryland forest between three areas under topographic conditions of plateaus and shoals; and, in the third chapter, the spatial distribution between two flooded forests in a distance gradient of 30 km is compared. All experiments were performed at the Ferreira Penna Scientific Station, located in Caxiuanã National Forest. Data collection in the three chapters was done using 2 m x 2 m plots. In Chapter 1, the number of species ranged from 129 in the control plot to 86 in the experimental plot, while the total number of individuals ranged from 660 in the control plot to 356 in the experimental plot. There was a significant reduction in the density of individuals ($t = 5.38$; $p = 0.0001$) and species ($t = 6.12$; $p = 0.0001$) in the natural regeneration of understory plant life forms in the experimental plots compared to the control plot. The arborous, palm and herbaceous life forms had a reduction in the density of individuals, ranging from -13% to -79%. The only life form that had a density increase in the experimental plot were lianas with 14%. There was a significant difference in species composition between experimental and control treatments ($F = 2,175$; $p = 0.001$). In Chapter 2, there was a clear separation of species composition between the plateau and shoal areas analyzed in this study. The 1st ordering axis clearly separates the plateau and shoal plots, accounting for 36% of the total variance, and the 2nd ordering separates the species composition between the three shoal areas, which does not occur between the three plateau areas. In Chapter 3, the 1st ordering axis clearly separates the plots from the two vegetation types, explaining 63% of the total variance. There is no significant relationship of species similarity in relation to the distance between plots in igapó ($r = 0.14$; $p = .014$) and floodplain ($r = 25$; $p = 0.08$) forests.

Taxonomic review of the genus *Erendira* Bonaldo, 2000 (Araneae, Corinnidae)

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Spiders included in *Erendira* Bonaldo, 2000 are exclusively found in northern neotropical region, mainly in Venezuela, the country with the largest number of known species. Currently, the genus harbors five described species, recognized by the presence, in the male palp, of a hyaline conductor, a prolatero-apical tegular process and a non-spiraled reservoir, ventrally describing a transverse “S” pattern with the terminal portion adjacent to the second fold; females are recognized by the presence of two anterior copulation openings, a broad median atrium and a pair of accessory pouches in the vulva, with posterior lateral apertures. This project proposes a taxonomic review of the genus *Erendira* with the proposition of new species and re-diagnoses of all currently known species, fully documenting informative characters of the new species and presenting an identification key for all species. The material analyzed belongs to the following institutions: American Museum of Natural History, New York (AMNH), Museum of Agricultural Zoological Institute “Francisco Fernández Yépez”, Caracas (MIZA), USP Museum of Zoology, São Paulo (MZUSP), Museum of the Central University of Venezuela, Caracas (MUCV); Private Collection of Gonzalez Sponga, Caracas (CPGS). The specimens were observed in a Leica MZ16 and in a M205A stereomicroscope for identification, choice of types, measurement and photography. Descriptions of the new species will be made from the chosen holotype and will present: type material; type locality; diagnosis; etymology; carapace, abdomen and leg coloration; spination of the femora, patellae, tibiae and metatarsi; total length, measurements of all leg articles from legs I, II, III and IV, cephalothorax length; genital description, geographical distribution and material examined. The drawings of the male palps will be made in the ventral and retrolateral views and of the female epigynum in the ventral and dorsal views. To date 48 specimens have been examined and 7 new species have been recognized. In addition, one poorly known species, *E. pictithorax* (Caporiacco 1955) will be redescribed based on the holotype. The hitherto unknown male *E. luteomaculata* (Petrunkevitch, 1925) will be described for the first time.

Geographic structuring of two endemic species of *Baryancistrus* genus in Tocantins-Araguaia basin

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The Araguaia-Tocantins is the fourth largest Brazilian exclusive basin and shelter approximate 175 endemic fish species, representing an endemism level greater than 40%. In addition, 23 of this species are in some threat categories according to Ordinance 445/2014 of the Brazilian Ministério do Meio Ambiente and six belonging to Loricariidae family; consider the most emblematic rheophilic group of fish in this basin. Loricariidae individuals live in lotic habitats and show adaptations in their mouth to fix in rapids and waterfall environments. These fishes are probably are the most strictly associated group of fishes with rheophilic habitats. Among these six Loricariidae species, *Baryancistrus niveatus* and *B. longipinnis* are considered critically endangered. These fishes are endemics of these habitats, but exist gaps in ecological and especially population dynamics knowledge and are a severe threat by the dam constructions. Despite the ecological importance of these rivers, fish species and these high endemic levels, this basin is considered the most impacted in the Amazon with nine dams in operation in Tocantins river and many other planned in both basin rivers. The dam construction radically alters rapid areas and are associated with ichthyofauna disappeared, and work as a barrier to genic flow to species. Thus, this work will generate information on whether impacts to this basin are causing loss of genetic variability among populations and verify the threat status of these species. In addition, these results may generate the basis for conservation actions. This study aims to investigate the genome-scale genetic population of *B. niveatus* and *B. longipinnis* populations in the Tocantins-Araguaia basin through molecular analysis. We will sample in four pedrais on Tocantins-Araguaia basin. Each fish will be photographed, measured and a piece of musculature tissue will be preserved in 95% ethanol. Restriction Site Associated DNA (RAD) markers will be used, which are a type of genetic marker useful for mapping associations, population genetics, ecological genetics and evolution. The radseq method we will use is Adapterama III: Quadruple-indexed, double/triple-enzyme RADseq libraries (2RAD/3RAD).

Seasonal dynamics of precipitation and temperature in the otter diet [*Lontra longicaudis* (Olfers, 1818)] in area of influence of hydroelectric reservoir in the Jari river, Amapá, Brazil

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The neotropical otter is a semi-aquatic mustelid (Carnivora: Mustelidae) with a wide distribution in South America, occupying the highest trophic level in its ecosystem. It is a solitary and elusive animal, sensitive to environmental and anthropic changes. Preferably consumes fish and shellfish but it has diversified menu, including birds, reptiles, amphibians, mammals, insects and fruit. Seasonal dynamics of temperature and precipitation are associated with variations in the composition and structure of its prey community. The present study aims to evaluate the seasonal dynamics of the environmental variables precipitation and temperature in the diet of *Lontra longicaudis* in the areas of direct and indirect influence of the Santo Antônio do Jari hydroelectric reservoir, located at the Jari river basin, on the border between the states of Amapá and Pará, in the period from 2015 to 2018. The diet composition is being determined based on the identification of remains present in 608 scat sampled in quarterly campaigns in the period of 8 days each, in six stretch river, covering about 360 km in each campaign. Monthly averages of precipitation (mm) and temperature (°C) data from years 2015 to 2018 referring to the weather stations of the municipalities Laranjal do Jari/AP and Almeirim/PA will be obtained through the Meteorological Database for Teaching and Research (BDMPEP) of the National Institute of Meteorology (INMet). To verify the relationship between the composition and frequency of the monthly diet and climate variables, diet matrices will be elaborated containing the composition and the feeding rate in the rainy and less rainy period through the Canonical Correspondence Analysis (CCA) with the aid of the R 3.2.2 software. Most of the food items identified so far correspond to fish and crustaceans (Decapoda). Less frequently it was possible to identify structures of lizards (Teiidae) and snakes (with at least one occurrence of the genus *Eunectes* sp.), and Hexapoda (Belostomidae) and Aracnida. The fur found on some samples can be attributed to Rodentia, although there are unidentified furs in other samples that can be derived from the otter's anal region, due to the absence of associated bones and teeth. The fish class presented Siluriformes structures with representatives Doradidae, Loricaridae and Callittiidae, Perciformes (Cichlidae) and Characiformes (Characidae).

Keywords: neotropical otter, environmental factors, diet, hydroelectric plant.

Habitat use and home range of Guiana dolphin (*Delphinidae*: *Sotalia guianensis*) in two Amazonian estuaries, Eastern Amazon, Brazil

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Cetaceans occur in different types of aquatic environments. Their distributions are influenced by ecological factors, habitat aspects, anthropogenic influence, such as accidental and / or intentional catches associated with fishery activity, as well as habitat degradation. One of the small coastal cetacean species most associated with such negative effects is *Sotalia guianensis* (Guiana dolphin), considered the most representative on the Brazilian coast. There is a knowledge gap about the ecological parameters of *S. guianensis* on the North Coast of Brazil. This species is considered to suffer the most from anthropic pressures in the country, increasing the relevance of studies that provide the basis for a more accurate assessment of its real population status. The objective of the present study is to understand the ecological parameters of *Sotalia guianensis*, evaluating the spatial distribution and area of use, by means of photo-identification of individuals. The influence of abiotic factors on the distribution of Guiana dolphin in the estuaries of Marapanim and Maracanã bays will be evaluated. In addition, interactions between fishing communities and aquatic mammals will be described, assessing the impact of fishing operations on species. The study will be conducted in the Marapanim and Maracanã estuaries, located in northeastern Pará State. Data will be collected over two years. There will be four campaigns/bay, two per semester, with five days of sampling each. An estimate of population size will be made using the photo identification method. The living areas of the dolphins will be estimated by minimum convex polygon and kernel estimator. Habitat utilization will be evaluated by a relating group of sighted dolphins, environmental variables (depth, turbidity, and salinity of water), landscape metrics (distance to shore and presence of ports) and anthropic interaction (proximity of vessels, presence of fishing nets and corrals). An analysis of Generalized Linear Models will be performed relating to the above descriptors and the occurrence of Guiana dolphins. The interactions between fishing activities and aquatic mammals will be analyzed through semi-structured interviews with artisanal fishermen.

Study of aspects and results of the process of updating the priority areas for conservation of the Tapajós River basin

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The selection of areas to be protected should be developed from a systematic approach that analyzes their location, design and includes a representative portion of each element of regional biodiversity. However, research indicates that, despite efforts to find the best conservation solution, the selection of areas for protection does not always produce results consistent with those expected for biodiversity conservation. Therefore, this research will analyze aspects of data quality and decisions made in the systematic planning approach for the conservation of the Tapajós River basin. Firstly, the representativeness achieved by protected areas (indigenous lands, integral protection conservation unit and sustainable use conservation unit), in the protection of amphibian species (23), lizards (41), birds (226) and mammals (75) will be analyzed, in two scenarios (protected in 2017; solution of the Brazilian event of identification of priority areas (2017/2018)), will be estimated, searching for a protection target of 30% of the distribution area of each species for the basin. The scenario with the highest proportion of targets met will be considered the most efficient. In another scenario it will also be analyzed the representativeness reached for the protection of mammals hunted for meat in a scenario in which sustainable use areas are not included as protected. In a second step, the target data, conservation costs and benefits will be used to generate different solutions, based on the minimum set (the minimum area to meet targets) and maximum coverage approaches. For the latter, 25% and 50% scenarios of protection will be generated with the use of Target-Based-TBF Function. In a third methodological investigation, minimal set solutions will also be produced using a database with different planning unit sizes (cell 60 m²; basin level 7) to analyze the effect of the scale and shape of them on the solution of spatial prioritization. In the different solutions, the spatial divergences and coincident will be compared. Finally, we will analyze the effect of using different conservation cost functions in the decision support software solution, based on changes in the 24 variable group (costs and benefits). In each scenario, the spatial changes and the amount of area of each solution will be analyzed.

Drosophilidae (Diptera) as an indicator in areas of post-mining regeneration in the municipality of Paragominas, Pará

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The consequences of mining activities in terms of impacts on the environment are diverse. One of these is the suppression of forest areas for mineral extraction such as bauxite that is found underground. Yet, there are other impacts related to land use in the Amazon, such as wood exploration, hunting, and fire use. These sets of factors lead to species isolation, habitat loss degradation and changes in biodiversity. According to the legislation, this type of activity requires a degraded area recovery plan (PRAD) to mitigate the impact caused by this activity. Drosophilidae (Diptera) flies are easily collected and can respond quickly to environmental changes. This study aimed to evaluate the recovery process of degraded areas, using drosophilids as indicators for biodiversity recovery trajectory, analyzing the similarity between the different recovery areas and the remaining forest the exploration area. The study is being performed at Hydro Mineração Paragominas S.A., in the municipality of Paragominas, Pará. Fifteen study sites were selected, composed of 5 in forest areas, 5 in recovery areas by the natural regeneration method and 5 in recovery areas by the nucleation method, both with 5 years of establishment. At each of these sites, only 1 transect of 250 m was established. To capture the drosophilids, we used traps with banana bait fermented for 48h in 100 g portions. Five traps were placed per site along the transect, 50 m apart, and one malaise trap in the center of each transect. Vegetation composition and structure metrics will be established for each sampling point as well as air temperature and humidity measurements to be associated with species occurrence results. The ecological analysis refers to the first campaign of June 2019, Shannon-Weaver was used to calculate diversity and Bray-Curtis to calculate the similarity between areas. Through the Bray-Curtis index, Nucleation areas are 46% similar to Forest areas, while Natural Regeneration areas share 24% of this similarity. When calculating diversity (H) observed that Nucleation areas have the highest diversity value (H) with 1,705, followed by Regeneration areas 1,531 and Forests with 1,343. From these results can be inferred that the Nucleation technique was more efficient in sheltering more forest community when compared to Natural Regeneration at this time of the regeneration process. However, are needed for temporal tracking data to identify if this trend is perpetuated along with the forest recovery.

Species composition, abundance, and diversity of necrophagous flies (Diptera: Calliphoridae, Sarcophagidae) in different vegetation types in Brazilian Amazon savannahs

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Amazonian savannahs are little-known environments and among the least studied. They occur as small enclaves, of various sizes, irregularly distributed throughout the Amazon forest. They are a heterogeneous mosaic of habitats, with grasslands at one extreme and forest formations at the other. Based on floristic composition, they can be divided into four types: forested, wooded, park, and grassy-woodland. Considering that different vegetation cover may affect the diversity of necrophagous flies, we will test the hypothesis that the most heterogeneous savannahs harbor a greater abundance and species richness of flies. The hitherto, there were no studies evaluating the effect of the floristic composition of Amazon savannahs on insect communities, which are the most numerous and important group in the maintenance of terrestrial ecosystems. Thus, the main objective of this study is to determine if there are significant differences in the species composition, abundance, and species richness in two families of necrophagous flies (Calliphoridae and Sarcophagidae) among the different types of savannahs in the states of Pará and Amapá. This study will be undertaken in five areas of Amazonian savannas: 1) Serra das Andorinhas in São Geraldo do Araguaia municipality, PA; 2) Carajás National Forest in Marabá municipality, PA; 3) Soure on Marajó Island, PA; 4) a savannah near Macapá, AP; and 5) a savannah in Monte Alegre, PA. At each of these localities, fly traps baited with rotting beef lung will be utilized. Two traps will be installed at every 100 m in two 500 m long transects (at least 500 m apart) for 48 h, where each set of two traps will be considered a sample. In order to verify if there is a difference in abundance among the studied localities, an analysis of variance of one factor (ANOVA) will be performed. In order to compare the species richness among the localities, rarefaction curves will be plotted using the Mao Tao equation. In order to graphically represent the similarity relation in the species composition between the locations, Multidimensional Non-Metric Scheduling (NMDS) will be used in R Core Team's R program, and a Multivariate Analysis of Variance (MANOVA) will be applied to verify if there is a significant difference in species composition among localities.

Philogeography of the specie *Rhinophylla pumilio* Peters, 1865 (Mammalia, Chiroptera, Phyllostomidae)

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The number of recognized bat's taxa has been expanded with the description and/or revalidation of numerous cryptic species. Recent research has shown that a molecular approach is a powerful tool for recognizing clades that may have remained hidden in traditional taxonomy due to morphological convergence. Studies combining different lines of evidence, such as morphometry and molecular approaches, have played an important role in addressing gaps in knowledge about Neotropical vertebrate diversity.

Within the Phyllostomidae family is the species *Rhinophylla pumilio*, a frugivorous bat that has a disjunct distribution, occurring in the Amazonia and Atlantic Forest biomes. Although all populations of this taxon are recognized as parts of the same species, karyotypic variation was observed among *R. pumilio* strains in Brazil. Samples from Amazonas and Bahia presented karyotypes different from those observed in samples from western Pará and Mato Grosso, with $2n = 34$; $NF = 62$ and $2n = 34$; $NF = 64$, respectively.

Motivated by the evidence of karyotypic variation, this study aims to broaden the current knowledge about *R. pumilio*, identifying geographic patterns of molecular and morphological variation in their populations. Genetic data will be used to investigate if there is molecular variation between populations of the Amazonia and Atlantic Forest. Therefore, two mitochondrial markers (COI and Cytb) and three nuclear markers (STAT5A, THY and DBY) were used. Sequence editing and alignment were done on BioEdit. All morphological analyzes were conducted in R environment. The results obtained so far point to a morphological and morphometric homogeneity analyzing only the samples from the Brazilian Amazonia. The maximum likelihood tree obtained for the Cytb marker shows two well supported groups, one formed by the Amazonian samples and the other by the Atlantic Forest samples. Despite this tree separation, the genetic distance between these populations is low. Future analyzes include diversity indices, Tajima D neutrality tests, and summary statistics (DnaSP 5), distribution of genetic variability within and between populations, F_{ST} and AMOVA (Arlequin), supernetworks (Splits Tree), number of population groups (Structure), N_e , migration rate, genetic flow and time of population divergence (IMa2). To evaluate the demographic history of each population (EBSP) coalescent method implemented in BEAST.

Quantifying Termite Ecosystem Engineering: A Global Meta-Analysis

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Termites (Blattaria: Termitoidea) are social insects with large biomass in tropical ecosystems and are involved in many essential ecological processes. Known as “ecosystem engineers,” these insects have potential impacts on soil dynamics affecting both local and ecosystem scales. Thus, they affect litter decomposition and nutrient cycling, soil water dynamics, and the complexity and distribution of nutrients at the landscape scale. However, many individual studies verify these isolated effects, and the magnitude of the impact of termites on all these scales has not yet been measured. Thus, we propose to quantify the effective size of termites' ecosystem services, using meta-analysis tools, and thus to verify possible sources of variation of these effects. We will conduct a systematic review using keyword sets in scientific journal search repositories (Google Scholar and CAPES Journals) and thus select articles based on the inclusion criteria. Only studies that verified in the same work the effect of some ecological factor on the presence or absence of termites (*e.g.* an exclusion experiment) will be included. Another inclusion factor for the construction of meta-analytic models is that studies report data means, some measure of variance (error or standard deviation), and the number of samples. Thus, we will calculate individual effect sizes based on the Hedge equation $(d) = (X_t - X_c / SD) * J$; where X_t will represent the treatment group response, X_c the control group response, SD is the standard deviation, and J is a correction term for small sample sizes. Finally, average effect sizes will be estimated for each ecological process of interest based on random effect models. These models are recommended for ecological data as they assume variation within and between studies. Thus, we expect the presence of termites to positively affect soil fertility and consequently plant parameters. Other expectations are that the presence of termites in the environment will have a positive effect on micro, meso and macrofauna as it provides resources and refuge for other animal species. Finally, by acting directly on the process of decomposition and release of greenhouse gases (CH_4 and CO_2) we expect their presence to increase nutrient cycling and contribute to the increase of these gas emissions.

***Tripunctata* group (*Drosophila*: *Drosophilidae*) associated with Lecythidaceae flowers in the Caxiuanã National Forest**

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The *tripunctata* group is inserted in the subgenus *Drosophila* Sturtevant, 1942 and has four subgroups (subgroups I, II, III, and IV). The determination of species in this group presents difficulties because of the high interspecific crypticity. Another barrier found for this group of *Drosophila* is the recognition of couples of the same species, because in some cases sexual dimorphism is observed. Also for some clades there is no complete separation between species and hybridization may occur in nature. The species of this group are widely distributed in tropical regions, being found in environments with more preserved forests. Their food preference is for yeast and bacteria found in decaying fruits and flowers. Many species in this group are not captured by traditional methods of collecting drosophilids for their substrate specificity in decaying flowers. On the other hand, the decay flowers of Lecythidaceae are very attractive for their food and breeding place. The aim of this study is to inventory and define the degree of association between *tripunctata* group species and Lecythidaceae flowers and to associate the respective males of *tripunctata* group females that visit these flowers. In this preliminary study, we focused in individuals from Tauari, large trees of the Lecythidaceae family. The collection was made with entomological net on the flowers exposed in the soil, within five days of activity in August 2019 in Caxiuanã National Forest. Each specimen was individualized for morphological evaluation. Specimens of similar morphology were recorded and one sample from each group submitted to barcode analysis. All males who were sent for molecular analysis had their genitals removed, and couples were photographed, and at least one specimen of each morphotype was available in alcohol at the Museu Paraense Emílio Goeldi. This study aims to describe possible new species, mainly from the association of males and females of this group. The continuity of the study will focus on the collection of drosophilids throughout the seasons flowering of Lecythidaceae in the first half of 2020, both at the Ferreira Pena Scientific Station, in Melgaço, and the Mocambo Reserve, in Belém, Pará, in order to inventory the species using morphological analysis and barcode method, establishing a degree of association with the species of Lecythidaceae, identify new species and position them phylogenetically within existing subgroups or propose new arrangements if necessary.