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THE RESEARCH EFFORT ON SEEDS OF PLANT SPECIES NATIVE TO THE BRAZILIAN FLORA

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Abstract

The study performed a checklist of publications on species with available seed information and identified their issues and volumes. These publications occurred during the existence of the online versions of Revista Brasileira de Sementes (Brazilian Journal of Seeds) and the Journal of Seed Science. This data survey intends to represent a foundation for other studies and contribute to the knowledge of native plant species in Brazil. The search focused on the seeds of plants native to Brazil, indicating high negligence regarding the knowledge of Brazilian biodiversity because of the total number of articles published in 33 issues of Revista Brasileira de Sementes between 2002-2012 and the Journal of Seed Science, a substitute of the former journal, from 2012 to the first semester of 2020, with 28 issues published, but only 208 studies addressing seeds of plant species native to Brazil.

Keywords: Ecology. Knowledge. Plant Production. Science.

1. Introduction

Regarding biodiversity management and preservation, researchers have often emphasized that the focus should lie on the functional process of ecosystems, moving away from preservation only centralized on species (Jordano et al. 2006; Rezende de Paula, 2013; Penna-Firme and Oliveira, 2017; Fernandes et al. 2020). The phenological phases of the vegetative community are relevant for understanding the functional interactions of different elements of the landscape. Overall, the development of phenological phases is associated with diverse biotic and abiotic components of the ecosystem and geosystem (Bencke and Morelato, 2002; Neves and Morellato, 2004; Chuine and Régnière, 2017). The life periods of plants include the production and dispersal of seeds, which is significant for vegetative propagation (Jordano et al. 2006).

Understanding the production of seeds in species of the native flora is important for the relationship between biodiversity management and conservation in Brazil. Examples of this matter are the production of native species seedlings to recover degraded areas (Souza et al. 2006; Nogueira e Medeiros, 2007), studies on genetic variability; (Nascimento et al. 2002; Hewitt, 2004), knowledge of vegetative propagation strategies of different plant groups; (Araújo et al. 2004; Gressler et al. 2006; Penhalber e Mantovani, 2007; Deminicis et al. 2009), the interactions among plants, dispersers, and pollinators; (Gressler et al. 2006), knowledge of seed dispersal ability of different taxonomic groups; (Jordano et al. 2006), maintenance of fruit and seed banks of native species; (Peixoto and Amorim, 2003), validation of

ethnobotanical knowledge; and support for paleoenvironmental studies, considering that seed fossils are proxies used in paleobotanic searches (Ramírez, 2014; Melo-Júnior and Magalhães, 2015).

2. Material and Methods

The methodological process was based on an annual review, with a search in all articles published during the existence of the online versions of Revista Brasileira de Sementes and the Journal of Seed Science. The study performed a checklist of publications on species with available seed information and identified their issues and volumes. This data survey intends to represent a foundation for other studies and contribute to the knowledge of native plant species in Brazil.

3. Results

The research focused on the seeds of plants native to Brazil indicated high negligence regarding the knowledge of Brazilian biodiversity because of the total number of articles published in 33 issues of Revista Brasileira de Sementes between 2002-2012 and the Journal of Seed Science, a substitute of the former journal, from 2012 to the first semester of 2020, with 28 issues published but only 208 studies addressing seeds of plant species native to Brazil. This scenario suggests an average of 10 articles per issue, representing only around 34% of the Brazilian scientific publication addressing seeds from native species of Brazil, an underestimated value considering the journal has published four annual volumes over the last decade.

A total of 103 native species were found in the analyzed issues of the referred scientific journal. Of this total, most are arboreal and shrub plants. Herbs were less studied, totaling 22 species, in addition to a liana (*Macroptilium lathyroides*). The most studied botanical groups at the taxonomic family level were Fabaceae, Myrtaceae, and Arecaceae. Altogether, 25 botanical families were represented in the studied articles. The Atlantic Forest biome stood out in the number of species with previous seed analyses, and the least studied domain was the Pampa. However, most species included in the studies show a wide geographic distribution, occurring in at least two different Brazilian biomes. Among the species in the studies, 84 occur in the Atlantic Forest, 70 in Cerrado, 56 in the Amazon, 50 in Caatinga, and 22 in the Pampa. However, it is worth noting that several species were the subject of more than one study.

The non-tree species studied were: *Salvia splenden; Sesbania virgata; Adesmia latifólia; Macroptilium lathyroides; Trifolium riograndense; Desmanthus depressus; Gleditschia amorphoides; Syngonanthus elegans; Adesmia latifólia; Operculina macrocarpa; Passiflora cincinnata; Chaptalia nutans; Bauhinia monandra; Piper hispidinervum; Piper aduncum; Talinum triangulare; Passiflora setácea; Adesmia tristes; Centrosema plumieri; Acanthospermum hispidum; Stenachaenium megapotamicum; Zephyranthes sylvatica; Plukenetia volubilis*. In this group are mostly plants of ornamental, food and medicinal value.

The studied arboreal and shrub species also show plants with different functions, such as medicinal, traditional, extractive, and conservationist, among others. The survey also showed a high variation in the number of native plants studied among the different issues of the scientific journal, as there are volumes with several articles on native species, others with a few, and some without any study on native species. There was also no frequency of increase or decrease in the number of native species addressed in the publications of this scientific journal.

Table 1. Publications on native species in Journal of Seed Science.

Year	Volume	Specie
2002	Vol.24 nº1	*Mimosa caesalpiniaefolia*
2002	Vol.24 nº1	*Oenocarpus mapora*
2002	Vol.24 nº1	*Bixa orellana*
2002	Vol.24 nº1	*Acacia polyphylla*
2002	Vol.24 nº1	*Dalbergia nigra*
2002	Vol.24 nº2	*Myrciaria dubia*
2003	Vol.25 nº1	*Bowdichia virgilioides*
2003	Vol.25 nº1	*Peltophorum dubium*
2003	Vol.25 nº2	*Bowdichia virgilioides*

2003	Vol.25 nº2	*Amburana cearensis*
2004	Vol.26 nº1	*Cnidosculus phyllacanthus*
2004	Vol.26 nº1	*Senna multijuga*
2004	Vol.26 nº1	*Senna macranthera*
2004	Vol.26 nº1	*Salvia splenden*
2004	Vol.26 nº1	*Sesbania virgata*
2004	Vol.26 nº2	*Adesmia latifolia*
2004	Vol.26 nº2	*Platymiscium pubescens*
2004	Vol.26 nº2	*Tabebeuia serratifolia*
2004	Vol.26 nº2	*T. impetiginosa*
2005	Vol.27 nº1	*Mimosa caesalpiniifolia*
2005	Vol.27 nº1	*Drimys brasiliensis*
2005	Vol.27 nº2	*Bixa orellana*
2005	Vol.27 nº2	*Allophylus edulis*
2005	Vol.27 nº2	*Drimys brasiliensis*
2005	Vol.27 nº2	*Cecropia glaziovi*
2005	Vol.27 nº2	*Dinizia excelsa*
2005	Vol.27 nº2	*Sebastiana commersoniana*
2005	Vol.27 nº2	*Pouteria pachycarpa*
2006	Vol.28 nº1	*Balfourodendron riedelianum*
2006	Vol.28 nº1	*Dinizia excelsa*
2006	Vol.28 nº1	*Himatanthus drasticus*
2006	Vol.28 nº1	*Eugenia brasiliensis*
2006	Vol.28 nº1	*Eremanthus erythropappus*
2006	Vol.28 nº1	*Pterogyne nitens*
2006	Vol.28 nº1	*Schizolobium amazonicum*
2006	Vol.28 nº2	*Esenbeckia grandiflora*
2006	Vol.28 nº2	*Guazuma ulmifolia*
2006	Vol.28 nº2	*Ocotea porosa*
2006	Vol.28 nº2	*Macroptilium lathyroides*
2006	Vol.28 nº3	*Trifolium riograndense*
2006	Vol.28 nº3	*Desmanthus depressus*
2006	Vol.28 nº3	*Gleditschia amorphoides*
2006	Vol.28 nº3	*Schizolobium amazonicum*
2006	Vol.28 nº3	*Dictyoloma vandellianum*
2006	Vol.28 nº3	*Podocarpus lambertii*
2006	Vol.28 nº3	*Podocarpus sellowii*
2006	Vol.28 nº3	*Croton floribundus*
2006	Vol.28 nº3	*Campomanesia adamantium*
2007	Vol.29 nº1	-
2007	Vol.29 nº2	*Euterpe oleracea*
2007	Vol.29 nº3	*Mimosa caesalpiniaefolia*
2007	Vol.29 nº3	*Theobroma grandiflorum*
2008	Vol.30 nº1	*Syngonanthus elegans*
2008	Vol.30 nº1	*Clitoria fairchildiana*
2008	Vol.30 nº1	*Oenocarpus minor*
2008	Vol.30 nº1	*Guazuma ulmifolia*
2008	Vol.30 nº1	*Caesalpinia pyramidalis*
2008	Vol.30 nº2	*pseudima frutescens*
2008	Vol.30 nº2	*Cecropia pachystachya*
2008	Vol.30 nº2	*Adesmia latifolia*
2008	Vol.30 nº2	*Poecilanthe parviflora*
2008	Vol.30 nº2	*Schinopsis brasiliensis*
2008	Vol.30 nº3	*Syngonanthus elegans*
2008	Vol.30 nº3	*Erythrina velutina*
2008	Vol.30 nº3	*Clitoria fairchildiana*
2009	Vol.31 nº1	*Ricinus Communis*
2009	Vol.31 nº1	*Bowdichia virgilioides*
2009	Vol.31 nº1	*Magnolia ovata*
2009	Vol.31 nº2	*Casearia Sylvestris*
2009	Vol.31 nº2	*Tabebuia impetiginosa*
2009	Vol.31 nº2	*Campomanesia adamantium*

2009	Vol.31 nº2	*Lychnophora pinaster*
2009	Vol.31 nº2	*Magonia pubescens*
2009	Vol.31 nº2	*Blepharocalyx salicifolius*
2009	Vol.31 nº2	*Schizolobium parahyba*
2009	Vol.31 nº3	*Operculina macrocarpa*
2009	Vol.31 nº3	*Magnolia ovata*
2009	Vol.31 nº3	*Passiflora cincinnata*
2009	Vol.31 nº3	*Chaptalia nutans (L.)*
2009	Vol.31 nº4	*Rollinia mucosa*
2009	Vol.31 nº4	*Dinizia excelsa*
2009	Vol.31 nº4	*Bauhinia monandra*
2010	Vol.32 nº1	*Euterpe oleracea*
2010	Vol.32 nº1	*Copaifera Langsdorffii*
2010	Vol.32 nº1	*Chrysophyllum gonocarpum*
2010	Vol.32 nº2	*Stryphnodendron*
2010	Vol.32 nº2	*Piptadenia moniliformis*
2010	Vol.32 nº2	*Caesalpinia echinata Lam.*
2010	Vol.32 nº3	*Blepharocalyx salicifolius*
2010	Vol.32 nº3	*Myrceugenia gertii*
2010	Vol.32 nº3	*Amburana cearensis*
2010	Vol.32 nº3	*Kielmeyera coriacea*
2010	Vol.32 nº3	*Melanoxylon brauna*
2010	Vol.32 nº3	*Piper hispidinervum*
2010	Vol.32 nº3	*Piper aduncum*
2010	Vol.32 nº4	*Erythrina velutina*
2010	Vol.32 nº4	*Talinum triangulare*
2011	Vol.33 nº1	*Piptadenia moniliformis*
2011	Vol.33 nº1	*Passiflora setacea*
2011	Vol.33 nº1	*Apeiba tibourbou*
2011	Vol.33 nº1	*Hymenaea stigonocarpa*
2011	Vol.33 nº2	*Psidium cattleianum*
2011	Vol.33 nº2	*Peltophorum dubium*
2011	Vol.33 nº2	*Caesalpinia pyramidalis tul.*
2011	Vol.33 nº2	*Anadenanthera colubrina*
2011	Vol.33 nº2	*Enterolobium contortisiliquum*
2011	Vol.33 nº2	*Chorisia glaziovii*
2011	Vol.33 nº3	*Bowdichia virgilioides*
2011	Vol.33 nº3	*Adesmia tristis*
2011	Vol.33 nº3	*Eugenia uniflora*
2011	Vol.33 nº4	*Tabebuia heptaphylla*
2011	Vol.33 nº4	*Curitiba prismatica*
2011	Vol.33 nº4	*Tabebuia avellanedae*
2011	Vol.33 nº4	*Tabebuia impetiginosa*
2011	Vol.33 nº4	*Centrosema plumieri Benth*
2011	Vol.33 nº4	*Schinus terebinthifolius*
2011	Vol.33 nº4	*Senna macranthera*
2012	Vol.34 nº1	*Melanoxylon brauna*
2012	Vol.34 nº2	*Poincianella pyramidalis*
2012	Vol.34 nº2	*Phenakospermum Guyannense*
2012	Vol.34 nº2	*Chrysophyllum amazonicum*
2012	Vol.34 nº2	*Chrysophyllum prieurii*
2012	Vol.34 nº3	*Tapirira obtusa*
2012	Vol.34 nº3	*Xylopia aromatica*
2012	Vol.34 nº3	*Tabebuia caraiba*
2012	Vol.34 nº3	*Acanthospermum hispidum*
2012	Vol.34 nº4	*Erythrina velutina*
2012	Vol.34 nº4	*Oenocarpus bacaba Mart.*
2013	Vol.35 nº1	*Dalbergia nigra ((Vell.) Fr All. ex Benth.)*
2013	Vol.35 nº1	*Inga vera Willd. subsp. affinis (DC.) T. D. Penn.*
2013	Vol.35 nº1	*Parapiptadenia rigida (Benth.)*
2013	Vol.35 nº1	*Dalbergia nigra ((Vell.) Fr All. ex Benth.)*
2013	Vol.35 nº1	*Acrocomia aculeata*

2013	Vol.35 nº2	*Bactris gasipaes Kunth*
2013	Vol.35 nº3	*Stenachaenium megapotamicum (Spreng.)*
2013	Vol.35 nº3	*Cereus jamacaru DC*
2013	Vol.35 nº3	*Casearia decandra*
2013	Vol.35 nº3	*Blepharocalyx salicifolius*
2013	Vol.35 nº4	*Genipa americana L.*
2013	Vol.35 nº4	*Caesalpinia echinata*
2013	Vol.35 nº4	*Annona crassiflora Mart*
2014	Vol.36 nº1	*Copernicia prunifera*
2014	Vol.36 nº1	*Tabebuia roseoalba*
2014	Vol.36 nº2	*Euterpe edulis*
2014	Vol.36 nº2	*Melanoxylon brauna*
2014	Vol.36 nº2	*Zephyranthes sylvatica*
2014	Vol.36 nº2	*Erythrina velutina*
2014	Vol.36 nº3	*Dalbergia nigra*
2014	Vol.36 nº3	*Eugenia involucrata*
2014	Vol.36 nº3	*Eugenia pyriformis*
2014	Vol.36 nº3	*Ormosia arborea*
2014	Vol.36 nº3	*Eugenia uniflora*
2014	Vol.36 nº4	*Eugenia brasiliensis*
2014	Vol.36 nº4	*Eugenia uniflora.*
2014	Vol.36 nº4	*Eugenia pyriformis*
2014	Vol.36 nº4	*Elaeis oleifera*
2015	Vol.37 nº1	-
2015	Vol.37 nº2	*Caesalpinia echinata*
2015	Vol.37 nº2	*Handroanthus serratifolius*
2015	Vol.37 nº2	*Plukenetia volubilis*
2015	Vol.37 nº2	*Poincianella pluviosa*
2015	Vol.37 nº3	*Melanoxylon brauna*
2015	Vol.37 nº3	*Eugenia uniflora*
2015	Vol.37 nº4	*Ormosia paraensis*
2015	Vol.37 nº4	*Piptadenia moniliformis*
2015	Vol.37 nº4	*Psidium guineense*
2015	Vol.37 nº4	*Senna macranthera*
2016	Vol.38 nº1	*Simira gardneriana*
2016	Vol.38 nº1	*Sesbania virgata*
2016	Vol.38 nº2	*Allophylus edulis*
2016	Vol.38 nº2	*Dalbergia nigra*
2016	Vol.38 nº2	*Anadenanthera colubrina*
2016	Vol.38 nº3	*Balfourodendron riedelianum*
2016	Vol.38 nº3	*Eugenia brasiliensis*
2016	Vol.38 nº3	*Eugenia pyriformis*
2016	Vol.38 nº3	*Hymenaea courbaril*
2016	Vol.38 nº3	*Sesbania virgata*
2016	Vol.38 nº4	-
2017	Vol.39 nº1	*Libidibia ferrea*
2017	Vol.39 nº1	*Senna multijuga*
2017	Vol.39 nº1	*Peltophorum dubium*
2017	Vol.39 nº2	*Bactris gasipaes*
2017	Vol.39 nº2	*Caesalpinia echinata*
2017	Vol.39 nº2	*Platymiscium floribundum*
2017	Vol.39 nº2	*Lonchocarpus muehlbergianus*
2017	Vol.39 nº2	*Acacia polyphylla*
2017	Vol.39 nº3	*Campomanesia pubescens*
2017	Vol.39 nº3	*Arachis pintoi*
2017	Vol.39 nº4	*Magonia pubescens*
2017	Vol.39 nº4	*Anadenanthera colubrina*
2017	Vol.39 nº4	*Amburana cearensis*
2018	Vol.40 nº1	*Senna spectabilis*
2018	Vol.40 nº1	*Campomanesia guazumifolia*
2018	Vol.40 nº2	*Euterpe oleracea*
2018	Vol.40 nº3	*Ormosia paraensis*

2018	Vol.40 nº3	*Senna macranthera*
2018	Vol.40 nº3	*Erythrina speciosa*
2018	Vol.40 nº4	-
2019	Vol.41 nº1	*Myracrodruon urundeuva*
2019	Vol.41 nº1	*Inga vera*
2019	Vol.41 nº1	*Eugenia brasiliensis*
2019	Vol.41 nº1	*Eugenia pyriformis*
2019	Vol.41 nº1	*Eugenia uniflora*
2019	Vol.41 nº1	*Eugenia involucrata*
2019	Vol.41 nº1	*Senna macranthera*
2019	Vol.41 nº2	*Eugenia candolleana*
2019	Vol.41 nº2	*Cedrela fissilis*
2019	Vol.41 nº3	*Calophyllum brasiliense*
2019	Vol.41 nº4	*Pentaclethra macroloba*
2019	Vol.41 nº4	*Tabebuia aurea*

Year (publication date); Vol. (edition in which it is published); Specie (native flora species). Source: Journal of Seed Science.

4. Discussion

Further studies are needed on the seeds of Brazilian native plants, which are essential for managing and preserving biodiversity, mainly because the trophic interaction network uses seeds to integrate people, animals, and plants in different ecosystems (Nascimento et al. 2002; Gressler et al. 2006; Souza et al. 2006; Santos et al. 2011).

The initial motivation of this research was the need to identify species through seeds in the scope of a chapter of the doctoral thesis by (2021). When seeds were collected to monitor the phenological cycle of some species in the forests the author studied. Considering the absence of specialized guidelines in the literature for identifying species through seeds in the case of seasonal forests, scientific articles were searched to find studies on the species identified in the local floristic composition.

In this sense, it was expected that Revista Brasileira de Sementes would have the highest number of publications on seeds of native species of the Brazilian flora. The results of this search show that the referred journal focuses on publishing studies on seeds of exotic plants cultivated in Brazil, although it occasionally addresses native species. This is more representative of the state of priority in seed research by Brazilian institutions than the state of the art of knowledge.

There are surely other scientific journals publishing studies on seeds of native species of the Brazilian flora, but, remarkably, Revista Brasileira de Sementes, although this has not been verified, had the function of beinga reference for the knowledge on seeds of native species. The Fabaceae and Myrtaceae families are expected to be the most studied because they are among those with the highest distribution and occurrence in the territory (Gonçalves, 2014).

However, the number of studies on the Arecaceae family is positively surprising because, despite its abundance throughout the tropical and subtropical region, it is not always among the most studied in the botanical groups of the Brazilian phytogeography (Gonçalves, 2019). Such focus on the study of palm seeds and their ecological importance may relate to the high agroextractive potential of several species of this botanical family (Eiserhardt et al. 2011).

Regarding phytogeography, seed research across biomes is proportionally distributed to the biological research in each domain, although there are asymmetries in the number of studies on each biome for reasons inherent to scientific research (Gonçalves, 2020).

5. Conclusions

The scientific production of knowledge in Brazil is dissimilar from the number of studies on plants of native and exotic species. Several species of Brazilian flora do not have available information about their seeds. A low number of species is addressed in more than one study, indicating the need to extend the basic knowledge about native species.

Governmental agencies that promote scientific studies should increase research resources focusing on the seeds of native species and provide more lines of scientific research in graduate programs specific to seeds of native species in Brazil.

There should be higher visibility for these knowledge gaps in Brazilian biodiversity because unavailable scientific information complicates the development of different aspects of relevant questions in Brazil, such as biotechnology, cosmetology, plant production, and biodiversity management.

Further research on the seeds of native species is required because the available production is insignificant considering the biodiversity of the numerous plants in the Brazilian native flora.

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References

BENCKE, C.S., and MORELLATO, L.P.C. Comparação de dois métodos de avaliação da fenologia de plantas, sua interpretação e representação. *Brazilian Journal of Botany*, 2002, **25**(3), 269-275.

CHUINE, I., and RÉGNIÈRE, J. Process-based models of phenology for plants and animals. Annual Review of Ecology, *Evolution, and Systematics*, 2017, **48**, 159-182. https://doi.org/10.1146/annurev-ecolsys-110316-022706

DEMINICIS, B.B., et al. Dispersão natural de sementes: importância, classificação e sua dinâmica nas pastagens tropicais. *Archivos de Zootecnia*, 2009, **58**(224), 35-58. https://doi.org/10.21071/az.v58i224.5073

EISERHARDT, W.L., et al. Geographical ecology of the palms (Arecaceae): determinants of diversity and distributions across spatial scales. *Annals of Botany,* 2011, **108**(8), 1391-1416. https://doi.org/10.1093/aob/mcr146

FERNANDES, G.W., et al. Floristic and functional identity of rupestrian grasslands as a subsidy for environmental restoration and policy. *Ecological Complexity*, 2020, **43**, 100833. https://doi.org/10.1016/j.ecocom.2020.100833

GONÇALVES, T.S. Caracterização fitogeográfica de grupos botânicos da floresta estacional decidual da Serra do Cipó. *Revista Geográfica Acadêmica*, 2014, **8**(2), 33-46. https://doi.org/10.18227/1678-7226rga.v8i2.2973

GONÇALVES, T.S. Ecology and importance of the Conservation from Specie Buritizinho (Mauritiella Armata (Mart) Burret - Arecaceae). *Annals of Geographical Studies*, 2019, **2**, 17-19.

GONÇALVES, T.S. A História paleoambiental da vegetação brasileira e seus apontamentos sobre a fitogeografia atual do Brasil. *Humboldt-Revista de Geografia Física e Meio Ambiente*, 2020, **1**(1), 1-25.

GONÇALVES, T.S. Origem e evolução fitogeográfica dos capões de mata associados aos ecossistemas de turfeiras da Serra do Espinhaço Meridional–MG. Tese de Doutorado. *Tese (Doutorado em Produção Vegetal*. Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, 2021.

GRESSLER, E., PIZO, M. A. and MORELLATO, L.P.C. Polinização e dispersão de sementes em Myrtaceae do Brasil. *Brazilian Journal of Botany*, 2006, **29**(4), 509-530. https://doi.org/10.1590/S0100-84042006000400002

HEWITT, G.M. Genetic consequences of climatic oscillations in the Quaternary. *Philosophical Transactions of the Royal Society of London.* Series B: Biological Sciences, 2004, **359**(1442), 183-195. https://doi.org/10.1098%2Frstb.2003.1388

JORDANO, P.M., et al. Ligando Frugivoria e Dispersão de sementes à biologia da conservação. p. 41 1-436, In: Duarte, C.F., Bergallo, H.G., Dos Santos, M.A., V, A.E. (eds.). *Biologia da conservação: essências*. Editorial Rima, São Paulo, Brasil.2007.

LIMA, R.A. Estrutura e regeneração de clareiras em Florestas Pluviais Tropicais. *Brazilian Journal of Botany*, 2005, **28**(4), 651-670. http://dx.doi.org/10.1590/S0100-84042005000400002

NASCIMENTO, L.C. and NASCIMENTO, C. Capões de mata como habitat para pequenos mamíferos não voadores. Dissertação de mestrado do programa de pós-graduação em Zoologia de Vertebrados da Pontifícia Universidade Católica de Minas Gerais. 55p. 2009.

NASCIMENTO, N.A., CARVALHO, J.O.P. and LEÃO, N.V.M. Distribuição espacial de espécies arbóreas relacionada ao manejo de florestas naturais. *Revista de Ciências Agrárias*, 2002, **37**, 175-194.

NEVES, F.F. and MORELLATO, L.P.C. Métodos de amostragem e avaliação utilizados em estudos fenológicos de florestas tropicais. *Acta Botânica Brasílica*, 2004, **18**(1), 99-108. https://doi.org/10.1590/S0102-33062004000100009

PEIXOTO, A.L. and AMORIM, M.P. Coleções botânicas: documentação da biodiversidade brasileira. *Ciência e Cultura*, 2003, **55**(3), 21-24.

PENHALBER, E.D.F. and VANI, W.M. Floração e chuva de sementes em mata secundária em São Paulo, SP. *Brazilian Journal of Botany*, **20**(2), 205-220. https://doi.org/10.1590/S0100-84041997000200011

RAMÍREZ, A.I.A. Reconstrução paleoambiental com base em sementes (semi-fósseis) na área de proteção ambiental das ilhas e várzeas do rio Paraná, Brasil. Tese de doutorado do programa de pós-graduação em Ecologia de Ambientes Aquáticos Continentais da Universidade Estadual de Maringá. 67p. 2014.

SANTOS, M.M.G.D., et al. Chuva de sementes de espécies lenhosas florestais em mosaicos de floresta com Araucária e campos no Sul do Brasil. *Acta Botanica Brasilica*, 2011, **25**(1), 160-167. https://doi.org/10.1590/S0102-33062011000100019

SOUZA, D. T. Composição florística e estrutura dos capões de altitude no parque estadual do Rio Preto, Minas Gerais, Brasil. Dissertação de mestrado do programa de pós-graduação em Biologia Vegetal da Universidade Federal de Minas Gerais. 86p.2009.

SOUZA, P.A., et al. Avaliação do banco de sementes contido na serapilheira de um fragmento florestal visando recuperação de áreas degradadas. *Cerne*, 2006, **12**(1), 56-67.

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