BIOTA-FAPESP PROGRAM

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ATLANTIC OMBROPHYLUS DENSE FOREST: FLORISTIC COMPOSITION, STRUCTURE AND FUNCTIONING WITHIN THE "SERRA DO MAR" STATE PARK

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Structure and floristic composition will be determined in the following Atlantic Forest types: Low Land Ombrophylus Dense Forest (5 to 50 m above sea level), Sub Montana Ombrophylus Dense Forest (50 to 500 m above sea level), and Montana Ombrophylus Dense Forest (500 to 1.200 m above sea level). All trees with a DBH ≥ 4,8 cm that fall inside 14 1ha permanent plots, divided into a grid of 10 x 10 meter parcels, will be considered. The 14 permanent plots will be established along the altitudinal gradient, 4 independent plots in each forest type plus 1 plot of Restinga Forest (sand dunes type of forest) and 1 extra plot of Low Altitude Ombrophylus Dense Forest. In the case of botanical families with relevant ecological roles, such as the Leguminosae in the nitrogen cycle, or Bromeliaceae, Melastomataceae, Rubiaceae, Solanaceae, Moraceae and Piperaceae responsible for the maintenance of key populations of pollinators and dispersors, a comprehensive floristic survey will include herbaceous, lianas and epiphytes. Data analysis will be conducted using the FITOPAC program. Where appropriate, more detailed analyses will be conducted using multivariate methods such as Canonical Correlation, Correspondence Analysis, PCA and PCO.

The database on composition and structure of the forest will allow a choice of species for more detailed studies on reproduction biology, seed anatomy and reserves, germination, photosynthesis and water use efficiency, nitrogen assimilation, transport and metabolism, plant populations structure and dynamics, techniques, genetic structure of plant populations using molecular markers, determination of forest age by DBH classes and using 14C, determination of annual average growth rates of key species, and phenology. Multivariate analyses will be used to check for functional groups, or groups of species that share a common behavior and ecology. The comparison of different groups along the altitudinal gradient will allow investigation of the effect of altitude in the functioning of these groups. Simultaneously, the inputs of nitrogen through precipitation, biological fixation, and soil mineralization and nitrification will be determined, along with key parameters of N losses through denitrification and export by streams, allowing a preliminary nitrogen mass balance along the altitudinal gradient. Water and carbon balance of the forest will be estimated along with the seasonal variation of this balance through use of micrometeorological towers and Eddy-covariance technique. The photosynthesis/respiration balance of the ecosystem will be used to determine the role of the forest as a sink or source of carbon to the atmosphere.

Micrometeorological Eddy Covariance flux tower installed at Núcleo Santa Virgínia/PESM, São Luis do Paraitinga/SP

Our final goal is to integrate the results of all activities listed above, scaling-up from individual trees, to families, to functional groups, and finally to phytophysiognomies, allowing us to understand forest structure and functioning.

The outcomes of this project will allow, for the first time, a full comparison between the Atlantic ODF and the Amazon ODF, and will enhance our capability in understanding how this biome will respond to future climatic changes.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

As established in the initial chronogram, all 14 parcels of 1ha have been set and their topography delineated through 1 meter contour lines. We have one plot in Restinga Forest, 5 plots in Low Land ODF, 4 plots in Sub Montana ODF and 4 plots in Montana ODF four parcels. In terms of structure, we can already show that the Atlantic Ombrophylus Dense Forest differs significantly from the Amazon Ombrophylus Dense Forest, since it has a lower canopy height (18 to 20 meters) and a different relation between height and diameter. Overall, we also found significant differences among the four phytophysiognomies along the altitudinal gradient. In the Restinga Forest, we found 90 species per hectare, this number increases to 130 species in the Low Land ODF (50 – 100 m of altitude) and in the Montana ODF (500 a 1000 m). In the Sub Montana ODF (100-500 m of altitude), we found so far the highest diversity, with more then 200 species per hectare.

The first results of floristics and phytossociology allowed us to choose species or group of species suitable for representing each phytophisiognomie for auto-ecology and population ecology studies. In the cariotypes of Fabaceae species, it was observed dominance of metacentric chromosomes, and a lower number of submetacentric chromosomes. Chromosome numbers varied from 2n = 14 to 24. Based on floristic and phytossociology studies, we choose species or group of species, like the palms for studies of population structure and distribution.

Regarding ecosystem functioning, we are developing studies about carbon and nitrogen cycles, including stock of this elements in the soil, in living biomass, recycling via liter fall, and potential losses via flux of gases. The first results showed that there are significant differences in the gas flux of carbon and nitrogen along the altitudinal gradient, suggesting that ecosystem functioning differs along this gradient. The main component of the living aboveground biomass are the trees, being responsible for more than 90% of the total; pteridophytes are responsible for less than 1% and palms from 1 to 5% depending on the altitude.

The highest total aboveground biomass was found in the Sub Montana ODF (235,42 Mg.ha-1) followed by the Montana ODF (223,87 Mg.ha-1). Low land ODF, both disturbed (T.B. Explorada) and not disturbed, had a lower biomass. The lowest biomass was found at the Resting forest.

An integrated analysis of the results obtained so far, allowed us, for instance, to use species niche distribution tools, like the Genetic Algorithm for Rule-set Prediction/ GARP, coupled with global warming models, like the Hadley Center model. The preliminary modeling efforts have shown that an increase of ≤ 2°C within the next 50 years, an optimistic scenario, would result in the reduction of 30% of the area today used by 30 species of trees of the Atlantic Forest. In a more realistic scenario, with an increase of 3°C, the reduction of the potential occurrence area of these species will be in the order of 70%.

MAIN PUBLICATIONS

Agostini K, Forni-Martins ER, Tozzi AMGA, Sazima M. 2008. Microsporogenesis and pollen cytology in two *Mucuna* species (Leguminosae: Faboideae). *Phytomorphology*, accepted.

Colombo AF, Joly CA. 2008. Potential consequences of global climate change for arboreal species of the Atlantic Forest of Brazil. *Conservation Biology,* accepted.

Costa IR, Forni-Martins ER. 2007. Chromosome studies in Gomidesia, Marlierea, Myrceugenia and Myrcia (Myrtaceae, subtribe Myrciinae). *Kew Bulletin*. *62*:113-118.

Costa IR, Forni-Martins ER. 2007. Karyotype analysis in South American species of Myrtaceae. *Botanical Journal of the Linnean Society*. **155**: 571-580.

Joly CA, Martinelli LA, Alves LF, Vieira SA, Tamashiro JY, Aidar MPM, Camargo PB, Assis MA, Bernacci LC. 2008. As parcelas permanentes do Projeto Temático BIOTA Gradiente Funcional: Composição florística, estrutura e funcionamento da Floresta Ombrófila Densa dos Núcleos Picinguaba e Santa Virgínia do Parque Estadual da Serra do Mar, São Paulo, Brasil. In: Carlos Roberto Sanquetta. (Org.). Parcelas Permanentes nos Biomas Mata Atlântica e Pampa. Brasília, Ministério do Meio Ambiente.

Pansarin LM, Pansarin ER, Sazima M. 2008. Reproductive biology of *Cyrtopodium polyphyllum* (Orchidaceae): a Cyrtopodiinae pollinated by deceit. *Plant Biology,* accepted.

Pansarin LM, Pansarin ER, Sazima M. 2008. Facultative autogamy in *Cyrtopodium polyphyllum* (Orchidaceae) through a rain-assisted pollination mechanism. *Australian Journal of Botany*, accepted.

Vieira SA, Alves LF, Aidar MPM, Araújo LS, Baker T, Batista JLF, Campos MCR, Camargo PB, Chave J, Delitti WB, Higuchi N, Honorio E, Joly CA, Keller M, Martinelli LA, de Mattos EA, Metzker T, Phillips O, Santos FAM, Shimak, Shimabukuro MT, Silveira M, Trumbore SE. 2008. Estimation of Biomass and Carbon Stocks: the Case of the Atlantic Rain Forest. *Biota Neotropica*. **8(2)**: (accepted).

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