ASSEMBLY AND EVOLUTION OF THE AMAZONIAN BIOTA AND ITS ENVIRONMENT: AN INTEGRATED APPROACH

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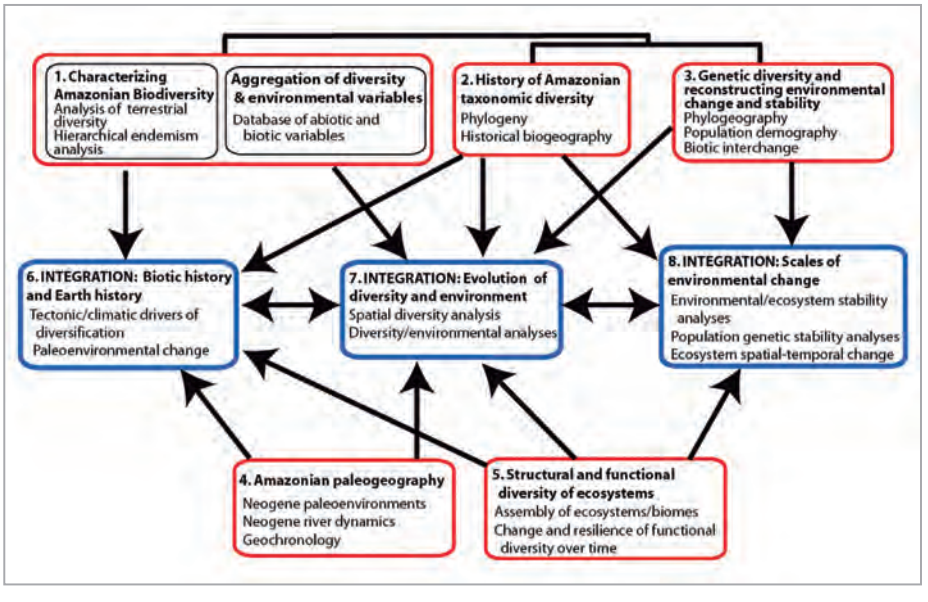

Figure 1. Summary of activities being developed within the project.

The Amazon is one of the most biodiverse areas on Earth; however, little is still known about the processes that led to such great diversity. Indeed, many uncertainties remain about its geologic history, age of formation, and extension of its terrestrial and aquatic systems. For instance, while some models claim that the Amazon was established during mid-Miocene, others established its origin in the Pleistocene. The resolution of these historical uncertainties and a better understanding of how the Amazonian biota has responded to past paleogeographic/climatic events are of extreme importance for a better understanding of the processes associated with the generation and maintenance of its biodiversity. This knowledge is also vital for predicting the future of this extremely important biome.

This project aims to achieve a new evolutionary and environmental synthesis of Amazonia biodiversity, integrating findings from phylogenetics, historical biogeography, phylogeography, remote sensing, geology and biogeochemical cycles in a new model about the origin and evolution of the Amazonian biota, from the Neogene to present. New geological data and biological studies with plants, butterflies, birds and primates will help solve several uncertainties about the mechanisms responsible for the diversification, spatial organization and dynamics of Amazonia over the last 20 million years.

This project aims to answer biogeographical, evolutionary and geological questions such as: (1) How species diversity is distributed and organized at varying spatial scales into common distribution patterns? (2) What has been the phylogenetic history and pattern of diversification of Amazonian taxa? (3) What has been the paleogeographical history of the Amazonian drainage system and terrestrial tropical Amazonia, particularly in the west, and since the latest Neogene when the World became cooler and drier and the effects of climate forcing more pronounced? (4) To what extent do large-changes in ecosystem structure relate to the distribution of species and ecosystem diversity? (5) How did the history of Amazonia influence global-scale changes in biogeochemical cycling?

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

During the first years of this project, we compiled the most complete georeferenced database for Amazonian vascular plants and terrestrial vertebrates to date. These data are now being analyzed using macroecological approaches to characterize patterns of Amazonian diversity and endemism and address fundamental questions about how that biodiversity has evolved. DNA sequences of hundreds of species of our target taxa (e.g., birds, butterflies, primates, and plants) from across Amazonia were obtained and used to generate a series of time-calibrated phylogenies and phylogeographic networks for biogeographic studies.

Geological studies to date have focused on the sedimentary geology and palynology of the Amazon Basin, as well as on the study of climatic changes in the Amazon during the last 20.000 million years. These studies aimed at describing the evolution of the Amazon river basin and Amazonian forests based on geological sedimentary sequences and their pollen content. In addition, ongoing studies using oxygen isotope records in cave speleothems have indicated an antiphased pattern of precipitation between Eastern and Western Amazonia. The new data obtained covers the last 250.000 years and represents the longest absolute paleoclimatic record for the Amazon thus far and a unique record of climate change during the last glacial/interglacial periods in the Amazon. As genetic data are overlaid on this new paleoclimatic data, new insights about are gained on the complex biogeographic history of Amazonia.

Great efforts were also invested towards planning and integrating international research teams. Four meetings, one at FAPESP (São Paulo, 2013), one at INPA (Manaus, 2014) and two at USP (São Paulo, 2015, 2016) provided multiple venues for collaborative research. These meetings included extensive discussions among project members and open symposia to the whole scientific community. Symposia included talks on the biogeographic history of Amazonian organisms, as well as overviews of the Amazonian past geological history, among others.

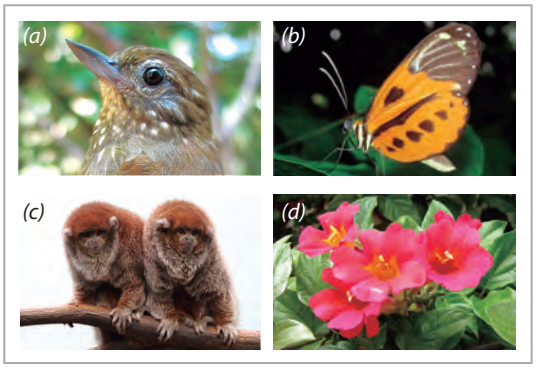

Figure 2. Project's focal organisms: (a) birds, (b) butterflies, (c) primates, and (d) plants.

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