

Project proposal

TITLE: Systematic of *Aguiaria*, *Catostemma* and *Scleronema* (Malvaceae; Bombacoideae)

INTRODUCTION. Bombacoideae (Malvaceae Juss.) comprises 27 genera and ca. 250 species with a pantropical distribution. The subfamily is found in the neotropics from Mexico to Central and South America (Bayer & Kubitzki 2003). Recent phylogenetic studies have recovered Bombacoideae as monophyletic, composed of three tribes - Adansonieae Horan., Bernoullieae Carv.-Sobr., and Bombaceae Kunth. (Carvalho-Sobrinho *et al.* 2016). Based on this new classification, tribe Adansonieae composed of five genera - *Adansonia* L., *Aguiaria* Ducke, *Cavanillesia* Ruiz & Pav., *Catostemma* Benth., and *Scleronema* Benth. The genera *Aguiaria*, *Catostemma* and *Scleronema*, are exclusively Neotropical, comprising 30 described names, out of which 20 are accepted, with 15 under *Catostemma*, four under *Scleronema*, and one under *Aguiaria* (Paula 1969; The Plant List 2013).

Aguiaria was described by Ducke (1935), based on Amazon endemic *A. excelsa* Ducke. This genus was only once the focus of a study, by Cardoso *et al.* (2015), which collected new samples of the same population discovered by Ducke (1935). Thus, it is presently known from this sole population in the Brazilian Amazon Forest, more precisely at Alto do Rio Negro, near São Gabriel da Cachoeira.

Catostemma and *Scleronema* were described by Bentham (1843, 1862, respectively), based on specimens from Guyana and Brazil, respectively. In the same way as *Aguiaria*, *Catostemma* and *Scleronema* are also endemic to the Amazon domain. Nonetheless, due to ambiguous circumscriptions of the latter two genera, great conflict arose in the past years with taxonomists recognizing different diagnostic features and thus, issues in recognizing both as distinct taxa. For this reason, some authors, like Bakhuizen (1924) and Ducke (1937), transferred different species from *Catostemma* to *Scleronema*, and vice-versa. The most recent and detailed accounts on these genera are the ones of Paula (1969), for the Brazilian Amazon, and Steyermark (1987), for Venezuela. Other relevant studies were made by Sandwith (1928, 1931, 1948), dealing with these plants in Guyana.

Hence, it is possible to observe several knowledge gaps, revolving mainly around the groups' taxonomy and morphology, its distribution, phylogeny, biogeography, and ecology. This is mainly due to all available studies being geographically limited, such as regional and national floras, which makes it necessary to study *Aguiaria*, *Catostemma* and *Scleronema* under a complete systematic light. Furthermore, no phylogenies to this moment have tested the monophyly of either of these genera. Also, no complete taxonomic account is available for them, reevaluating species' delimitation, presenting an identification key to all species, and reviewing nomenclatural issues.

OBJECTIVES. Present a taxonomic revision of *Aguiaria*, *Catostemma* and *Scleronema*, supported by a well-sampled molecular phylogeny. Test the monophyly and the relationship between these three genera, based on molecular data and supported by the evolution of selected morphological characters. Reevaluate species' boundaries, recognizing diagnostic features and the species' geographical distribution. Based on all gathered information, propose conservation assessments for all accepted taxa.

METHODS. *Taxonomy* – Specimens from the following herbaria will be studied: COAH, COL, EAFM, F, HAMAB, HSTM, HUEFS, INPA, K, MG, MO, NY, P, RB, S, SPF,

UEC, USM, US, and VEN (Thiers, continuously updated). These collections will be given priority since they present a considerable number of specimens and type specimens of the studied genera. The studied specimens will serve as the basis of detailed morphological descriptions, identification keys and illustrations. They will also be fundamental for the biogeography, distribution and confection of maps, and assessment of environmental preferences. Field expeditions will also be made in certain localities that allow us to collect a higher amount of samples and data for morphological and molecular studies.

Phylogeny – Three species of *Adansonia* and three of *Cavanillesia* will be used as outgroups, while species of *Aguiaria*, *Catostemma* and *Scleronema* will be used as the ingroup, totalling 26 taxa. Out of these, 12 taxa already have sequences for the selected markers on GenBank, while the remaining 14 will need to have their DNA extracted, amplified and sequenced. The DNA will be extracted from leaves dried in silica gel or from herbarium samples following Doyle & Doyle (1987) or using DNeasy Plant Mini Kit (Qiagen, Hilden, Germany), following the specifications from the manufacturer. Sequences for the nuclear markers ETS and ITS and from the plastidial markers *matK*, *trnS-G* and *trnL-F* will be generated. The three main phylogenetic reconstruction approaches will be used in this study, parsimony, maximum likelihood, and Bayesian inference, all of them run on Cyberinfrastructure for Phylogenetic Research (CIPRES) Portal 2.0 (Miller *et al.* 2010). Visualization and partial edition of the trees for graphical purposes will be done using FigTree v.1.4.2 (Rambaut 2014). Ancestral trait reconstruction of the group will be done over parsimony on a Bayesian consensus tree, using the “Trace over trees” option on Mesquite v.3.04 (Maddison & Maddison 2015).

RELEVANT INFORMATION. The current study is being developed as part of the requirements to obtain a Ph.D., initiated in March 2019 with an expected conclusion in February 2023. Thus far, we have conducted detailed bibliographic and herbaria studies, including all digitized collections and type specimens, and have initiated the description of some species. This proposal will play a key role in enabling us to make several herbarium visits, as well as aiding us to cover the costs of our field expeditions to the Amazon Forest. These expeditions are essential not only for the phylogenetic study, allowing us to collect fresh leaf samples and producing high-quality sequences, but they are also a crucial part of the taxonomic revision. This study is partially funded by the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ). Nonetheless, this funding is insufficient to cover all costs, especially with the need for expensive trips, such as Northern Brazil, Colombia, and Peru, which are a priority in order to ensure the success of this study.

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