IAPT RESEARCH GRANT APPLICATION TEMPLATE

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TAXONOMY AND FILOGENY OF *ELEOCHARIS* (CYPERACEAE)

Advisor: Dr. André dos Santos Bragança Gil
Co-Advisor: Dr. Rafael Trevisan

SUMMARY

This project has as main objectives to contribute to the taxonomic knowledge of *Eleocharis* in the Brazilian Pampa, fundamental to reconstruct the phylogeny of the genus. Extensive fieldwork and morphological analysis of specimens of *Eleocharis* in the herbariums of southern Brazil and Uruguay will be carried out.

INTRODUCTION

Cyperaceae is among the seven most representative families of angiosperms and is considered the third largest family among monocots (Govaerts et al. 2007). The family has a higher richness in the biomes belonging to the Neotropical and Subtropical regions, always being among the most representative, as is the case of the Pampa biome, in which Cyperaceae is among the four most diverse families of angiosperms, with countless rare and endemic species, many of which have vulnerable conservation status (Boldrini 2009).

Species of Cyperaceae occupy almost all terrestrial environments, highlighting the genus *Eleocharis* that inhabits aquatic and palustrial environments, inclusive characterizing water environments (Gil & Bove 2007). *Eleocharis* is widely distributed in Tropical and Subtropical regions and comprises approximately 250 species (Govaerts *et al.* 2007). The morphology of *Eleocharis* is simple (Figure 1), such as reduced leaves, a tubular sheath, absence of the typical involucral bracts found in Cyperaceae, and an inflorescence reduced to a single terminal spikelet, characteristics that make its identification a great challenge, as many diagnostic characteristics of the species are associated to small structures (Svenson 1929; González-Elizondo & Peterson 1997). Roalson et al. (2010) with molecular phylogenetic studies tested the traditionally accepted morphological classification (González-Elizondo & Peterson 1997), and despite the high support for many of the infragenic clades and taxa, the study evidenced the low sampling and little support in some taxa like *Eleocharis* ser. *Tenuissimae* and its sister group, *Eleocharis* ser. *Maculosae.* Both series comprise three large groups of species complexes, *Eleocharis minima* Kunth, *Eleocharis retroflexa* (Poir.) Urb. and *Eleocharis maculosa* (Vahl) R. Br., which are the least understood within the genus, generating forced taxonomic identification, due to the wide range of morphological variation and the difficulty of finding diagnostic characters (Trevisan & Boldrini 2010).

FIGURE 1. A-B. Detail of the inflorescence of *Eleocharis*; **C.** Detail of the sheath apex; **D.** C.S. Nunes collecting samples in the Amazon; **E.** habitat.

In the Neotropical region occur approximately 145 species of *Eleocharis* (González-Elizondo & Tena-Flores 2000), growing in moist or inundated soils, lagoons, lakes, marshes, on river margins, and in the sandy

coastal vegetation (known in Brazil as *restinga*) (Gil & Bove 2007; Trevisan & Boldrini 2008). Abundant water and light are the main resources required for good development of the species (Gil & Bove 2004). Among the biomes belonging to the Neotropics, the Pampa holds the largest number of species of *Eleocharis*, many of which are endemic (Flora do Brasil 2020, in construction). The Pampa covers an area of approximately 750,000 km^2 in South America, covering most of the state of Rio Grande do Sul, in the southern region of Brazil, the entire territory of Uruguay and part of Buenos Aires, Córdoba, Corrientes, Entre Ríos, La Pampa, Misiones, Santa Fe and San Luis in Argentina (Overbeck 2007; Viglizzo et al. 2006). The Pampa occupies a transition area between tropical and temperate climates and is one of the most important grasslands areas on the planet (Cabrera & Willink 1980; Waechter 2002). Conservation, biogeographic and evolutionary studies for *Eleocharis* species in the Pampa region require a consistent taxonomy, as this important Neotropical biome has the fewest protected areas, and according to the Ministry of the Environment of Brazil (MMA), it is one of most lacking in scientific knowledge and information.

OBJECTIVES

The main objective of the project is to contribute to the taxonomic knowledge of *Eleocharis* in the Brazilian Pampa, fundamental to reconstruct the phylogeny of the genus, and focused on the circumscription of *Eleocharis* ser. *Tenuissimae*. In this context, the specific objectives are: a) accomplish field collections in the Brazilian Pampa biome, and increase the collections of the main Brazilian and international herbariums; b) obtain dry material on silica for DNA extraction and phylogenetic reconstruction of *Eleocharis*; c) update and correctly identify the samples of *Eleocharis* deposited in the main herbaria throughout the Pampa region; d) provide data on the distribution, habitat and conservation status of the *Eleocharis* species occurring in the Pampa.

MATERIAL AND METHODS

The execution of the objectives will follow the following steps: a) Extensive fieldwork in potential areas of the Brazilian Pampa, in order to obtain sufficient samples for the most robust phylogenetic reconstruction; b) Morphological analysis of *Eleocharis* specimens, mainly of nomenclatural Types, deposited in the herbariums of the South region of Brazil (FLOR, JOI, FURB, ICN, SFPA, HAS, IBP, UPCB, FUEL, HUEM) and Uruguay (MVFA, MVM, MVJB); c) Collection of geographic and habitat data through the labels of samples deposited in the herbariums, which is essential to understand the distribution, patterns and diversity in the Pampa region; d) In-depth study of the evolution of characters in the genus, in order to test specific hypotheses about morphological character states in *Eleocharis*.

PRELIMINARY RESULTS

During the first years of my Ph.D., I completed all courses required for the Ph.D. program at UFRA/MPEG and advanced with my Ph.D. project. More specifically, I analyzed the specimens deposited at the Amazon herbaria HBRA, HSTM, IAN, INPA and MG. In those herbaria, I examined ca. 500 specimens. In addition, field trips were carried out from past two years in Amazon region, encompassing the flowering and fruiting of several *Eleocharis* species. During those field-expeditions, I sampled 20 of the 65 species which we intend to include on the phylogeny.

EXPECTED RESULTS

The results will be published in at least tree periodics of broader scope, in international journals: the results of the phylogeny will be submitted to the Taxon (3.823). One taxonomic paper, involving the circumscription of *Eleocharis* ser. *Tenuissimae*, with delimitation and characterization of species complexes and necessary nomenclatural adjustments will be submitted to Botanical Journal of the Linnean Society (3.057). At least three articles with the taxonomic and nomenclatural novelties that arise during the development of the project, such as new species and typifications, will be submitted to Systematic Botany (1,259).

PROJECT SIGNIFICANCE

The execution of this project, generating data through floristic surveys, as well as evolutionary and ecological studies, benefit some traditional communities, since an ambiguous identification or even assigning ranges of morphological and ecological variation to a given taxon can induce misinterpretations about its geographic distribution, autoecology and on the ecological quality of ecosystems.

BUDGET AND JUSTIFICATION

The Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, Coordination for the Improvement of Higher Education Personnel) awarded a PhD scholarship to C.S. Nunes with an annual stipend of USD 6200. In addition, the Fundação Amazônia de Amparo a Estudos e Pesquisa (FAPESPA, Amazon of Support for Studies and Research) has already provided financial support to the project "Cyperaceae Juss. in the state of Pará: increase in collections, taxonomy and conservation" coordinated by Dr. André Gil, and a proponent composes a team, aiming to collect Cyperaceae in the Amazon region. During these field expeditions carried out by the project described above in the Amazon, 20 of the 65 species that intend to be sampled in phylogeny have already been collected. A grant from IAPT would be used to cover costs associated with visit to the main herbariums with expressive collections of *Eleocharis* located in the region of the pampas and also fieldwork in the Pampa in Brazilian territory, in order to sample mainly 15 species strictly endemic to the biome, essential for the robustness of phylogeny and to understand the diversity of species of the genus in the area. It is worth mentioning my co-supervisor, Dr. Rafael Trevisan, one of the greatest specialists in the *Eleocharis* genre, who works in the southern region of Brazil and has an opportunity to exchange experiences and networks, which will be of great relevance for this research. The general budget for this proposal is presented below:

Items	Description	Value (US$)
Airplane tickets	Belém (BEL/Brazil) – Porto Alegre (POA/Brazil)	135,00
	Porto Alegre (POA/Brazil) – Montevideo (MVD/Uruguay)	135,00
	Montevideo (MVD/Uruguay) – Belém (BEL/Brazil)	270,00
Car Rent	Estimated cost/US$20(per day) – 10 days	200,00
Personal Daily expenses	40 days/US$ 30 (per day)	1.200,00
Total		**1.940,00**

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