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Etnoecologia para o controle de *Hovenia dulcis* Thunb. (Rhamnaceae) em ecossistemas agrícolas e naturais

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O presente trabalho em nível de mestrado foi avaliado e aprovado por banca examinadora composta pelos seguintes membros:

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Certificamos que esta é a **versão original e final** do trabalho de conclusão que foi julgado adequado para obtenção do título de mestre em ciências.

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Profª Dra. Karine Louise dos Santos
Orientadora

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Este trabalho é dedicado aos meus pais.

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RESUMO

A floresta estacional decidual (FED) pertence ao bioma da Mata Atlântica e encontra-se ameaçada por diversas ações antrópicas, como a introdução de espécies exóticas invasoras. A espécie caducifólia *Hovenia dulcis* é uma destas ameaças. A área de estudo desta pesquisa, o Parque Estadual Fritz Plaumann (PAEFP) registra a presença de *H. dulcis* na FED desde 1940. Sua introdução é marcada pelo uso da planta em atividades agropecuárias como sombreamento e lenha. O objetivo desta pesquisa foi avaliar o uso da *H. dulcis* na área de estudo, bem como identificar junto a população residente no entorno do Parque quais espécies florestais poderiam ser usadas como substitutas. Adicionalmente, o estudo buscou avaliar o consumo e a dispersão dos frutos de *H. dulcis* pela fauna nativa presente no interior do Parque. O local de estudo contemplou a porção continental do PAEFP e sua Zona de Amortecimento, incluindo duas comunidades rurais (Linha Sede Brum e Linha Porto Brum). A pesquisa foi realizada entre janeiro e março de 2017; foi conduzida por meio de entrevistas com os moradores lindeiros ao Parque e por metodologia específica para a fauna, como o uso de carretéis de linha presos aos frutos de *H. dulcis* e fornecimento dos frutos por meio de bandejas plásticas em seis estações amostrais. Como resultados a pesquisa mostrou que a população local já faz uso da *H. dulcis* desde 1940 na região; sendo que o maior uso é para lenha. Como possíveis substitutos para *H. dulcis* foram indicados, por exemplo, o angico-vermelho (*Parapitadenia rigida*) e o eucalipto (*Eucalyptus* sp.). Como resultados para o estudo da fauna nativa dentro do PAEPF, percebeu-se que os animais procuram pelo fruto de *H. dulcis* mais do que da espécie nativa *Syagrus romanzoffiana.* A fauna prefere os frutos da espécie exótica invasora e o maior período de consumo é o inverno. A maior distância de dispersão da planta-mãe foi de 7,2 metros. Conclui-se, portanto, que a *H. dulcis* exerce pressão sobre a FED, pois é utilizada pela população da área de estudo e pela fauna nativa, ocorrendo dentro e fora do Parque. Ao mesmo tempo foram identificadas espécies potenciais para substituição da *H. dulcis*, que podem ajudar a reduzir a pressão da espécie sobre o ecossistema local, desde que adotadas iniciativas de difusão de informações a comunidade.

Palavras-chave: Etnobotânica, dispersão de sementes, zoocoria.

ABSTRACT

The seasonal deciduous forest (SDF) belongs to the Atlantic Forest biome and is threatened by several anthropic actions such as the introduction of invasive alien species. The deciduous species *Hovenia dulcis* is one of these threats. The study area of this research, Fritz Plaumann State Park (FPSP) recognizes the presence of *H. dulcis* in the SDF since 1940. Its introduction is marked by the use of the plant in aviaries and sties as shade and firewood. The objective of this research was to evaluate the use of *H. dulcis* in the study area by the population living in the surroundings of the Park; establish a timeline of species use; to evaluate the consumption and dispersion of the fruits of *H. dulcis* by the native fauna present in the interior of the Park. The study site was the continental portion of the FPSP and its Buffer Zone, covering two rural communities (Sede Brum Line and Porto Brum Line). The survey was conducted between January and March 2017; the research was conducted by means of interviews with the residents bordering the Park and by specific methodology for the fauna, such as the use of spools of thread attached to the fruits of *H. dulcis* and the supply of fruits through plastic trays at six sampling stations. As a result, the research showed that the local population has been using *H. dulcis* since 1940 in the region; The biggest use is for firewood. As possible substitutes for H. dulcis, angico-vermelho (*Parapitadenia rigida*) and eucalyptus (*Eucalyptus* sp.*)* were indicated. As a result, for the study of native fauna within the FPSP, it was noticed that the animals look for the fruit of *H. dulcis* more than the native species *Syagrus romanzoffiana*. The fauna prefers the fruits of the invasive alien species and the longest period of consumption is the winter. The greatest dispersal distance from the mother plant was 7.2 meters. It is concluded, therefore, that *H. dulcis* is a threat to the SDF as it is used by the population of the study area and by the native fauna, occurring inside and outside the Park.

Keywords: Ethnobotany, seed dispersal, zoochory

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LISTA DE ABREVIATURAS E SIGLAS

BZ – Buffer Zone

FED – Floresta Estacional Decidual

FPSP – Fritz Plaumann State Park

PAEFP – Parque Estadual Fritz Plaumann

SDF – Seasonal Deciduous Forest

SUMÁRIO

INTRODUÇÃO

A Floresta Estacional Decidual (FED) é um ecossistema pertencente ao bioma Mata Atlântica onde encontram-se populações características de espécies vegetais, tais como a grápia (*Apuleia leiocarpa*), a canafístula (*Peltophorum dubium*); e animais, como o graxaim (*Cerdocyon thous*) e a cutia (*Dasyprocta azarae*), as quais interagem entre si e com o ambiente (VIANA *et al*., 1992), o que garante uma fisionomia típica dessa formação florestal. Na região Sul do Brasil, a FED é caracterizada pela presença nítida de duas estações climáticas bem definidas, sendo uma seca e outra chuvosa (IBGE, 1992). Ainda, apresenta cobertura vegetal fechada, dominada por espécies caducifólias emergentes (SIMINSKI *et al.*, 2011), que durante a estação seca (coincidente com o inverno) perdem suas folhas.

Este tipo de formação florestal, ecossistema, encontra-se amplamente ameaçada devido às inúmeras ações antrópicas. Os autores Scolforo e Carvalho (2006) estimaram que a cobertura das florestas estacionais foi reduzida a 8,9% de suas áreas originais. As intervenções humanas no ambiente comprometem a funcionalidade biológica dos ecossistemas e dos habitats, afetando severamente as cadeias produtivas neles existentes (HADDAD *et al.*, 2015), podendo inclusive avariar a disponibilidade dos serviços ecossistêmicos ofertados pelas áreas florestadas (ANDRADE e ROMEIRO, 2009).

Como exemplo de intervenção humana, a introdução de espécies exóticas invasoras na flora ocorre como uma das maiores ameaças para a biodiversidade (TABARELLI e GASCON, 2005), afetando diretamente a composição da fauna localmente e, colocando em risco as interações animal-planta, em especial a dispersão de sementes (JORDANO *et al*., 2006).

A espécie arbórea *Hovenia dulcis,* conhecida popularmente como uva-do-japão é mencionada na Lista Oficial de Espécies Exóticas Invasoras no Estado de Santa Catarina (Resolução CONSEMA 11/2010). Devido a sua característica de caducifólia, a *H. dulcis* adaptou-se bem ao microclima do estado catarinense, sendo encontrada em abundância na FED, onde assume agressivo potencial invasor (ZENNI e ZILLER, 2011). Em sua pesquisa, Lima (2013) evidenciou que a fauna nativa da FED apresenta preferência na escolha dos frutos na *H. dulcis* em comparação com as arbóreas nativas, auxiliando na dispersão dos frutos e contribuindo diretamente no acréscimo da invasão pela espécie.

Em contrapartida, a uva-do-japão é amplamente recomendada para uso madeireiro, como lenha para produção de erva-mate, uso medicinal, ornamental e como quebra-vento para

proteção de benfeitorias, e na criação de animais de produção em propriedades rurais (RIGATTO *et al*., 2001; CARVALHO, 1994; CARDOSO *et al.,* 2015).

Esta realidade, juntamente com a ação da fauna nativa como dispersora, faz da *H. dulcis* uma invasora agressiva (LIMA, 2013), em especial em áreas de proteção e conservação de ecossistemas naturais, como em unidades de conservação (DECHOUM *et al.,* 2014). No caso de Santa Catarina, a unidade de conservação destinada a proteção da FED é o Parque Estadual Fritz Plaumann, o qual apresenta seu entorno caracterizado por propriedades rurais lindeiras com ocorrência de *H. dulcis*, abrindo possibilidade de reentrada de propágulos por ação animal.

De acordo com Fleury (2003), a compreensão dos processos de interação ecológica animal-planta, bem como o estudo das causas das intervenções antrópicas nestes processos é um passo inicial e de fundamental importância para a conservação das espécies arbóreas, bem como dos animais que delas necessitam e, dos ecossistemas em geral.

Desta forma, estudos que busquem avaliar como se estabelecem as interações nos ecossistemas são altamente estratégicos, uma vez que, o conhecimento sobre estes processos ecológicos propicia o desenvolvimento de métodos que evidenciem o resguardo e a manutenção das florestas degradadas (HOWE *et al*., 1988). É possível ainda, assegurar o melhor aproveitamento dos serviços ecossistêmicos pelo homem, de forma segura e economicamente viável, além de proporcionar o acesso à espécies de flora e fauna interligadas a estes sistemas naturais extremamente ricos e potencialmente ameaçados, visando a conservação e a regeneração florestal (ANDRADE e ROMEIRO, 2009).

Nesse contexto, a proposta desse estudo é colaborar com a proposição de estratégias de restauração em propriedades rurais lindeiras ao Parque Estadual Fritz Plaumann (PAEFP), que sejam fundamentadas em interações ecológicas e etnoconhecimento, a fim de promover o controle da dispersão da *H. dulcis.*

Esta dissertação está dividida em dois capítulos nos quais, no primeiro capitulo objetivou-se levantar dados etnobotânicos sobre a *H. dulcis* na área de estudo e, sendo que esse capítulo deu origem a artigo publicado na revista Ethnobotany Research and Applications. http://dx.doi.org/10.32859/era.24.31.1-14. No segundo capítulo objetivou-se avaliar o consumo e a dispersão de sementes de *H. dulcis* pela fauna nativa no PAEFP.

OBJETIVOS

OBJETIVO GERAL

Propor estratégias de restauração no Parque Estadual Fritz Plaumann, uma unidade de conservação de proteção integral da Floresta Estacional Decidual, fundamentadas em interações ecológicas e conhecimento local associado.

OBJETIVOS ESPECÍFICOS

1. Levantar dados etnoecológicos sobre a espécie *Hovenia dulcis* nas comunidades rurais lindeiras ao Parque Estadual Fritz Plaumann;
2. Elencar espécies vegetais nativas de potencial ecológico e econômico compatíveis às estratégias de restauração;
3. Identificar espécies da fauna consumidoras e dispersoras de frutos e sementes de *H. dulcis*;
4. Avaliar o consumo e a distância de dispersão de frutos de *H. dulcis* pela fauna;
5. Analisar a preferência de consumo pela fauna quanto à disponibilidade de frutos de espécies nativas.

REFERENCIAS

ADDICOTT, F.T. Abscission. California: University of California Press, Berkeley, 1982.

ALBUQUERQUE, et al. **Métodos e Técnicas na Pesquisa Etnobiológica e Etnoecológica.** Recife, PE:NUPPEA, 2010.

ALBUQUERQUE, U.P.; LUCENA, R.F.P.; CUNHA, L.V.F.C. **Métodos e técnicas na pesquisa Etnobotânica**. 2.ed. Recife: Comunigraf, 2008.

ANDRADE, D.; ROMEIRO, A. **Capital natural, serviços ecossistêmicos, e sistemas econômicos: rumo a uma economia dos ecossistemas**. Texto para discussão: I/E Unicamp, Campinas, 2009.

ALVES-COSTA, C. P. **Efeitos da defaunação de mamíferos herbívoros na comunidade vegetal.** Tese de Doutorado, Universidade Estadual de Campinas, Campinas, 2004.

AMOROZO, M. C. M. Uso e diversidade de plantas medicinais em Santo Antônio do Leverger, MT, Brasil. **Acta Botanica Brasílica**, v.16, p.189-203, 2002.

AMOROZO, M. C. M. **Sistemas agrícolas tradicionais e a conservação da agrobiodiversidade.** 2007.

AMOROSO, M.; MING, L. e SILVA, S.. Métodos de Coleta e Análise Dados em etnobiologia, etnoecologia e disciplinas Correlatas: **Anais do I Seminário de Etnobiologia e Etnociências do Sudeste** – UNESP, Rio Claro, SP, 2002.

BALICK, M.J.; COX, P.A. **Plants, people and culture**. New York: Scientific American Library, 1997.

BARROS, R.S.M. **Medidas de diversidade biológica.** Pós-Graduação em Ecologia Aplicada ao Manejo e Conservação de Recursos Naturais – PGECOL. Universidade Federal de Juiz de Fora – UFJF. Juiz de Fora, MG.2007.

BERNARD, H. R. **Research methods in anthropology. Analysis of qualitative data**. Walnut Creek: Altamira Press. 1994, 585 p.

BLANEY, C. S.; KOTANEN, P. M. 2001. Post-dispersal losses to seed predators: an experimental comparison of native and exotic old field plants. **Canadian Journal of Botany,** 79: 284-292.

BRACE-GOVAN, J. Issues in snowball sampling: The lawyer, the model and ethics. **Qualitative Research Journal**. 2004

BUCKLAND, S.T.; ANDERSON, D.R.; BURNHAM, K.P.; LAAKE, J.L.; BORCHERS,

D.L.; THOMAS, L. **Introduction to distance sampling.** Oxford: Oxford University Press, 2001. 568p.
CARVALHO, P. E. R. **Ecologia, silvicultura e usos da uva-do-japão (Hovenia Dulcis Thunberg).** Colombo, PR, EMBRAPA, Comunicado Técnico n. 23, 1994.

CASETTA, E.; RUBIM, P.; LUNARDI, V. O.; FRANCISCO, M. R. & GALETTI, M. **Frugivoria e dispersão de sementes de *Talauma ovata* (Magnoliaceae) no sudeste brasileiro.** Ararajuba, 10(2): 199-206, 2002.

DALY, H.; FARLEY, J. **Ecological Economics: Principles and Applications. Washington, DC: Island Press, 2004.**

DECHOUM, M.; CASTELLANI, T. T.; ZALBA, S. M.; REJMANEK, N.; PERONI & TAMASHIRO, J. Y. Community structure, sucession and invasibility in a seasonal deciduous forest in Southern Brazil. **Biological Invasions.** 2014

DONATTI, C. I. **Conseqüências da defaunação na dispersão de sementes e no recrutamento de plântulas da palmeira brejaúva (*Astrocarium aculeatissimum*) na Mata Atlântica.** Dissertação de Mestrado, Universidade de São Paulo, Piracicaba, 2004.

ESTIMATES. Disponível em: http://viceroy.eeb.uconn.edu/estimates/. Acesso em: 09/09/2016.

FLEURY, M. **Efeito da fragmentação florestal na predação de sementes da palmeira jerivá (*Syagrus romanzoffiana*) em florestas semidecíduas do estado de São Paulo,** 2003.

FONSECA-KRUEL, V. S.; PEIXOTO, A. L. Etnobotânica na Reserva Extrativista Marinha de Arraial do Cabo, RJ, Brasil. **Acta Botanica Brasilica**, v. 18, n. 1, p. 177-190, mar. 2004.

FORGET, P.M. & MILLERON, T. **Evidence for secondary seed dispersal by rodents in Panama.** Oecologia. 1991

FRAGOSO, J.M.V.; SILVIUS, K.M.; CORREA, J.A. Long-distance seed dispersal by tapirs increases seed survival and aggregates tropical trees. **Ecology**, v.84, n.8, p.1998-2006, 2003.

FRISCH, J. D.; FRISCH, C. D. **Aves Brasileiras e Plantas que as Atraem**. São Paulo: Ecoltec. 2005

FUNDAÇÃO DO MEIO AMBIENTE DE SANTA CATARINA (FATMA). **Plano de manejo do Parque Estadual Fritz Plaumann.** Caipora, 2012

GALETTI, M.; DONATTI, C. I.; PIRES, A. S.; GUIMARÃES, P. R. & JORDANO, P. Seed survival and dispersal of an endemic Atlantic forest palm: the combined effects to defaunation and forest fragmentation. **Botanical Journal of the Linnean Society**, 2006.

GALETTI, M.; COSTA, C.; CAZETTA, E. Effects of forest fragmentation, anthropogenic edges and fruit color on the consumption of ornithochoric fruits. **Biological Conservation**, 2003

HADDAD, N.M. Habitat fragmentation and its lasting impact on Earth's ecosystems. **Science.** 2015

HERRERA, C.M. Habitat – Consumer **interactions in frugivorous birds**. In: HABITAT selection in birds. Seville: Academic Press. Inc, 1985.

HOWE, H.F. & WESTLEY, L.C. **Ecological relationships of plants and animals.** Nov York, Oxford University. 273 p, 1988.

HOWE, H. F. & SMALLWOOD, J. **Ecology of seed dispersal. Annual Review of Ecology and Systematics,** 1982.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). **Manual técnico e geomorfologia**. Instituto Brasileiro de geografia e Estatística. Rio de Janeiro, 1995.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA (IBGE). **Manual técnico da vegetação brasileira**. Série manuais técnicos de geociências, n. 1. Rio de Janeiro, 1992.

INSTITUTO HÓRUS. **http://i3n.institutohorus.org.br.** Acesso em: 01/11/2016.

Inter-American Biodiversity Information Network. Disponível em: **http://www.institutohorus.org.br/iabin/i3n/.** Acesso em 01/11/2016

JORDANO, P., GALETTI, M., PIZO, M. A. & SILVA, W. R. Ligando frugivoria e dispersão de sementes à biologia da conservação. *In* C. F. D. ROCHA, H. G. BERGALLO, M. V. SLUYS & M. A. S. ALVES **(Eds.).** ***Biologia da conservação:*** *essências*. RiMa, São Carlos, 2006.

KLEIN, R. M. Mapa fitogeográfico de Santa Catarina. Itajaí: **Flora Ilustrada Catarinense**, 1978.

KOPACHON, S.; et al. **Forest restoration research in northern Thailand, 1.The fruits, seeds and seedlings of Hovenia dulcis Thunb. (Rhamnaceae).** Natural History Bulletin of the Siam Society, 1996.

LIMA, R.E.M. **DISPERSÃO DE SEMENTES DE Hovenia dulcis Thunb. (Rhamnaceae) – UMA ESPÉCIE INVASORA EM ÁREA DE FLORESTA ESTACIONAL DECIDUAL.** 2013. 79 f. Dissertação (Mestrado) - Curso de Pós-graduação em Ecologia, Universidade Federal de Santa Catarina, Florianopolis, 2013.

MEDEIROS, M. F. T.; FONSECA, V. S.; ANDREATA, R. H. P. Plantas medicinais e seus usos pelos sitiantes da Reserva Rio das Pedras, Mangaratiba, RJ, Brasil. **Acta Botânica Brasílica**, v. 18, n. 2, p. 391–399, 2004

MILES, L., NEWTON, A.C., DEFRIES, R.S., RAVILIOUS, C. A global overview of the conservation status of tropical dry forests. **Journal of Biogeography**, v. 33, n. 3, p. 491-505, 2006.

MINISTÉRIO DO MEIO AMBIENTE. **Sistema Nacional de Unidades de Conservação.** Disponível em: http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=322

MINISTÉRIO DO MEIO AMBIENTE. **Plano Estratégico de Biodiversidade. 2011-2020.** Disponível em: http://www.mma.gov.br/estruturas/sbf2008_dcbio/_arquivos/metas_aichi_147.pdf. Acesso em: 09/10/2021.

MOSER, B.; FRIDLEY, J.D.; ASKEW, A.P.; GRIME, J.P. Simulated migration in a long-term climate change experiment: invasions impeded by dispersal limitation, not biotic resistance. **Journal od Ecology.** 2011

OLMOS, F., PARDINI, R., BOULHOSA, R. L. P., BURGI, R. & MORSELLO, C. Do Tapirs steal food from palm seed predators or give them a lift? **Biotropica** 31: 375- 379, 1999.

PENNINGTON, R. T.; LAVIN, M.; OLIVEIRA FILHO, A. Woody Plant Diversity, Evolution, and Ecology in the Tropics: Perspectives from Seasonally Dry Tropical Forests. **Evolution and Systematics**, v. 40, n. 1, p. 437-457, 2009.

PERES, C. A.; BAIDER, C. Seed dispersal, spatial distribution and population structure of Brazil nut trees (Bertholletia excelsa) in Southeastern Amazonia. **Journal of Tropical Ecology**, Cambridge, GB, v. 13, p. 595-616, 1997.

PIMENTEL, D. S. & TABARELLI, M. Seed dispersal of the palm *Attalea oleifera* in a remnant of the Brazilian Atlantic forest. **Biotropica**, 36:74-84, 2004.

PIZO, M.A. & OLIVEIRA, P.S. 2000. The use of fruits and seeds by ants in the Atlantic Forest of southeast Brazil. **Biotropica** 32: 851-861.

RESOLUÇÃO CONSEMA Nº 11/2010. Disponível em: http://www.sema.rs.gov.br/upload/Resolucao%20CONSEMA%20245-2010.pdf Acesso em 01/11/2021.

REJMANEK, M.; RICHARDSON, D.M. What attributes make some plant species more invasive? **Ecology.** 1996

RICHARDSON, D. M.; PYSEK, P.; REJMÁNEK, M.; BARBOUR, F.; PANETTA, F. R.; WEST, C. J. **Naturalization and invasion of alien plants: concepts and definitions. Diversity and Distributions**, Malden, v. 6, p. 93-107, 2000.

RICHARDSON, D. M.; VAN WILGEN, B. W. Invasive alien plants in South Africa: how well do we understand the ecological impacts? **South African Journal of Science,** Tygervalley, v. 100, p. 45-52, 2004.

RICHARDSON, D.M.; REJMANEK, M. **Trees and shrubs as invasive alien species—a global review.** Divers Distrib. 2011.

RIGATTO, P. A.; PEREIRA, J. C. D.; MATTOS, P. P.; SCHAITZA, E. G. **Características Físicas, Químicas e Anatômicas da Madeira de Hovenia dulcis.** Comunicado Técnico – Embrapa Florestas - Colombo - PR, novembro - 2001.
RODRIGUES, V. E. G., CARVALHO, D. A. Levantamento Etnobotânico de plantas medicinais no domínio do cerrado na região alto rio grande – Minas Gerais. **Ciências Agrotecnicas**, Lavras, v. 25, n. 1, p. 102-123, 2001.

SAKAI, A. K.; ALLENDORF, F. W.; HOLT, J. S.; LODGE, D. M.; MOLOFSKY, J.; WITH, K. A.; BAUGHMAN, S.; CABIN, R. J.; COHEN, J. E.; ELLSTRAND, N. C.; McCAULEY, D. E.; O'NEIL, P.; PARKER, I. M.; THOMPSON, J. N.; WELLER, S. G. **The population biology of invasive species. Annual Review of Ecology, Evolution and Systematics**, Palo Alto, v. 32, p. 305-332, 2001.

SANTA CATARINA (Estado). Gabinete de Planejamento e Coordenação Geral. **Atlas de Santa Catarina**. Rio de Janeiro: Aerofoto Cruzeiro, 1986.

SANTA CATARINA. **Decreto Estadual nº 797 de 24 de setembro de 2003**. Disponível em: http://server03.pge.sc.gov.br/LegislacaoEstadual/2003/000797-005-0-2003-004.htm

SCHUMACHER, M. V. *et al.* **A floresta estacional subtropical:** caracterização e ecologia no rebordo do planalto meridional. Santa Maria, 2011.

SHEA, K; CHESSON, P. Community ecology theory as a framework for biological invasions. **Trends in Ecology and Evolution**, Cambrigde, v. 17, n. 4, p. 170-176. 2002.

SIGRIST, T. **Avifauna brasileira: guia de campo Avis Brasilis.** São Paulo: Avis Brasilis, 2009. 1080 p. 2 v

SIMINSKI, A.; FANTINI, A.C; REIS, M.S. Classifiação da vegetação secundária em estágios de regeneração da Mata Atlântica em Santa Catarina.

SIMINSKI, A. et al. Secondary Forest Succession in The Mata Atlantica, Brazil: Floristic and Phytosociologic Trends. ISRN Ecology, v. 2011, p. 1-19, 2011.

SIMINSKI, A. A floresta do futuro: conhecimento, valorização e perspectivas de uso das formações florestais secundárias no Estado de Santa Catarina. **Dissertação de Mestrado,** Programa de Pós-Graduação em Recursos Genéticos Vegetais, Universidade Federal de Santa Catarina, Florianópolis, Brasil. 2009.

SCOLFORO, J. R. S. & CARVALHO, L. M. T., 2006, **Mapeamento e inventário da flora nativa e dos reflorestamentos de Minas Gerais.,** Editora UFLA, Lavras.

TABARELLI, M. & GASCON, C. Lições da pesquisa sobre fragmentação: aperfeiçoando políticas e diretrizes de manejo para a conservação da biodiversidade. **Megadiversidade**, 2005.

TSOAR, A.; SHOHANI, D.; NATHAN, R. **A movement ecology approach to study seed dispersal and plant invasion: an overview and application of seed dispersal by fuit bats.** In: Richardson, D. M. Fifty years of invasion ecology: The legacy of Charles Elton. Wiley-Blackwell, West Sussex, UK. 2011.

VACCARO, S.; LONGHI, S. J. Análise fitossociológica de algumas áreas remanescentes da Floresta do Alto Uruguai, entre os rios Ijuí e Turvo, no Rio Grande do Sul. **Ciência Florestal**, Santa Maria, v. 5, n. 1, p. 33 - 53, 1995.

VACCARO, S. Caracterização fitossociológica de três fases sucessionais de uma Floresta Estacional Decidual, no município de Santa Tereza – RS. **Dissertação** (Mestrado em Engenharia Florestal) – Universidade Federal de Santa Maria, Santa Maria, 1997.

VIANA, V.M.; TABANEZ, A.A.J.; MARTINS, J.L.A. Restauração e manejo de fragmentos florestais. In: CONGRESSO NACIONAL SOBRE ESSÊNCIAS *NATIVAS,* 2, São Paulo. ***Anais*****.** São Paulo: Instituto Florestal de São Paulo, 1992. p. 400-40, 1992.

WILLIAMSON, M. **Biological invasions.** London: Chapman & Hall, 1996. 244 p

ZENNI, R.D. & ZILLER, S.R. An overview of invasive plants in Brazil. **Revista brasileira de Botânica.** 2011.

ZILLER, S. R. Espécies exóticas da flora invasoras em unidades de conservação. In: CAMPOS, J. B.; TOSSULINO, M. G. P.; MULLER, C. R. C. (Ed.). **Unidades de conservação: ações para valorização da biodiversidade.** Curitiba: Instituto Ambiental do Paraná, 2006. p. 34-52.

CHAPTER 1

Ethnoecology for the control of *Hovenia dulcis* in the deciduous seasonal forest, Concórdia, Santa Catarina, Brazil

Based on: Karine Petter da Silva, Carolina Novicki, Karine Louise dos Santos and Alexandre de Oliveira Tavela. Ethnoecology for the control of *Hovenia dulcis* in the deciduous seasonal forest, Santa Catarina, Brazil. Ethnobotany Research and Applications 24:31 (2022). http://dx.doi.org/10.32859/era.24.31.1-14

O Termo de Consentimento livre esclarecido e questionário relacionados a esse capítulo, encontram-se nos Apêndices 2 e 3, respectivamente.

Ethnoecology for the control of *Hovenia dulcis* in the deciduous seasonal forest Santa Catarina, Brazil

Karine Petter da Silva[1], Carolina Novicki[1], Karine Louise dos Santos[1], Alexandre de Oliveira Tavela[1]

ABSTRACT

The Deciduous Seasonal Forest (DSF) is the most abundant phytophysiognomies in Santa Catarina State/Brasil. However, the DSF is severely impacted by fragmentation and the introduction of invasive exotic species. In this cenario, the tree species *Hovenia dulcis* is a species with a high degree of biological invasion, including in protected areas as the Fritz Plaumann State Park in Concordia, Santa Catarina. Our objective was to understand the history of introduction of this invasive species in the park area, as well as to identify plant species with potential to replace *H. dulcis*. Semi-structured interviews were carried out with informants residing in the Park's Buffer Zone (BZ). As base data for analysis we use citations of use and potential replacement species. For the complementary analysis, the consensus value or level of fidelity for the uses was estimated. As a result, 24 informants were interviewed. The uses related to *H. dulcis* comprised 13 citations. In the analysis of rapid ordering, firewood (23.25) was the most cited use. During the interviews, a total of 34 cited species with potential to replace *H. dulcis* was obtained. The species' introduction history confirmed the technical indication as one of the main stimulators of the species' expansion in the region. This data is corroborated by the bibliographic survey that demonstrated studies and technical indications, promoting the use of the species. Our results demonstrate that the *H. dulcis* is considered, by farmes, technically suitable for cultivation in the BZ zone of the Park. Hence the importance of highlighting in this study other species with greater or equal level of biological characteristics to replace *H. dulcis* in the study area.

Keywords: Invasive alien species; ethnobotanical, protected areas.

INTRODUCTION

The Deciduous Seasonal Forest (DSF) has two well-defined climatic seasons, dry and rainy, with very typical forest extracts. About 50% of the plant species are deciduous (Gasper *et al*. 2013). In Santa Catarina (SC), mainly in the west of the state, the predominant forest formation is the DSF, with an extension of 16% of forest remnants (Vibrans et al. 2012).

However, in the state of Santa Catarina, the DSF is severely degraded. This impact was caused by the occupation of the territory between the 1920s and 1960s, by the arrival of immigrants, who started the extractive activity for the timber sector, predominant converting the forest into areas for livestock or agriculture (Ruschel *et al*. 2003). Besides fragmentation, another impact on this forest formation is the introduction of invasive exotic species, especially the *Hovenia dulcis* Thunb. (Rhamnaceae), belonging to the Rhamanaceae family, with its origin in Asia. This deciduous species reaches up to 25 meters high with a spheric crown. Its fruits are capsules in fleshy peduncles, attractive to fauna (Carvalho 1994, Dechoum *et al*. 2015).

H. dulcis has a large distribution in southern Brazil, especially due to introductions in degraded areas. However, this species tends to form dense clusters hindering the development of native species (Carvalho 1994, Mundeleski *et al*. 2008). Nonetheless, through technical recommendations, the species was indicated for introduction in agricultural properties as a form of shading in aviaries, besides having good timber contribution, especially for firewood (Cardoso *et al*. 2013).

Because *H. dulcis* is considered an invasive exotic species, bringing damage to biodiversity. Also, it has been considered a problem in several locations in the midwest of Santa Catarina, such as in Fritz Plaumann State Park (PAEFP) located in the municipality of Concórdia/SC; where it is estimated that 50% of the total area of this protected area (PA) is occupied by the species (Fatma 2014). This PA is the only one that protects the DSF in Santa Catarina, besides being home to several native species that are economically valuable, as Grápia *Apuleia leiocarpa* (Vogel) J.F.Macbr., but whose populations are declining due to logging in previous decades (Ruschel *et al*. 2003, Fatma 2014).

Strategies are being considered for controlling the species in this unit. However, the Buffer Zone (BZ) properties still use the species in the productive context. Thus, for the control activities to be effective, offering producers alternative replacement species is necessary.

Given the diversity of native species that occur in the region, especially due to the presence of the DSF vegetal formation, there are potential species known to farmers that could replace *H. dulcis*, thus reducing the pressure of this species on native populations while meeting the needs of farmers. Additionally, the Convention on Biological Diversity (1992) suggests establishing public policies that encourage the use of alternative species to invasive species, restricting the practice of indicating invasive exotic species.

In this context, the study's main hypothesis is that farmers know local species that can act as substitutes for *H. dulcis*. Suppose the existence of these genetic resources and the knowledge associated with the use and management of these species is proven. In that case, it could be possible to reduce the pressures on natural ecosystems gradually. Additionally, the work seeks to promote discussion about the economic and especially ecological impacts of agricultural activities, favoring a careful look at the complexity of the inter-relationship between agricultural and natural ecosystems.

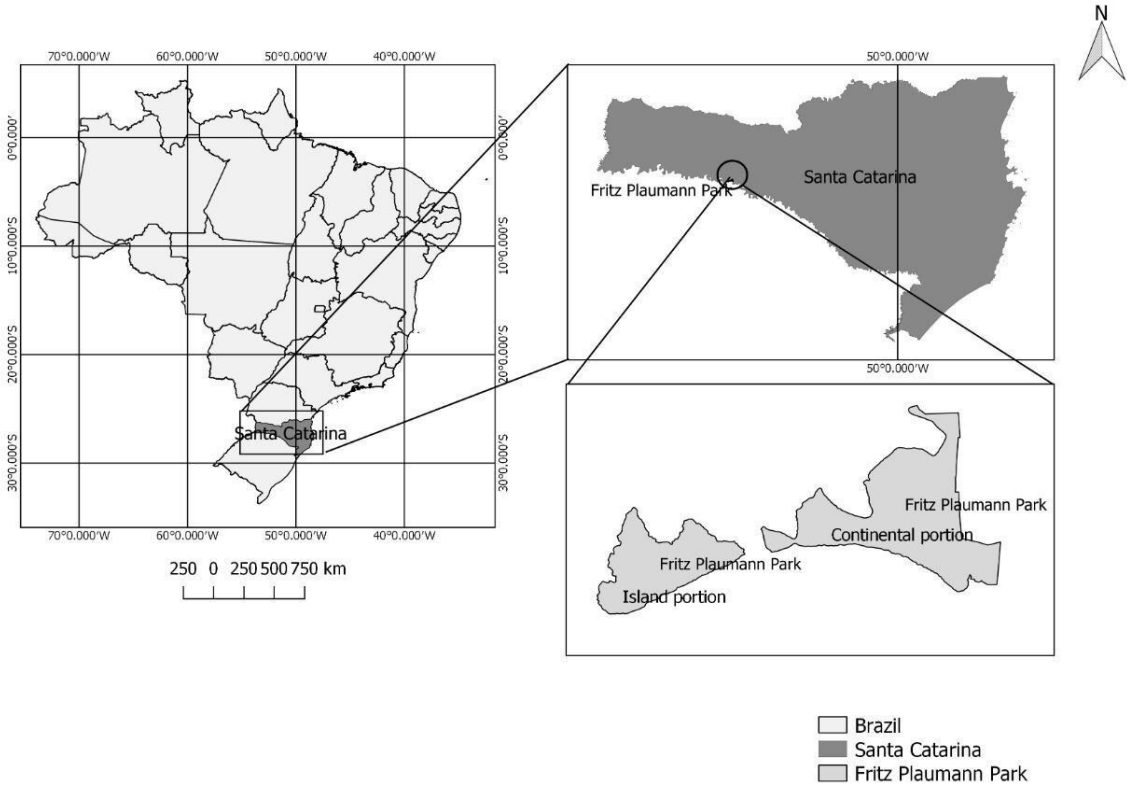
In this scenario, the challenge of this study arises. It aims to understand the history of the introduction of *Hovenia dulcis*, in the Buffer Zone of Fritz Plaumann State Park in Concordia/SC, based on the diversity of uses of the species, and to identify non-invasive species with similar attributes that can reduce the pressure of *H. dulcis* on the DSF.

MATERIAL AND METHODS

Study area

The study area comprised the Buffer Zone (BZ) of Fritz Plaumann State Park, a protected area located in the municipality of Concórdia, Santa Catarina, Brazil, with South latitude 27°17'26" 28 and West longitude 52° 05'15 "61 (Figure 1).

Figure 1 – Map of the Fritz Plaumann State Park area showing the continental portion and the island, located in the municipality of Concórdia, state of Santa Catarina, Brazil.



Fonte: A autora (2022).

The BZ covers an area of 1,778.95 hectares within a 29.31 km² perimeter. These surrounding areas are home to three rural communities: Sede Brum, Porto Brum, and Linha Laudelino, totaling approximately 70 rural properties with activities focused on pig farming, cattle farming, poultry farming, sheep farming, citrus farming, viticulture, and yerba mate plantations (Fatma 2014). The study sites included farms in Sede Brum and Porto Brum, which have *H. dulcis* specimens and where farmers were willing to participate.

Data collection took place from Jan/2017 to Apr/2017, covering two rural communities in the BZ, Sede Brum and Porto Brum.

Planning of the study

The participating farmers were contacted based on the non-probability intentional sampling technique "snowball" (Bernard 1994), where each farmer/informant indicates another possible informant who possesses the target attributes of the study (i.e., being in the Park's BZ and having *H. dulcis* specimens on the property). The farm was considered as the unit of analysis.

The research focused on a qualitative approach and consisted of two stages. The first stage relied on a semi-structured questionnaire (Bernard 1994, Viertler 2002) to collect data from the farmers. The second stage consisted of a bibliographic survey on: i) the history of *H. dulcis* introduction through a timeline; ii) recommendations for its use; iii) a survey of potential species to replace *H. dulcis*; iv) and verification of regulatory issues on the use of invasive alien species in BZ.

Analysis of the collected data

A content analysis was carried out (Franco 2005) through a literature review on the themes addressed for confirmation and/or discussion of the data. Additionally, the literature review stage sought to investigate the period and form of introduction of *H. dulcis* in the region.

The rarefaction method (Barros 2007, Miranda & Hanazaki 2008) was applied to verify the sampling sufficiency using the software *Estimates* (Estimates 2018). For this analysis, the statements about use and potential species for replacement were used.

For the complementary data analysis, the consensus value or fidelity level (FL) for the uses that farmers mentioned was estimated (adapted from Monteiro *et al*. 2006, Albuquerque *et al*. 2010). Being:

FL: (lp/lu)x100%, where:

lp= number of informants who mentioned the main use of the species;

lu= total of informants who mentioned the species for any purpose.

The survey of species that could replace *H. dulcis* was based on interviews conducted with farmers and a literature survey. In order to list a preference index for each substitute species mentioned, an estimate was made by rapid ordering (Albuquerque *et al*. 2010).

Due to the regulations regarding studies with humans, the study was submitted to the authorization of the CEPSH (Committee for Ethics in Research with Humans) according to the

Federal University of Santa Catarina regulations, with the Certificate of Presentation for Ethics Appreciation number 63202516.3.0000.0121.

RESULTS

Twenty-four informants were interviewed, ranging in age from 36 to 86 years (mean= 48 years). The interviews were carried out in family units with the couple's participation (man and woman) on 16 occasions; only the man on six occasions and only the woman on two occasions.

For 22 family units, most property residents were reported as farmers, highlighting citrus production, annual crops, dairy cattle, poultry and pig farming. In two family units, the informants and family members have a relationship with the agro-industry regarding yerba mate processing.

Use of *H. dulcis*

The uses related to *H. dulcis* comprised 13 mentions (Table 1), where the uses with the highest consensus rates were: firewood (100%), wood for internal use (66%), wood for external use (46%), cachaça/grappa (46%) and furniture manufacturing (38%).

In the Rapid Ordering analysis (RIR) shown in Table 1, it is possible to observe the preference of the informants regarding the uses mentioned. The 12 uses mentioned were listed by ranking them from 6 - "least important use" to 12 - "best/most important use". As a result, firewood (23.25) was the most frequently mentioned one, followed by wood for internal use (14.25), wood for external use (9.16), cachaça/grappa (8.16) and shadow (7.41). Thus, it can be observed that the RIR and the level of consensus were similar where firewood stands out, followed by woods for improvement and cachaça, differing only for shadow in the RIR and LC for furniture.

Regarding the potential species to replace *H. dulcis*, a total of 34 species were mentioned, distributed in 18 botanical families (Table 2). The species with the highest number of references among the informants through the level of consensus were: Canela (*Ocotea sp.*) (44%), Angico Vermelho (*Parapitadenia rigida* Benth.) (44%), Eucalyptus (*Eucalyptus sp.*) (41%) and Grápia (*A. leiocarpa*) (35%), in that order, respectively.

Table 1: Uses mentions for *H. dulcis* followed by the level of consensus and rapid ordering stated in the interviews conducted in the Buffer Zone of Fritz Plaumann State Park/Concórdia-SC.

Uses	Fidelity level (FL) %	Rapid ordering (RIR)
Firewood	100	23.25
Wood for internal use	66	14.25
Wood for external use	46	9.16
Cachaça/Grappa	46	8.16
Furniture	38	7.08
Shadow	33	7.41
Honey	21	3.33
Fruit	13	2.66
Wine	13	2.66
Food (*in natura)*	8	1.50
Vinegar	4	0.66
Reforestation	4	0.66

The Rapid Ordering Analysis (RIR) (Table 1) shows the preference of informants regarding tree species to replace *H dulcis*. There were 34 species mentioned, ranked from 23 - "less important species" – to 34 - "better/more important species." The species that presented priority in the informants' statements were respectively: Angico Vermelho (*P. rigida*) (14.5), Canela (*Ocotea sp.*) (12,2), Grápia (*A. leiocarpa*) (11,29), and Eucalyptus (*Eucalyptus sp.*) (10.91). It is also observed that the RIR and LC were similar for the four species listed before, emphasizing that not only are they mentioned by most of the producers, but that they are more important, according to what they say. It is because the plants mentioned first are generally the most relevant to the farmers.

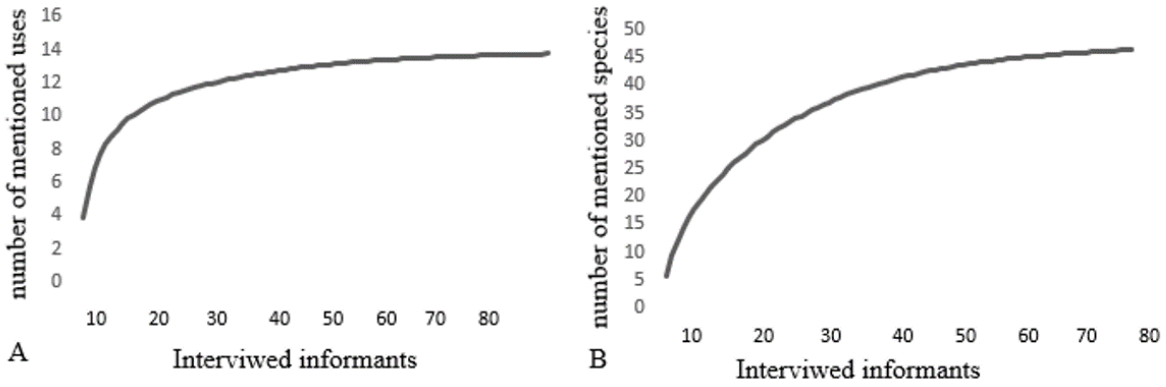
The rarefaction curve presented in Figure 2 (a) shows that the sampling effort (24 informants) was sufficient to cover the diversity of uses for the species known by the community. The curve shown in Figure 2 (b) indicates the potential for mentioning new tree species with economic and ecological characteristics similar to *H. dulcis* if there were new interviews. However, the stabilization for this indication would only occur after 50 interviews. This result is possibly due to the diversity of species present in this forest formation and to the profile of the informants who have a direct relationship with the rural environment and its landscape.

Table 2: Species with potential replacement of *H. dulcis*, followed by their respective botanical families, the fidelity level and the rapid ordering value obtained in the interviews conducted in the Buffer Zone of Fritz State Park/Concordia-SC.

Family	Common Name	Scientific Name	Fidelity level (FL) %	Rapid ordering (RIR)
Fabaceae	Angico vermelho	*Parapitdadenia rigida* Benth.	44	14.50
Lauraceae	Canela	*Ocotea* sp.	44	12.20
Myrtaceae	Eucalyptus	*Eucalyptus* sp.	41	10.91
Fabaceae	Grápia	*Apuleia leiocarpa* (Vogel) J.F.Macbr.	35	11.29
Meliaceae	Cedro	*Cedrela fissilis* Vell.	32	10.14
Araucariaceae	Araucária	*Araucaria angustifolia* (Bertol.) Kuntze	26	8.44
Fabaceae	Cabreúva	*Myrocarpus frondosus* Allemão	26	7.23
Malvaceae	Açoita Cavalo	*Luehea divaricate* Mart.	18	5.50
Fabaceae	Rabo de bugio	*Lonchocarpus campestris* Mart. ex Benth	12	1.85
Boraginaceae	Guajuvira	*Cordia Americana* (L.) Gottschling & J.S.Mill.	12	3.35
Lauraceae	Canela Sassafras	*Ocotea odorifera* (Vell.) Rohwer	8	2.53
Pinaceae	Pinus	*Pinus.*sp.	8	1.88
Lauraceae	Canela Amarela	*Nectandra lanceolate* Ness	8	2.82
Fabaceae	Angico Branco	*Albizia polycephala* (Benth.) Killip ex Record	6	1.97
Platanaceae	Platanus	*Platanus* sp.	6	1.68
Myrtaceae	Guabiroba	*Campomanesia xanthocarpa* (Mart.) O.Berg	6	1.62
Lauraceae	Canela Branca	*Ocotea spixiana* (Nees) Mez	6	1.67
Meliaceae	Canjarana	*Cabralea canjerana* (Vell.) Mart.	6	1.56
Verbanaceae	Tarumã	*Citharexylum myrianthum* Cham.	6	1.70
Fabaceae	Bracatinga	*Mimosa scabrella* Benth.	3	1.00
Myrtaceae	Araçá	*Psidium cattleianum* Sabine	3	0.91
Myrtaceae	Pitanga	*Eugenia uniflora* L.	3	0.88
Myrtaceae	Cereja do Rio Grande	*Eugenia involucrate* DC.	3	0.85

Lauraceae	Canela preta	*Ocotea catharinensis* Mez	3	0.68
Lauraceae	Canela do brejo	*Ocotea pulchella* Nees & Mart	3	0.94
Cannabaceae	Grandiúva	*Trema micrantha* (L.) Blume	3	0.85
Bignoniaceae	Ipe	*Handroanthus* sp.	3	0.82
Aquifoliaceae	Yerba mate	*Ilex paraguariensis* A.St.-Hil.	3	0.97
Sapotaceae	Vassourinha	*Chrysophyllum marginatum* (Hook. & Arn.) Radlk.	3	0.94
Moraceae	Ficus	*Ficus* sp.	3	0.76
Sapindaceae	Maria preta	*Diatenopteryx sorbifolia* Radlk.	3	0.97

Figure 2: (A) Rarefaction curve referring to the mentioned uses for *Hovenia dulcis* in the Buffer Zone of Fritz Plaumann State Park/Concórdia-SC. (B) Rarefaction curve for tree species that can replace the *H. dulcis* according to informants from the Buffer Zone of Fritz Plaumann State Park/Concordia-SC.



Fonte: A autora (2022).

We also asked the farmers if they had observed animals feeding on *H. dulcis* on their properties during the interviews. For this data, the results were that, in 100% of the interviews (24 informants), they had observed fauna feeding on *H. dulcis.* When asked about which animals they observe the most, 24 species were mentioned (Table 3).

Table 3: Fauna mentioned as consumers of *H. dulcis* fruits in the Buffer Zone of Fritz Plaumann State Park, Concordia/SC.

Order, Family Genus or Species mentioned by the interviewee	Number of informants that mentioned the species (N=24)
Passerines	21
Bovine	19
Sapajus spp.	11
Canis lupus familiaris	07
Ramphastidae	07
Penelope obscura	06
Nasua nasua	05
Cerdocyon thous	04

Ovine	03
Mazama spp.	03
Swine	02
Didelphis albiventris	02
Leopardus tigrinus	02
Eira barbara	01
Mustela putorius furo	01
Dasypodidae	01

DISCUSSION

The activities performed by the informants are closely related to the economic situation of the city of Concórdia-SC, which is based on agriculture and livestock with a focus on livestock production (pigs, poultry and dairy cattle). Additionally, an herbal company uses 15% of the raw material from its own cultivation in the Park's surroundings. The rest is acquired from producers in the Park's surroundings, encouraging the planting of yerba mate as a source of income. The introduction of H. dulcis in the region is also commented by Lima *et al*. (2021) who report that the occurrence of the species has been present since the 1980s.

Regarding the introduction of *H. dulcis* in the activities of the BZ, based on the level of consensus among the informants, 12 of them stated that they had not received an indication for the use of the species; 10 of the informants received indications for planting from technical indications coming from public and private research and extension agencies; two informants received indication from other farmers.

When asked about the occurrence of the species on their property, 13 of the informants reported that the species occurs spontaneously. At the same time, nine had already planted the species once, but nowadays, it remains spontaneously. In one case, the informant reported that he does not maintain the species on the property and, in case of incidence; it is controlled by grubbing it up at the seedling stage. According to the informant, this practice would avoid shading his plantation areas. And finally, one of the informants reports that he maintains the species even through planting and eventually buying it from third parties to use as firewood.

According to the Instituto Hórus (2018), the preferred environment for the invasion of *H. dulcis* is secondary forest formations, especially in a clearing. In addition, some producers still deliberately plant the species in degraded areas or on the edges of dams, with a tendency to form dense clusters preventing the development of native species (Carvalho 1994, Mundeleski *et al*. 2008).

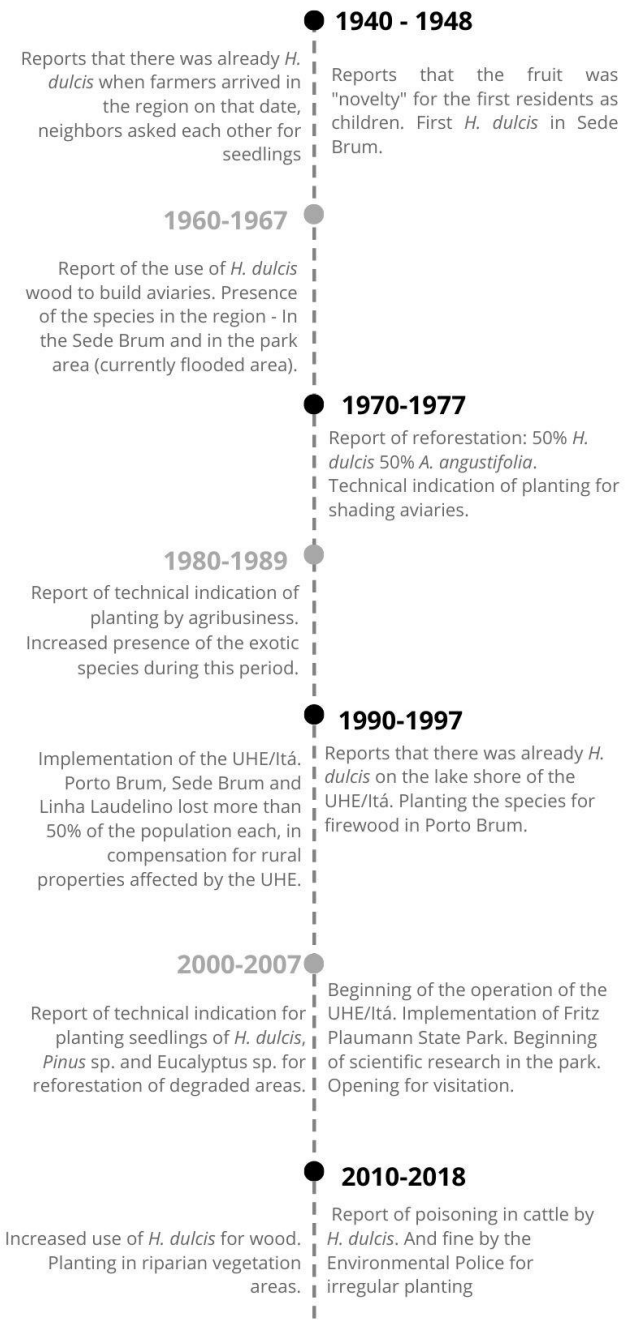
Additionally, through a timeline constructed together with the informants (Figure 3), milestones in the history of the introduction of *H. dulcis* can be verified. The timeline was divided into decades, highlighting the information reported by the informants and contrasting it with the data available in the literature.

In 1930, the informants reported that before the arrival of the hydroelectric plant of Ita, some of them already lived in lands that belonged to Rio Grande do Sul (RS). At that time, there were already, in small quantities, specimens of Japanese Raisin.

In 1944, there was an expansion of poultry farming and meat processing in the municipality of Concordia. As reported by informants, some farmers were advised to plant the species around their poultry for shade. The integration system indicated to producers which improvements to be performed to improve the productivity of farms (Gandolfi 2017).

In 1980, there was an intensification of deforestation of native forests (MMA, 2008). In addition, the use of agricultural techniques not compatible with the local soil and low productivity promoted the rural exodus (Silva 2003). However, the informants' reports point out that even in the same decade, exotic species, such as *H. dulcis*, were indicated for reforestation of degraded areas, aiming to reduce deforestation.

Figure 3 - Timeline of the introduction history of H. dulcis in the study area, BZ Fritz Plaumann State Park, Concórdia/SC



Fonte: Carolina Novicki (2021).

In 1994, Carvalho (1994) mentions that experimental plantings of *H. dulcis* were carried out in the South, Southeast and Central-West of Brazil. Concórdia appears as an experimental site, taken as a source of data from the National Center for Forest Research (CNPF). In addition, informants reported that in 1994, the government-financed green areas, in which 200 seedlings of *H. dulcis* should be planted.

In the 2000s, a study developed by Medrado (2000) suggests planting *H. dulcis* for Agroforestry Systems (SAFs). Moreover, Cardoso (2013) indicates that *H. dulcis* leaves could be included in hay for cattle. However, the informants themselves report too much intoxication in cattle using this type of silage.

Such background demonstrates that the invasive potential of the species and its ecological damage in the region has been overlooked. Nevertheless, farmers' reports highlight that "where the animals excrete, only Japanese Grape grows, no other species come." When asked why, they reported that *H. dulcis* is like "pest and weed". Additionally, it is noteworthy that in two interviews, the perception that the species was considered native to the region was reported, demonstrating the lack of information regarding the place of origin of the species.

It is evident that *H. dulcis* has become a relevant species for the productive context of the communities, but the technical indication should be much more than just analyzing productive potentials; the indication should be made analyzing a whole post-installation context of any crop. The economic return may have been interesting when the first indications were made. Nevertheless, knowledge about the damage and impacts that this species is causing many years after its introduction is still embryonic.

The example of *H. dulcis* is an alert for the professionals/technicians of the agricultural area to keep in mind different factors regarding the indication of species for agricultural use. Often, the lack of knowledge about the range of genetic resources that can be used may be related to the limitation of integration between professionals from different backgrounds or even the disqualification of local knowledge held by local and traditional communities. In the latter case, attention to the different knowledge may favor the resilient use of our "own" biodiversity.

Possibly the ecological damage caused by invasive alien species cannot be reversed. Still, it can be mitigated through coherent technical indications, such as the indication of non-invasive or native species with similar potentials.

Use of H. dulcis

The use of the species for firewood, according to the interviewees, is because it grows fast and has no impediment to cutting (because it is an exotic species). Additionally, the interviewees reported that *H. dulcis* firewood is preferably used for drying yerba mate because it does not leave a strong "taste" in the herb, preserving the aroma and flavor properties of the plant.

Additionally, according to Andrade *et al*. (2019), in an experiment conducted to evaluate the performance of *H. dulcis*, pinus and Eucalyptus for firewood, the authors observed that *H. dulcis* showed similar performance to the other standard species, and it was also indicated to meet the requirements for use in the industry.

As for the use of external and internal wood, in a study on the composition of wood panels, Napoli *et al*. (2013) showed that the mixture of *H. dulcis* and Eucalyptus wood in the proportion of 1:1 showed better stability in swelling and thickness. Furthermore, when comparing data from the mixture of Bracatinga (*Mimosa scabrella* Benth.) wood, there is a direct relationship with water absorption. In contrast, the wood of Japanese Raisin and Eucalyptus showed an inversely proportional relationship (Napoli *et al*. 2013).

The use of *H. dulcis* for producing cachaça/grappa with the fruits of *H. dulcis* is discussed by Cancelier (2013), who analyzed which are the influences in the process of obtaining fermented-distilled beverage from the fruits of Japanese Raisin. The author characterized that the pH of the solution does not change with increasing temperature, making it a viable alternative in the production of a fermented-distilled beverage or as a raw material for the production of bioalcohol.

There are no studies on manufacturing furniture from Japanese Raisin wood that test its resistance and quality. Still, it is possible to verify the indication of utensils made with this wood in the national commerce, such as beds, chairs, stools, and tables.

Potential species to replace *H. dulcis*

As a proposition, there are species with similar potential to *H. dulcis* that can be recommended through a management plan that contemplates the diversity of species such as Angico Vermelho (*P. rigida*), Açoita cavalo (*Luehea divaricate* Mart.), Canela Guaicá (*Ocotea*

puberula Rich.), Canela Lageana or Canela do Brejo (*Ocotea pulchella* Nees & Mart.), Canela amarela (*Nectranda lanceolata* Ness), Grápia (*A. leiocarpa*), Cedro (*Cedrela fissilis* Vell.), Cabreúva (*Myrocarpus frondosus* Allemão), Guajuvira (*Cordia Americana* (L.) Gottschling & J.S.Mill.), Tarumã (*Citharexylum myrianthum* Cham.), Angico Branco (*Albizia polycephala* (Benth.) Killip ex Record), Canjerana (*Cabralea canjerana* (Vell.) Mart.), which are indicated for mixed plantations, thus avoiding the attack of pathogens, as is the case with cinnamon trees in general. Furthermore, as shown in Table 4, the species have similar uses reported by the producers as internal-use wood, external-use wood, cachaça/grappa, and furniture manufacturing (38%).

The growth rates indicated for each species can help farmers to establish crops in areas where there is *H. dulcis*, the species Rabo de bugiu (*Lonchocarpus campestris* Mart. ex Benth.), Guabiroba (*Campomanesia xanthocarpa* (Mart.) O.Berg), Bracatinga (*M. scabrella*) also mentioned, have potencial for timber production and can be efficient in the production of firewood and charcoal. Moreover, all species mentioned contain fruit for feeding the fauna, alleviating the problem of the lack of it.

Of the four species with the highest level of consensus, three are native to the Atlantic Forest Biome. The references to the species are mainly due to the constant contact with them, for being integrated with the knowledge acquired over the years, and the farmers' way of life (Albuquerque & Andrade 2002, Hanazaki et al. 2006).

Canela (*Ocotea* sp.) was one of the most commonly mentioned. Nonetheless, many informants did not specify which Cinnamon species they were referring to. It was mentioned in the interviews that in 1948 there were two distilleries of sassafras/safrol oil, extracted from the Canela Sassafras (*Ocotea odorifera* (Vell.) Rohwer), in Sede Brum. This oil was and is important for the food, chemical, and pharmaceutical industries. In Santa Catarina, between 1940 and 1980, thousands of trees were transformed into sassafras oil through a steam process. Its exploitation was so intense that when there was news that there were no more trees of this species, the local population even sought the roots in the soil to remove the rest of safrole oil because they knew that the roots also have this concentration of oil. Its wood was also used for noble purposes such as furniture making and improvement (Prochnow 2007). With this exploitation, Canela Sassafras *(O. odorifera*) is found on the 2008 Official List of Species of Brazilian Flora Threatened with Extinction of the state of SC. Such a situation results in the

loss of biological diversity, leading to the extinction of the species in local populations (MMA 2008).

The study conducted by Lorenzi (1992) clarifies that Angico Vermelho (*P. rigida*) is used and recommended for heterogeneous reforestation in degraded areas. However, according to Gasparin (2012), germination tests for Angico plants are considered fundamental due to the delay in seed birth and because there are few studies on the species. Otherwise, their potential could be further explored, compromising its cultivation.

Due to the exploitation of its wood, the Cedro (*C. fissilis*) is also on the Official List of Species of Brazilian Flora Threatened with Extinction of 2008 of the state of Santa Catarina, Brazil. Besides, there are photographic and spoken records that indicate that the cedar was exploited in the 1950s.

According to Zuchiwschi *et al*. (2010), in work developed in Anchieta-SC, area of occurrence of DSF, the species mentioned are similar to the present study where i) Canela (*Ocotea sp.*) was mentioned as having good contribution for sawn timber, firewood, and flooring wood; ii) Angico Vermelho (*P. rigida*) could be used for sawn timber, flooring wood, medicinal bark, firewood, and fence posts; iii) Grápia (*A. leiocarpa*) was used for flooring wood, fence posts, and sawn timber and; iv) Cedro (*C. fissilis*) for furniture and sawn timber.

One of the greatest obstacles described by the informants for the replacement of *H. dulcis* is the delay in the growth of native trees. Moreover, there's Law No. 9.605, of February 12, 1998, which does not allow cutting native species without permission from the responsible agencies to use species.

The informants also characterize that the absence of an adequate forestry policy is an obstacle to the use and commercialization of native species. As a result, the potential of native species is only exploited by a very small and restricted number of companies in the timber sector. The policies developed in the form of legislation only increase the list of what is not allowed (Fantini & Siminski 2011).

In contrast, among the mentioned species with greater consensus (41%), the Eucalyptus (*Eucalyptus sp.*) stands out, which is an exotic species. It is important to emphasize that there are 5.56 million hectares planted in Brazil, and the states with the highest concentration of this species are: São Paulo, Minas Gerais, and Mato Grosso do Sul, representing 71.9% of the area planted with Eucalyptus (IBÁ 2015). According to Angeli *et al*. (2015), this species is used to meet the demands of both industries and small producers' demands because it grows fast and

presents desirable silvicultural characteristics. Based on this, there is a concern that with the suppression of the Japanese Raisin on the properties, instead of replacing it with native species, the planting of Eucalyptus or other fast-growing exotic species will be carried out.

Table 4: Native species mentioned and their phenological, general characteristics, and growth habits with potential for replacing *H. dulcis*, BZ of Fritz Plaumann State Park. Concórdia-SC

Species	General Characteristic	Phenology	Growth
Angico vermelho (Parapitadenia rigida)	Native. Used in construction, woodwork, carpentry, landscaping, and mixed reforestation	Blooming season November-January, fruiting season June-July	Fast
Açoita cavalo (Luehea divaricata)	Native. Used in furniture structures, civil construction, framing, landscaping, and mixed reforestation in preservation areas	Blooming season December-February, fruiting season May-August	Fast
Canela-guaicá (*Ocotea puberula*)	Native. Used in construction, woodwork, carpentry, landscaping, and mixed reforestation	Blooming season July-August, fruiting season November-December	Fast
Canela lageana (*Ocotea pulchella*)	Native. Used for covering roofs, floors, walls, bridges in general, landscaping, and mixed planting in degraded areas	Blooming season November-December	Moderate
Canela amarela (Nectranda lanceolata)	Native. Used for civil construction, internal renovation, ornamentation, and mixed reforestation in degraded areas	Blooming season September-December, fruiting season January-March	Fast

Grápia (Apuleia leiocarpa)	Native. Used as wood for internal and external use, conservation reforestation.	Blooming season August-September, fruiting season January-February, but the fruits remain on the trees for many months	Slow
Cedar (Cedrela fissilis)	Native. Used for plywood, civil construction, reforestation of degraded areas	Blooming season August-September, fruiting season July-August	Fast
Cabreúva (Myocarpus frondosus)	Native. Used in construction, furniture, and ornamentation	Blooming season September-October, fruiting season November-December	Fast
Rabo-de-bugiu (Lonchocarpus campestris)	Native. Used for indoor rural constructions, firewood and charcoal, urban afforestation	Blooming season October-December, fruiting season June-July	Moderate
Guajuvira (Cordia americana)	Native. Used for constructions, exposed works, landscaping, and reforestation	Blooming season September-October, fruiting season November-December	Moderate
Angico branco (Albizia polycephala.)	Native. Used for covering roofs, floors, walls, bridges in general, internal use in construction, ornamental for shading, heterogeneous planting of degraded areas	Blooming season November-December, fruiting season May-June	Fast

Guabiroba (Campomanesia xanthocarpa)	Native. Used for making tool handles, firewood, and charcoal	Blooming season September-November, fruiting season November-December	Fast
Canjerana (Cabralea canjerana)	Native. Used in furniture, sculpture works, construction, landscaping, heterogeneous reforestation of preserved areas	Blooming season September-October, fruiting season August-November	Slow
Tarumã (Citharexylum myrianthum)	Native. Used for covering roofs, floors, walls, bridges in general, light artifacts, planting of degraded riparian areas	Blooming season October-December, fruiting season January-March	Fast
Bracatinga (Mimosa scabrella)	Native. Used for civil construction, plywood, firewood, charcoal, and ornamental purposes	Blooming season June-August, fruiting season November-January	Fast

CONCLUSIONS

The analysis of the history of the introduction of the species confirmed the technical indication as one of the main stimulators for the expansion of *H. dulcis* in the region, with more than 50% of the informants mentioning the technical indication for use on farms around the Park. Moreover, the statements are corroborated by the literature survey that showed studies and technical indications, promoting the use of the species.

As for the uses found for the species *H. dulcis*, it can be seen that firewood was the most present use in all interviews due to the species being of rapid growth and cutting allowed because it is exotic.

As potential species to replace *H. dulcis* in the study area, the angico-vermelho (*P. rigida*) and Eucalyptus (*Eucalyptus sp.*) are native and exotic species.

As for the consumption of *H. dulcis* fruits by native fauna, 100% of the interviewees mentioned observing the animals consuming them. Particularly the order passerines were the most frequently observed.

These data, corroborated by other scientific researches, demonstrate the importance of controlling *H. dulcis* in the study area. However, it is important to emphasize that the species were technically indicated for their cultivation in the Park's BZ. Therefore, other studies showing the gradual replacement of this species by others with greater or equal level of biological characteristics are of paramount importance for controlling *H. dulcis* in the study area.

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LITERATURE CITED

Albuquerque UP, Lucena RFP, Cunha LVFC. 2010. Métodos e Técnicas na Pesquisa Etnobiológica e Etnoecológica. Recife, PE:NUPPEA. 559p.

Albuquerque UP, Andrade LHC. 2002. Conhecimento botânico tradicional e conservação em uma área de caatinga no estado de Pernambuco, Nordeste do Brasil. Acta Botanica Brasilica 16: 273-85.

Andrade C, Mayer SLS, Ferrarez FA, Marchesan R, Rossi L, Silva DA. 2019. Propriedades energéticas da madeira e do carvão de Hovenia dulcis Thuberg. Ciência da Madeira (Brazilian Journal of Wood Science) 10(2): 166-175. DOI: 10.12953/2177-6830/rcm.v10n2p166-175

Barros RSM. 2007. Medidas de diversidade biológica. Pós-Graduação em Ecologia Aplicada ao Manejo e Conservação de Recursos Naturais – PGECOL. Universidade Federal de Juiz de Fora – UFJF. Juiz de Fora, MG.

Bernard HR. 1994. Research methods in anthropology. Analysis of qualitative data. Walnut Creek: 585. Altamira Press.

Cancelier A, Capeletto C, Pereira BA, Todescato D, Costelli MC, Silva A, Lopes TJ. 2013. Influência de parâmetros de processo na obtenção de bebida fermento-destilada de uva-japão (*Hovenia dulcis* Thunberg). Brazilian Journal of Food Technology 16(1): 59-67.

Convenção sobre Diversidade Biológica – CDB (1992). Cópia do decreto legislativo n 2, de 5 de junho de 1992.

Cardoso T. 2013. Intoxicação experimental pelos frutos de Hovenia dulcis (Rhamnacea) em bovinos. Dissertação (Mestrado em Ciência Animal- área: Sanidade Animal) Universidade Federal de Santa Catarina. Programa de Pós- Graduação em Ciencia Animal Lages.

Carvalho PER. 1994. Ecologia, silvicultura e usos da uva-do-japão (*Hovenia dulcis* Thunberg). Colombo, PR, EMBRAPA, Comunicado Técnico n. 23, 24 p.

Dechoum MS, Zenni RD, Castellani TT, Zalba SM, Rejmanek M. 2015. Invasions across secondary forest successional stages: effects of local plant community, soil, litter, and herbivory

on *Hovenia dulcis* seed germination and seedling establishment. Plant Ecol. 216:823–833. DOI 10.1007/s11258-015-0470-z

Estimates. Retrieved from: http://viceroy.eeb.uconn.edu/estimates/. Accessed on: April 12, 2018.

Fantini AC, Siminski A. 2011. Espécies madeireiras nativas da região sul do Brasil. In: Coradin C, Siminski A, Reis A. Espécies nativas da flora brasileira de valor econômico atual e potencial: Plantas para o futuro - Região Sul. Brasília: MMA. 403 - 409p.

Fatma. Parque Fritz Plaumann. Plano de Manejo: fase II. 2014. Retrieved from: http://parquefritzplaumann.org.br/arquivos/edicao_digital/resumo_executivo.pdf. Accessed on: April 16, 2018.

Franco MLPB. 2005. Análise de Conteúdo. 2. ed. Brasília: Liber Livro. 79p

Galdolfi E. 2017. Motivação para a permanência ou retorno dos jovens no campo: O caso do município de Arovredo-SC. Monografia(Graduação) UFSS. Chapecó.

Gasper AL, Uhlmann A, Sevegnani L, Lingner DV, Rigon-Junior, MJ. Verdi M, Stival-Santos A, Dreveck S Sobral M, Vibrans AC. 2013. Inventário Florístico Florestal de Santa Catarina: espécies da Floresta Estacional Decidual. Rodriguésia 64(3): 427-443. DOI: 10.1590/S2175-78602013000300001

Gasparin E, Araujo MM, Avila AL, Wielewicki AP. 2012. Identificação de substrato adequado para germinação de sementes de *Allophylus edulis* (A. St.-Hil., A. Juss. & Cambess.) Radlk. Ciência Florestal, Santa Maria 22(3): 625-630.

Instituto Hórus. Uva-do-japão (*Hovenia dulcis* Thumb.). Retrieved from: Accessed on May 22, 2018.

Lima CL, Oliveira FH de, Sothe C, ALVES FH. 2021. Ocorrencia da espécie invasora *Hovenia dulcis* no estado de Santa Catarina. Ciência e Natura 43(e63). DOI: 10.5902/2179460X42748

Lorenzi, H. 1992. Árvores brasileiras: manual de identificação e cultivo de plantas arbóreas nativas do Brasil. Nova Odessa: Ed. Plantarium. 352p.

Medrado MJS. 2000. Sistemas agroflorestais: Aspectos básicos e indicações. In: Galvão, APM. Reflorestamento de propriedades rurais para fins produtivos e ambientais: Um guia para ações municipais e regionais. Brasília: Embrapa Florestas. P 269 – 312.

Miranda TM, Hanazaki N. 2008. Conhecimento e uso de recursos vegetais de restinga por comunidades das ilhas do Cardoso (SP) e de Santa Catarina (SC), Brasil. Acta bot. Bras 22(01): 203-215.

MMA- Ministério do Meio Ambiente. 2008. Instrução Normativa No 6, de 23 de setembro de 2008. Lista Oficial das Espécies da Flora Brasileira Ameaçadas de Extinção de 2008 do estado de SC.Acesso em: May 29, 2018.

Monteiro JM, Albuquerque UP, Lins-Neto EMF, Araújo EL, Amorim ELC. 2006. Use patterns and knolwledge of medicinal species among two rural communities in Brazil's semi-arid northeastern region. Journal of Ethnopharmacology 105: 173-186.

Mundeleski E, Schmitz JAK, Biondo E. 2008. Estudo ambiental da microbacia do Arroio Jacarezinho (Nova Boréscia e Encantado/RS) com ênfase na mata ciliar e na qualidade da água. Caderno de Pesquisa série Biologia 20(3): 44-62.

Napoli LM, Sanches FL, Iwakiri S, Hillig E. 2013. Propriedades físicas da madeira e de painéis aglomerados produzidos com misturas de espécies florestais. Floresta 43(3): 475-484. DOI: 10.5380/rf.v43i3.26204

Ruschel AD, Nodari ES, Guerra, MP, Nodari RO. 2003. Evolução do uso e valorização das espécies madeiráveis da Floresta Estacional Decidual do Alto-Uruguai, SC. Ciência Florestal 13(1): 153-166. Doi: 10.5902/198050981734

Prochnow, M (org). 2007. **No Jardim das Florestas**. Rio do Sul: Apremavi. 188p.

Silva FCA, Heiden FC, Aguiar VVP, Paul JM. 2003. Migração rural e estrutura agrária no oeste catarinense. 2 ed. Florianópolis. Instituto Cepa. 99pg.

Zuchiwschi E, Fantini A C, Alves AC, Peroni N. 2010. Limitação uso de espécies florestais pode contribuir com a erosão do conhecimento ecológico tradicional e local de agricultores familiares. Acta Botanica Brasalica (Impresso) 24: 270-282.

Vibrans AC, Mcroberts RE, Lingner DV, Moser P, Nicoletti A. 2012. Extensão original e remanescentes da Floresta Estacional Decidual em Santa Catarina. *In*: Vibrans AC, Sevegnani L, Gasper AL, Lingner DV. (eds.). Inventário Florístico Florestal de Santa Catarina, Vol. II, Floresta Estacional Decidual. Blumenau, Edifurb. Pp. 25-31.

Viertler RB. 2002. Métodos antropológicos como ferramentas para estudos em etnobiologia e etnoecologia. In: Métodos de coleta e análise de dados em etnobiolgia, etnoecologia e disciplinas correlatas. Rio Claro: UNESP, p. 11-29.

CHAPTER 2

Analysis of the fruits dispersion of *Hovenia dulcis* in seasonal deciduous forest in Santa Catarina state, Brazil

Based on: SILVA, K. P.; TAVELA, A. O.; SANTOS. K. L. Analysis of the fruits dispersion of *Hovenia dulcis* in seasonal deciduous forest in Santa Catarina state, Brazil.

Submetted to: Biotemas

ABSTRACT

In Brazil, the seasonal deciduous forest (SDF) is at an advanced stage of degradation due to numerous human interactions such as the introduction of invasive alien species. The arboreal species *Hovenia dulcis* was introduced into the SDF, especially in the west of Santa Catarina/Brazil. In this scenario, the objectives of this study were to analyze the dispersion of fruits of *H. dulcis* by the fauna, to verify the existence of a preference of the fauna between fruits of *H. dulcis* and the native species *Syagrus romanzoffiana*, and to analyze the dispersion distance of *H. dulcis* by the fauna. For this study, six sampling stations were carried out where the fruits of *H. dulcis* were offered in treatments: i) attached to spools of line to measure the dispersion distance; ii) in plastic trays; iii) fruits of *S.romanzoffiana*. The fauna observation, using camera traps, was conducted during 01 year and 05 months covering the seasons summer, autumn, winter and spring in the first year (2017), and summer and autumn in the second year (2018). As a result, the greatest dispersion distance was 7.2m. There was greater dispersion of *H. dulcis* fruits during the winter. Control groups and small animals had the highest means and standard deviation for the consumption treatments. There was a preference of the native fauna for the fruits of *H. dulcis*.

Keywords: Invasive alien species, Seasonal Deciduous Forest, Zoochory.

INTRODUCTION

Seasonal forests are ecosystems with special characteristics in terms of their distribution and structure because of their occurrence in dry and humid climates (SCHUMACHER et al. 2011). Currently, this forest is widely threatened due to a myriad of human actions, especially the fragmentation of habitats and the introduction of invasive alien species (GASPER et al., 2013; TSOAR et al., 2011). Those human interventions in the environment compromise the biological functionality of ecosystems (HADDAD et al., 2015).

In the southern region of Brazil, in the state of Santa Catarina, the Seasonal Deciduous Forest (SDF) is intricately linked to the seasonality presenting in this phytophysiognomy, adapted and characteristic specimens of this environment, giving its own aspect (KLEIN, 1978). It is possible to notice the establishment of two well-defined climatic seasons - summer and winter - with rainfall partially distributed throughout the year, with a reduction in precipitation during the autumn and winter months (KLEIN, 1978). During the period of water restriction, the canopy presents more than 50% of its species without leaves (SANTA CATARINA, 1986). This is the most important stratum, as it characterizes the SDF as a seasonal forest formation (VIBRANS et al., 2012)

In the region where the SDF occurs, rural landowners use different wood species in order to address their local demands. Among these species the Japanese raisin tree (*Hovenia dulcis* Thunberg) has been used as an alternative timber resource for their activities, which, highlighting its characteristics as a pioneer plant, made *H. dulcis* an invasive species in this ecosystem (SIMINSKI, 2009). In addition, the pulp and paper industry takes advantage of the species, as a source of energy, or the civil construction and carpentry have been using it in beams, boards, floors, furniture and laminates, also used in the shading of poultry and swine sheds (CARVALHO, 1994).

The tree species *H. dulcis* belongs to the family Rhamnaceae, native to Japan, Korea and eastern China (KOPACHON et al., 1996). In Brazil it is popularly known by several names, especially as grape-of-japan, grape-japanese (CARVALHO, 1994) or Japanese raisin tree. It has deciduous characteristics, reaching up to 25 meters in height, presenting its flowers in the period from August to February and ripe fruits from March to October. The leaves fall from April or May, and may remain until the month of August (CARVALHO, 1994). Due to its deciduous characteristic, *H. dulcis* is adapted to the microclimate of the state of Santa Catarina,

being found in abundance in the SDF, where it assumes an aggressive invasive potential (LIMA et al., 2021; DECHOUM, 2015; ZENNI E ZILLER, 2011). The tree species *H. dulcis* is mentioned in the Official List of Invasive Alien Species in the State of Santa Catarina (CONSEMA Resolution 11/2010).

Biological invasion directly affects fauna composition locally, and putting animal-plant interactions at risk, especially seed dispersal (JORDANO et al., 2006). Seed dispersal is a symbiotic and mutualistic process, in which the dispersers receive nutritional feedback and the plants have their seeds dispersed. In a diagnosis carried out by Instituto Horus (2011), processes of biological invasion were verified in all the ten protected areas (PA) managed by the Institute of the Environment of Santa Catarina (IMA), where more than 105 invasive alien species (89 plants) were identified. These areas require intense control actions, especially the Fritz Plaumann State Park, which has an extensive area invaded by *H. dulcis*.

In a research at the Fritz Plaumann State Park, Lima et al. (2015) evidenced the invasive problem because native fauna of the SDF showed preference for *H. dulcis* fruits in comparison with the native trees, helping the dispersion and directly contributing to the increase of this aggressive invasive species; especially in areas of protection and conservation of natural ecosystems, such as conservation units (DECHOUM, 2012).

Knowing that dispersing agents can assist in the installation process, as well as the biological invasion of an exotic plant species, it is evident that this relationship can compromise the structure and processes of ecological interaction of forest ecosystems, leading to the loss of important native specimens, both animals and vegetables. To advance understanding about ecological interactions, particularly in the SDF, the jeriva palm (*Syagrus romanzoffiana*), a native key species in seasonal forests (JORGE et al, 2021), can be used to verify the fauna's demand for fruit throughout the year, including during the dry season, when this species featuring as an important source of energy for the region's native animals (NETO et al., 2020; OLIVEIRA et al., 2016).

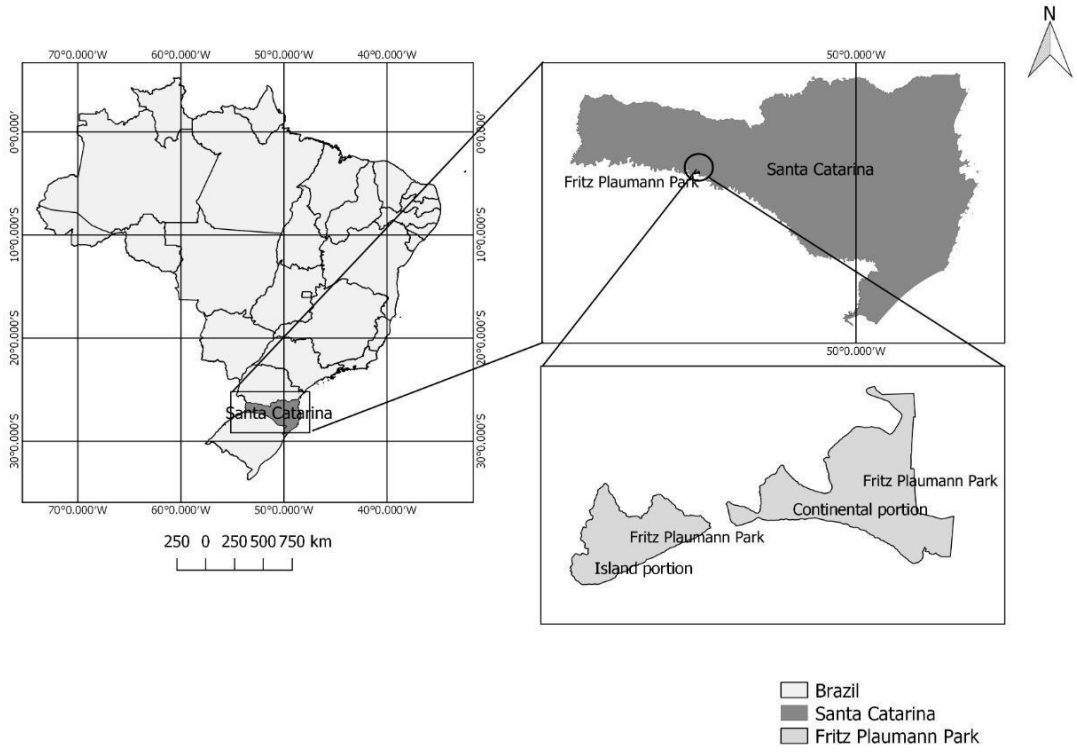
Based on this, the study aimed to evaluate the seasonality in the consumption and dispersion of the fruits of *H. dulcis* and *S. romanzoffiana* by animals and to verify the role of native fauna in the dispersion of the fruits of these plants. Our hypothesis are that i) there are differences in the dispersion of fruits of *H. dulcis* against native species *S. romanzoffiana*; ii) there is a difference in the dispersion of fruits during a certain season of the year.

MATERIAL AND METHODS

Study site

The experiment was conducted during the years 2017 and 2018 in the Fritz Plaumann State Park (FPSP), protected area of Integral Protection (Fig. 1), according to the National System of Nature Conservation Units (SNUC, 2000), and included in the National Park category according to IUCN (International Union for the Conservation of Nature). The FPSP encompasses an area of 741 ha divided into two portions: continental and island (Fig 1). It is located between the coordinates 27º 16'18" and 27º 18´57" S, 52º 04 '15" and 52º 10' 20" W, in Concordia, western of Santa Catarina, Brazil (FATMA, 2014).

Figure 1: Map of the Fritz Plaumann State Park area showing the continental portion and the island, located in the municipality of Concórdia, state of Santa Catarina, Brazil.



Fonte: A autora (2022).

According to the FPSP Management Plan (FATMA, 2014), the Park is part of the Atlantic Forest Domain, in the transition region between the Deciduous Seasonal Forest (DSF) and the Mixed Rain Forest (MRF). Most of the Park's forest areas are in different stages of

regeneration, after having been clear cut for the establishment of agricultural, livestock and logging activities, or even selective cutting of commercially valuable tree species without any type of management (FATMA, 2014).

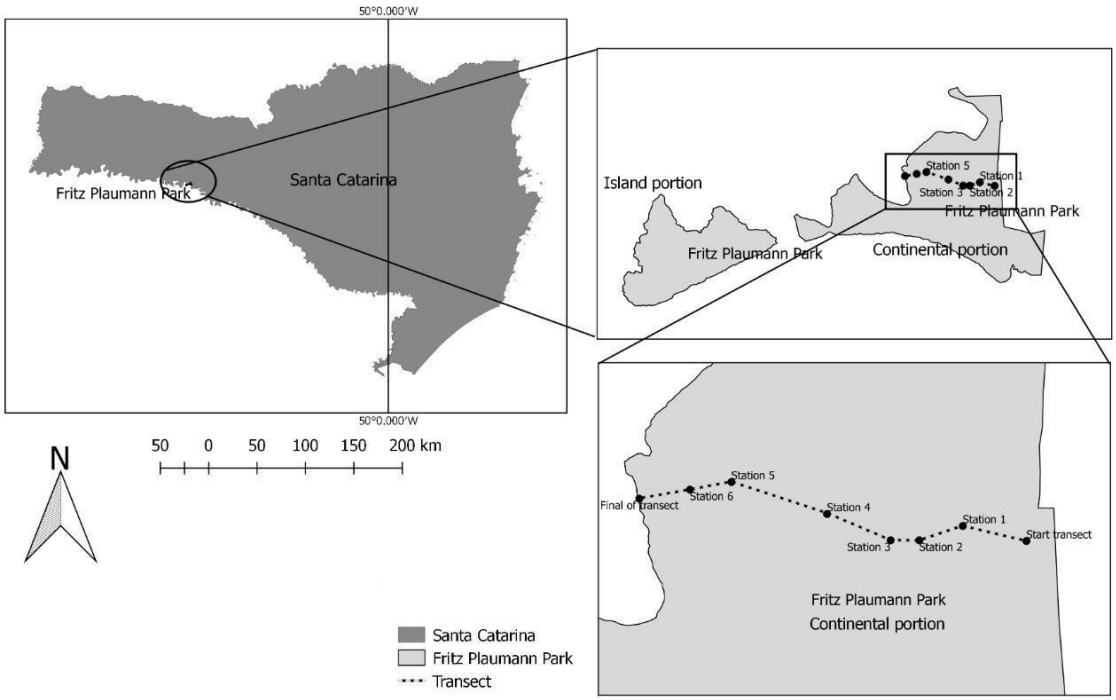
The average annual temperature at the study site is 19.6ºC, varying approximately 10ºC on average according to seasonality, rising from August to January and declining from February to July (FATMA, 2014). The absolute minimum temperatures below zero eventually occurred from May to August, a period that includes the autumn and winter seasons. Conversely to the annual behavior of the temperature, the relative humidity of the air has maximum values in the winter season and minimum values in the summer season.

About the phytophysiology of the region there are plant species that are representative within the seasonal deciduous forest, such as the *Apuleia leiocarpa*, the *Ocotea odorifera*, *Cabralea oblongifoliola*, *Peltophorum dubium, Cedrus* spp. and *Syagrus romanzoffiana* which exert intense activity on the local fauna.

Study design

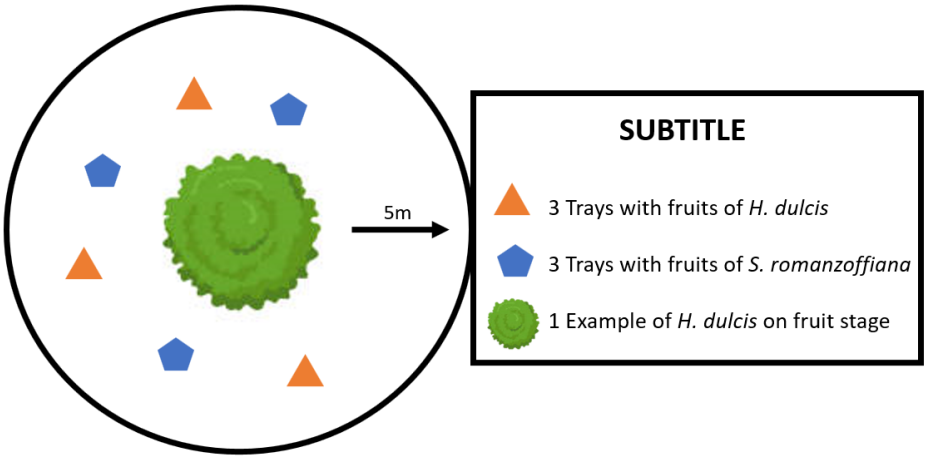
For this study, only the continental part of the FPSP was considered to carry out fauna sampling. The transect of public use that comprises the access road to the headquarters of the park was used as guide line, with an approximate length of 1000m. Along this transect, six stations were set up and characterized by the presence of clusters of individuals of *H. dulcis.* The distribution of the plots considered a minimum distance of around 5m to 20m from the transect and, at least 100m apart, as shown in Figure 2. In each plot, characterized by the presence of one adult *H. dulcis* in fructification, sampling stations were installed with treatments in a radius of 5 meters (Figure 3). Local fauna consumers and dispersers were recorded by camera (digital Tigrinus® camera traps), placed one in each sampling plot.

Figure 2 - Location map of sampling stations in the continental part of Fritz Plaumann State Park, municipality of Concórdia, state of Santa Catarina, Brazil. The sampling transect shows the sampling stations numbered from 1 to 6 separated by a minimum distance of 6 meters.



Fonte: A autora (2022).

Figure 3 - Schematic showing the composition of sampling stations located in the sampling transect. The sampling included 1 specimen of *H. dulcis* in adult and reproductive stages, where, below the specimen in a radius of 5 meters, plastic trays containing fruits of mature *H. dulcis* and mature fruits of the species *S. romanzoffiana* were deposited.



Fonte: A autora (2022).

Fruit dispersion

Using Donatti's modified methodology (2004), the fruit dispersion experiment was carried out using line spools attached to *H. dulcis* fruits. In each station, five reels of line containing 50m of line were installed, containing one fruit of *H. dulcis* tied to the end of the thread. For the removal analysis, the reel carrying distance was counted to dimension the possible dispersion distance.

Fruit consumption and removal

In each sampling station, plastic trays fixed with wooden rods containing 10 fruits of *H. dulcis* in each one was installed and divided into three treatments, being these: A) Control (access to all types of animals); B) Large animals (tray 60 cm from the ground – access to birds and large mammals) and C) Small animals (tray 30 cm from the ground – access birds and medium size mammals and birds). The proportion of removed or consumed fruits was evaluated after 10 days, the remaining fruits found were classified as adapted from Galetti et al. (2003) and Lima (2013) in: Intact (fruit on the spot with no sign of predation); Consumed (fruit with indications of feeding by the fauna); and Scattered (fruit not found). The study was carried out in different seasons of the year, covering winter and spring season of 2017, and the summer and autumn of 2018.

Preference of consumption by fauna

To analyze the preference of the fauna for the fruits of *H. dulcis* compared to the fruits of one native species through time, a “tasting panel” was offered based on the methodology adapted from and Lima (2015). Lima used and its methodology *H. dulcis* fruits in plastic trays. In our methodology we did the same procedure. For this, the same methodology used in the consumption and removal stations was applied, exposing *Syagrus romanzoffiana* fruits to different groups of animals in parallel to the *H. dulcis* fruit offer. After the offer, the remaining

fruits were classified into: Intact (fruit on the spot with no sign of predation); Consumed (fruit with signs of feeding by the fauna); Scattered (fruit not found).

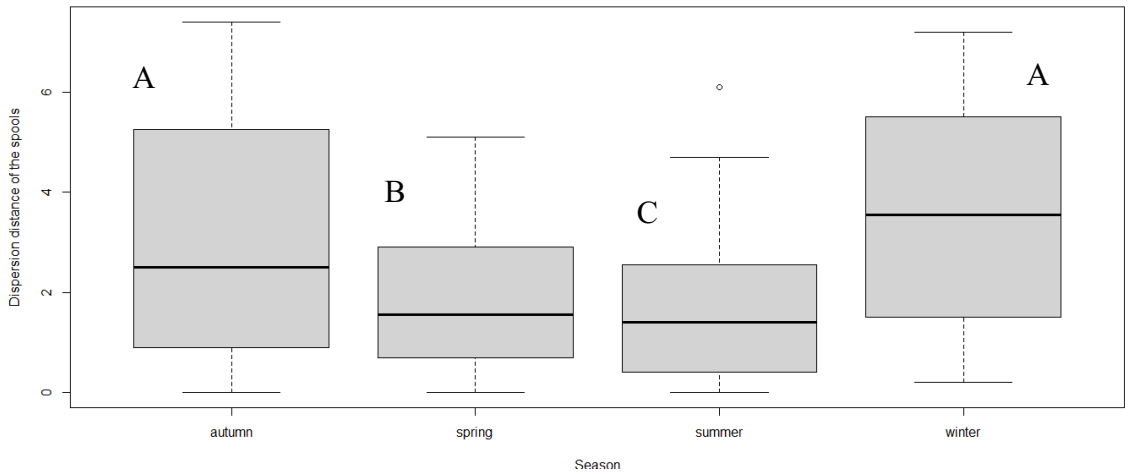
Statistical analysis

To test the normality of the data of consumption and removal of fruits, a Shapiro-Wilk test was performed. An ANOVA test was also carried out to check if there was a difference between the years of the research. A two-way ANOVA test was also carried out to check if there was a difference between the sampling stations in each season of the year. A test of means (T test) and standard deviation was performed for all variables of the state of the fruits. The analyzes were performed using the software R (R CORE TEAM, 2018).

RESULTS

The study of the dispersed fruits showed difference for the seasons ($p < 0,05$). The winter season showed the highest mean of dispersion distance (3.60 ± 2.28) followed by autumn season (Fig. 4). The longest dispersion distance occurred during the winter season and it was 7.2m.

Figure 4 - Spool scattering distance per sampled season, where: A - Larger scattering distances during winter and autumn seasons. B - Dispersion distance in spring. C - Dispersion distance in summer.



For the scattered fruits of *H. dulcis* there was a difference between the seasons of the year when the fruits were offered to native fauna ($p < 0,05$) (Fig. 5a). The control group presented the highest dispersion (4.00 ± 2.65) and small animals (sa) treatment (3.92 ± 2.67). As for the plant species offered in the study, it is possible to perceive, for the scattered fruits, a preference of the native fauna for the fruits of *H. dulcis* (Fig. 5b). For scattered fruits there was a difference between the species tested in this study and between the seasons in which the fruits were offered ($p < 0,05$). There was also a difference when we compare the seasons by species (*H. dulcis* vs. *S. romanzoffiana*) (Fig. 5c).

Figure 5 - A) Fruits of *H. dulcis* scattered by seasons during the sampling period, showing greater dispersion during the winter. B) Scattered fruits of invasive exotic species (ias) and native species (natives), demonstrating greater interest of the native fauna for the fruits of the ias. C) Scattered fruits by season of the year in the two-year sampling period during the winter. during the winter, where ias (invasive alien species) and native *(S. romanzoffiana*).

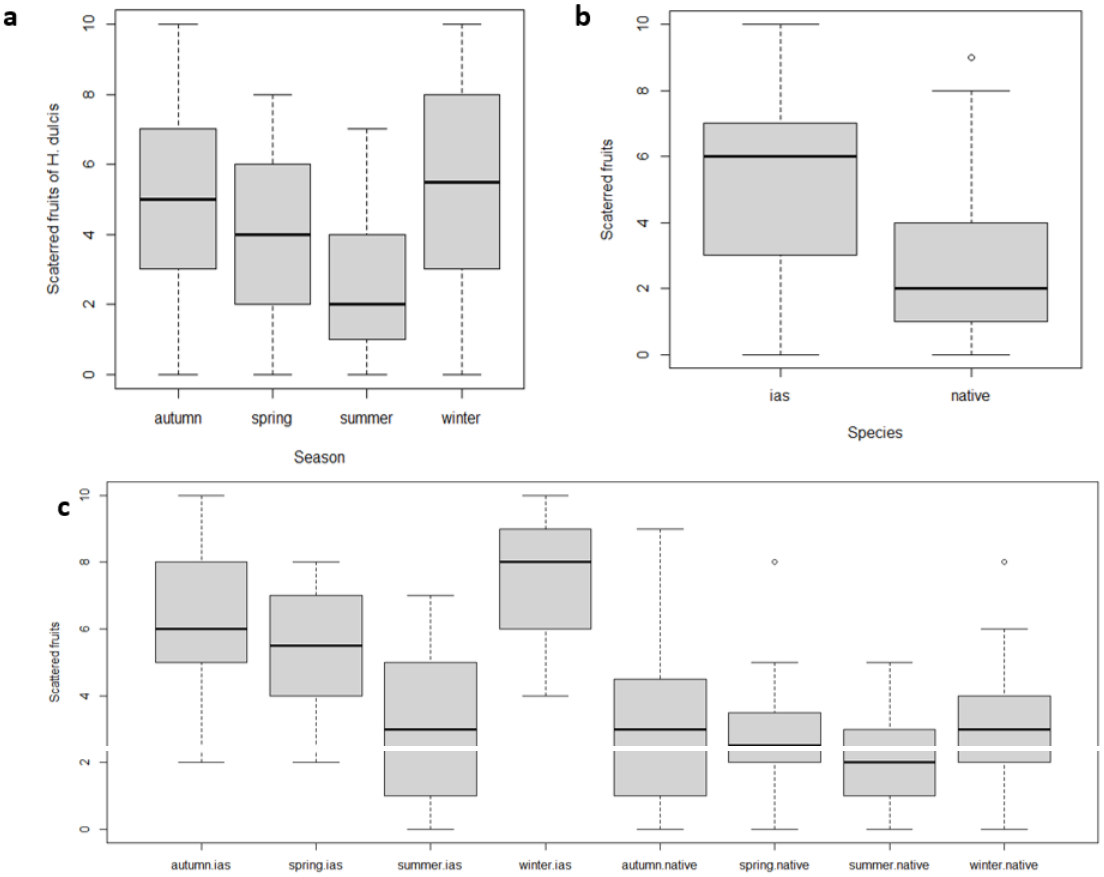


Table 1: Table demonstrating preference for fruit consumption and removal in the tray experiment by native fauna in Fritz Plaumann State Park for *H. dulcis*. For this result, a two-way ANOVA was used, which demonstrates that the consumption and removal of fruits is greater in the autumn and winter seasons in the years 2017 and 2018.

Year	Station	Treatment	Intact	Consumed	Scattered
2017	Summer	Control	65	32	20
		Big animals	59	36	19
		Small animals	72	28	20
	Autumn	Control	10	24	86
		Big animals	25	35	51
		Small animals	15	35	70
	Winter	Control	08	22	90
		Big animals	16	21	83
		Small animals	08	18	94
	Spring	Control	42	48	30
		Big animals	42	38	40
		Small animals	49	40	21
2018	Summer	Control	55	38	52
		Big animals	27	30	64

		Small animals	41	40	39
	Autumn	Control	11	22	87
		Big animals	15	18	87
		Small animals	19	28	73

DISCUSSION

Consequently it this possible demonstrated a relationship between seasonality on the dispersion of fruits by the fauna. The winter showed the highest rates of scattered fruits of *H. dulcis*, followed by autumn. This fact can be explained due to the period of fruiting of *H. dulcis* that occurs during the months of March to October, coinciding with the dry season of winter (SCHMIDT et al., 2020).

Therefore, our hypothesis that there would be an interference of seasonality in the scattered of *H. dulcis* fruits was corroborated. Seasonality is an important resource that can lead to higher levels of scattered fruits in the DSF. Currently, large trees lose their leaves because they are deciduous and, consequently, fail to provide fruit to the native fauna. *Hovenia dulcis*, on the other hand, starts to bear fruit in this period, from March to October (VIBRANS et al, 2012). This factor may favor *H. dulcis* against native tree species (SILVA et al., 2021). Another factor is the capacity of *H. dulcis* to colonize areas where natural or anthropogenic openings occur in the DSF, especially in the dry period (SCHMIDT et al., 2020).

Our hypothesis that there would be a difference in scattered fruits for the animal groups tested was proven. For the study of consumption preference by fauna it was found that the control group and the small animals (sa) for the scattered fruits showed the best averages (Table 1). Our results demonstrate that the control treatment was more representative for the fruits consumed (SILVA et al., 2021). Similar results, where the animal groups tested did not show any difference, may suggest that both large and medium-sized animals and small animals may be associated with the dispersion of *H. dulcis* fruits (ROSA et al. 2021; DECHOUM et al., 2015; LIMA et al., 2015). Tree species such as *H. dulcis* have a complex invasion process and become invasive according to different ecological strategies (LARSEN et al., 2020); the scattered fruits of *H. dulcis* by the native fauna of the Fritz Plaumann State Park is an important resource for the propagation of the invasive alien species (LABBE & KING, 2020).

For the study of the preference of the fruits for the native fauna, it was possible to perceive that there is a tendency for the fruits of *H. dulcis* especially during the winter season. When comparing the two species of the study (*H. dulcis* and *S. romanzoffiana*), the fauna preferred to consume the fruits of the invasive alien species during the winter and autumn periods. Associated with that fact the dispersion of fruits by the native fauna increases the

chances of recruiting new plants, thus increasing the spread of the invasive alien species (VELEZ et al., 2020).

CONCLUSION

In general, our results indicate that the native fauna of the Fritz Plaumann State Park chose to disperse *H. dulcis* fruits during the winter. They also pointed out that the animal groups with the highest dispersion indexes were the control group and the small animal group. We also emphasize that there was a preference of the native fauna for the fruits of *H. dulcis* to the detriment of the native species (*S. romanzoffiana*). These results reinforce the need for efforts to reintroduce native species that offer year-round fruit, with a view to gradually re-establishing ecological interaction networks.

REFERENCES

CARVALHO, P. E. R. **Ecologia, silvicultura e usos da uva-do-japão (Hovenia Dulcis Thunberg).** Colombo, PR, EMBRAPA, Comunicado Técnico n. 23, 1994.

DECHOUM, M.; CASTELLANI, T. T.; ZALBA, S. M.; REJMANEK, N.; PERONI & TAMASHIRO, J. Y. Community structure, sucession and invasibility in a seasonal deciduous forest in Southern Brazil. **Biological Invasions.** 2014

DECHOUM, M. S. et al. Limited Seed Dispersal May Explain Differences in Forest Colonization by the Japanese Raisin Tree (Hovenia Dulcis Thunb.), an Invasive Alien Tree in Southern Brazil. **Tropical Conservation Science**. 2015

DONATTI, C. I. **Consequências da defaunação na dispersão de sementes e no recrutamento de plântulas da palmeira brejaúva (*Astrocarium aculeatissimum*) na Mata Atlântica.** Dissertação de Mestrado, Universidade de São Paulo, Piracicaba, 2004.

FUNDAÇÃO DO MEIO AMBIENTE (FATMA). **Plano de Manejo Fase II do Parque Estadual Fritz Plaumann.** Volume I: Plano Básico. / Florianópolis: FATMA, Caipora Cooperativa para Conservação da Natureza, 2014.

GALETTI, M.; COSTA, C.; CAZETTA, E. Effects of forest fragmentation, anthropogenic edges and fruit color on the consumption of ornithochoric fruits. **Biological Conservation**, 2003.

GASPER, A. L., UHLMANN, A.; SEVEGNANI, L.; LINGNER, D. V.; RIGON-JUNIOR, M. J.; VERDI, M.; STIVAL-SANTOS, A.; DREVECK, S.; SOBRASL, M.; VIBRANS, A. C. Floristic and Forest Inventory of Santa Catarina - species of Seasonal Deciduous Forests. **Rodriguésia**, Rio de Janeiro, v. 64, n. 3, p. 427-443, 2013.

HADDAD, N.M. Habitat fragmentation and its lasting impact on Earth's ecosystems. **Science.** 2015

INSTITUTO HÓRUS. **http://i3n.institutohorus.org.br.** Acesso em: 20/04/2021.

JORDANO, P., GALETTI, M., PIZO, M. A. & SILVA, W. R. Ligando frugivoria e dispersão de sementes à biologia da conservação. *In* C. F. D. ROCHA, H. G. BERGALLO, M. V. SLUYS & M. A. S. ALVES **(Eds.).** ***Biologia da conservação:*** *essências*. RiMa, São Carlos, 2006.

JORGE, N.; SILVA, A. C. DA; VERONEZI, C. M. *Syagrus romanzoffiana.* chapter 9. in fruits of the brazilian cerrado: composition and functional benefits. springer, 2021.

KLEIN, R. M. Mapa fitogeográfico de Santa Catarina. Itajaí: **Flora Ilustrada Catarinense**, 1978.

KOPACHON, S.; SURIYA, K.; HARDWICK, K.; PAKAAD, G.; MAXWELL, J. F.; ANUSARNSUNTHORN, V.; BLAKESLEY, D.; GARWOOD, N. C.; ELLIOTT, S. Forest restoration research in northern Thailand. The fruits, seeds and seedlings of *Hovenia dulcies* Thunb. (Rhamnaceae). **Natural History Bulletin of the Siam Society**, v.44, p. 41-52, 1996.

LABBE, M. A.; KING, D.I. Songbird Use of Native and Invasive Fruit in the Northeastern USA. **Wildlife Society Bulletin** 44(3):570–578; 2020.

LARSEN, J.G. et al. Functional niche differences between native and invasive tree species from the southern Brazilian mixed forest. **AGRARIAN SCIENCES** • An. Acad. Bras. Ciênc. 92 (3) • 2020

LIMA, R.E. **Dispersão de sementes de *Hovenia dulcis* Thunb. (Rhammnaceae) - uma espécie invasora em área de floresta estacional decidual**. 2013. 79 f. Dissertação (mestrado em Ecologia) - Universidade Federal de Santa Catarina, Centro de Ciências Biológicas, Programa de Pós-Graduação em Ecologia, Florianópolis. 2013.

LIMA, C.L.; OLIVEIRA, F. H.; SOTHE. C.; ALVES, F. E. Ocorrencia da espécie invasora *Hovenia dulcis* no estado de Santa Catarina. Ci. e Nat., Santa Maria, v. 43, e63, 2021.

LIMA, R.E. et al. Native Seed Dispersers May Promote the Spread of the Invasive Japanese Raisin Tree (Hovenia Dulcis Thunb.) in Seasonal Deciduous Forest in Southern Brazil, **Tropical Conservation Science**. 2015.

MESSEDER, J.V.S.; et al. **Frugivory and seed dispersal in a hyperdiverse plant clade and its role as a keystone resource for the Neotropical fauna** *Annals of Botany*, Volume 127, Issue 5, 9 April 2021.

R CORE TEAM R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna. Disponível em <https://www.R-project.org>. Acesso em: 2018.

ROSA, C.A., HEGEL, CARLA G.Z., PASSAMANI, M. Seed removal of Araucaria angustifolia by native and invasive mammals in protected areas of Atlantic Forest. **Biota Neotropica** 21(1): e20201111. 2021.

SANTA CATARINA (Estado). Gabinete de Planejamento e Coordenação Geral. **Atlas de Santa Catarina**. Rio de Janeiro: Aerofoto Cruzeiro, 1986.

SCHMIDT. A. D.; et al. **Biotic and abiotic changes in subtropical seasonal deciduous forest associated with invasion by *Hovenia dulcis* Thunb. (Rhamnaceae)**. *Biological Invasions* **volume 22**, pages293–306 (2020)

SCHUMACHER, M. V. *et al.* **A floresta estacional subtropical:** caracterização e ecologia no rebordo do planalto meridional. Santa Maria, 2011.

SILVA, G.G. et al. **Seed dispersal by neotropical waterfowl depends on bird species and seasonality**. Freshwater Biology. 2020.

SILVA, K. P. da.; TAVELA. A. O.; SANTOS, K.L. **Predação de frutos de *Hovenia dulcis* em fragmento de floresta estacional decidual.** Congresso Brasileiro de Biodiversidade Virtual v. 2 n. 2 (2021): Edição Especial: Anais de Eventos. 2021.

SIMINSKI, A. A floresta do futuro: conhecimento, valorização e perspectivas de uso das formações florestais secundárias no Estado de Santa Catarina. **Dissertação de Mestrado,** Programa de Pós-Graduação em Recursos Genéticos Vegetais, Universidade Federal de Santa Catarina, Florianópolis, Brasil. 2009.

SNUC. SISTEMA NACIONAL DE UNIDADES DE CONSERVAÇÃO. 2000. Disponível em <http://www.planalto.gov.br/ccivil_03/leis/l9985.htm>. Acesso em: 18 junho 2021

TSOAR, A.; SHOHANI, D.; NATHAN, R. **A movement ecology approach to study seed dispersal and plant invasion: an overview and application of seed dispersal by fuit bats.** In: Richardson, D. M. Fifty years of invasion ecology: The legacy of Charles Elton. Wiley-Blackwell, West Sussex, UK. 2011

VACCARO, S.; LONGHI, S. J. Análise fitossociológica de algumas áreas remanescentes da Floresta do Alto Uruguai, entre os rios Ijuí e Turvo, no Rio Grande do Sul. **Ciência Florestal**, Santa Maria, v. 5, n. 1, p. 33 - 53, 1995.

VELEZ, M. C. D. et al. **Seed dispersal interactions promoting plant invasions.** Plant invasions: The Role of Biotic Interactions. 2020

VIBRANS, A.C.; et al. Extensão original e remanescentes da Floresta Estacional Decidual em Santa Catarina. *In*: Vibrans, A.C.; Sevegnani, L.; Gasper, A.L. & Lingner, D.V. (eds.). **Inventário Florístico Florestal de Santa Catarina, Vol. II, Floresta Estacional Decidual.** Blumenau, Edifurb. Pp. 25-31.2012.

VIBRANS AC, SEVEGNANI L, GASPER AL, LINGNER DV. **Inventário Florístico Florestal de Santa Catarina: diversidade e conservação dos remanescentes florestais.** Blumenau: EdFurb, 2012. 344 p.

ZENNI, R.D. & ZILLER, S.R. An overview of invasive plants in Brazil. **Revista brasileira de Botânica.** 2011.

CONSIDERAÇÕES FINAIS

Para o estudo da etnobotânica verificou-se que os agricultores entrevistados fazem uso da *H. dulcis* especialmente para lenha. Os entrevistados citaram diversos usos para a espécie, sendo este o que mais se destacou. Animais como Veado-virá (*Mazama americana*), Graxaim (*Cerdocyon thous*) e Quati (*Nasua nasua*) foram citados se alimentando dos frutos da espécie exótica, o que corrobora com o capítulo 2, no qual a fauna se alimentou dos frutos da uva-do-Japão em detrimento da espécie nativa *S. romanzoffiana.*

No capítulo 1 foi possível perceber que o uso de *H. dulcis* ocorre desde os anos de 1940 na região de estudo. Os 24 informantes entrevistados citaram 34 espécies arbóreas a exemplo do angico (*P. rigida*), canelas (*Ocotea* sp) e grápia (*A. leiocarpa*) como possíveis substitutas da *H. dulcis.* O processo de introdução da uva-do-Japão confirma indicação técnica para plantios da espécie na região. No capítulo 2 foi possível evidenciar que a fauna nativa se alimenta de frutos de *H. dulcis* especialmente durante o inverno. A dispersão ocorre especialmente nesta época do ano. A maior distância de dispersão foi de 7,2 metros a partir da planta-mãe.

A estratégia de restauração proposta neste estudo é a substituição gradual da *H. dulcis* por espécies madeireiras de igual uso dentro da área de estudo. Ações paralelas associadas a pesquisas do Nesbio – Núcleo de Estudos em SocioAgroBiodiversidade, vem sendo realizados no sentido de socializar a partir de material didático e ações de extensão, os resultados obtidos nesse e em demais estudos.

Esta pesquisa demonstra ser de grande importância, pois, levanta dados inéditos para a área de estudo. É importante ressaltar a papel de relevância das instituições de ensino, pesquisa e extensão em difundir informações corretas sobre o manejo de espécies exóticas invasoras. Todavia também é importante salientar a participação das empresas em informar corretamente os agricultores a respeito de espécies como a *H. dulcis*, sua forma de uso, manejo e principais danos causados pela espécie. Além disso, o potencial das espécies da flora nativa tem grande relevância e devem ser considerados na hora de escolher para o plantio em sombreamentos e demais usos.

APENDICES

APENDICE 1

FIGURAS ILUSTRATIVAS DA METODOLOGIA PARA OS CAPÍTULOS I E II

Fig. 1. A e B: Condução das entrevistas com os agricultores lindeiros ao Parque Estadual Fritz Plaumann para elaboração do capítulo 1 desta dissertação.

Fontes: Karine Louise dos Santos (2018).

Fig. 2. Carretéis de linha presos a frutos de *H. dulcis* para o teste de distância de dispersão presente no capítulo 2 desta dissertação.

Fonte: A autora (2017).

Fig. 3. A: Frutos de *H. dulcis* ofertados para a fauna nativa em bandeja plástica contendo dez frutos maduros. Metodologia referente ao grupo de grandes animais situada a 60cm do solo, B: Frutos de *H. dulcis* ofertados a fauna nativa em bandeja plástica no grupo controle onde a bandeja fica rente ao chão para acesso a todos os tipos de animais.

Fonte: A autora (2017).

Fonte: A autora (2018).

Fig. 4. Fauna nativa do Parque Estadual Fritz Plaumann se alimentando dos frutos de *H. dulcis* nas bandejas plásticas situadas nas estações amostrais registrados por armadilhas fotográficas. A: Veado-virá (*Mazama americana*). B: Graxaim (*Cerdocyon thous*). C: Quati (*Nasua nasua*).

Fontes: A autora (2017).

Fig. 5. Situação de bandeja plástica presente nas estações amostrais após predação dos frutos de *H. dulcis* pela fauna nativa. Percebe-se os frutos predados e os frutos ausentes dos dez disponibilizados.

Fonte: A autora (2018).

APÊNDICE 2

Local, Data

TERMO DE CONSENTIMENTO LIVRE ESCLARECIDO

Apresentação do Projeto

Prezado (a) Senhor (a),

Estamos desenvolvendo um trabalho intitulado **"Aspectos etnoecológicos para o controle de *Hovenia dulcis* thunb. (rhamnaceae) em ecossistemas agrícolas e naturais"** que tem como objetivo promover estratégias de restauração em propriedades rurais lindeiras ao Parque Estadual Fritz Plaumann, que sejam fundamentadas em interações ecológicas e etnoconhecimento, a fim de promover o controle da dispersão da *H. dulcis.* O estudo será realizado entre 2017/1 e 2018/1 e esta vinculado a dissertação de Karine da Silva e ao trabalho de conclusão de curso de Carolina Novicki.

Para atingir nossos objetivos, o trabalho será realizado através de visitas para a realização de entrevistas onde vamos fazer anotações sobre o que os agricultores conhecem sobre a espécie, em especial sobre as espécies nativas que podem substitui-la do ponto de vista econômico e ecológico.

Neste sentido, para que este trabalho possa ser realizado, gostaríamos de convida-lo a participar desse estudo e nos permitir agendar visitas para conversar sobre as plantas e se possível tirar algumas fotos em sua propriedade. Caso tenha alguma dúvida antes de iniciarmos ou no decorrer do trabalho, poderá solicitar esclarecimento a qualquer momento pessoalmente ou pelo endereço e telefone listados no fim desse documento.

Informamos ainda que a realização deste trabalho respeitará o cotidiano e organização das propriedades, objetivando causar o menor impacto possível a rotina dos participantes. Assim sendo, será realizado contato prévio com cada família no sentido de realizar as visitas nos momentos mais adequados às mesmas. Nesse sentido, os riscos que podem ocorrer ao participar da pesquisa são mínimos. Podemos citar a possibilidade de haver uma troca cultural entre informante e pesquisador durante a realização das entrevistas, não caracterizando um risco propriamente dito. Há o risco de cansaço ou aborrecimento ao responder questionários, entretanto, caso o participante se sinta

desconfortável em participar, ou por qualquer outro motivo, a qualquer hora poderá desistir de participar do trabalho sem qualquer penalidade ou prejuízo pessoal.

A legislação não permite que os participantes tenham qualquer compensação financeira pela participação na pesquisa, todavia ressalta-se que não haverá nenhuma despesa advinda da sua participação. As entrevistas serão realizadas apenas em função da disponibilidade de seus horários visando evitar prejuízos as suas atividades produtivas e, em suas propriedades não necessitando de deslocamento. Todavia, os pesquisadores preveem como forma de ressarcimento/benefício o retorno dos resultados gerados através de cartilhas didáticas. Fica também garantida indenização em caso de danos, comprovadamente em virtude de ações diretas dessa pesquisa.

Os resultados serão divulgados nas comunidades envolvidas por meio de cartilhas, posters, e/ou reuniões. Igualmente os resultados serão divulgados aos agentes de desenvolvimento local e parceiro do projeto com o intuito de manter disponíveis as informações a toda comunidade.

Adicionalmente será realizada a divulgação dos resultados por meio de publicações e eventos científicos, sempre citando as comunidades envolvidas na pesquisa e detentoras do conhecimento, sendo vedado qualquer uso comercial das informações publicadas, salvo pelos detentores dos conhecimentos. Se houver alguma informação que se deseja manter em segredo, isto deverá ser informado para que não seja divulgada; os pesquisadores ainda se comprometem a manter o sigilo na identificação dos participantes.

No sentido de evitar qualquer desconforto e garantir a privacidade dos participantes e segurança dos dados, os pesquisadores envolvidos neste estudo se comprometem a atender todos os preceitos da legislação vigente em especial o item IV.5 (a) da Resolução Nº 466, de 12 de Dezembro de 2012.

_____

Pesquisador/Técnico

AUTORIZAÇÃO

Declaro, por meio deste termo, que concordei em ser entrevistado(a) e participar do trabalho intitulado **"Aspectos etnoecológicos para o controle de *Hovenia dulcis* thunb. (rhamnaceae) em ecossistemas agrícolas e naturais"** desenvolvido por Karine da Silva e Carolina Novicki e coordenado por Karine Louise dos Santos, a quem poderei contatar a qualquer momento que julgar necessário através do telefone no 48 37214172 ou e-mail karine.santos@ufsc.br.

Declaro que aceitei participar por minha própria vontade, sem receber qualquer incentivo financeiro ou ter qualquer ônus e, com a finalidade exclusiva de colaborar para o sucesso da pesquisa. Fui informado que os resultados do estudo poderão ser apresentados em eventos técnico-científicos e publicações, porém mantendo o sigilo de meu nome se eu assim desejar.

Declaro ainda que recebi uma cópia assinada deste Termo de Consentimento Livre Esclarecido e que me foi dado o direito a recusar ou desistir de participar do trabalho a qualquer momento que eu desejar.

Nome Completo:_____

- Caso tenha alguma dúvida basta enviar sua dúvida ou telefonar.
  Universidade Federal de Santa Catarina/Centro de Curitibanos - Karine Louise dos Santos
  Rod. Ulisses Gaboardi, Km 3 C.P. 101, Curitibanos/SC
  CEP 89520-000. Fone- 48- 37214172 ou 49 99135460
  Email – karine.santos@ufsc.br

  Contato do Comitê de Ética em Pesquisa da UFSC
  R. Desembargador Vitor Lima, n.222, sala 401, Trindade/Florianópolis/SC
  CEP 88040-400. Fone - (48) 3721-9206 - Email – cep.propesq@contato.ufsc.br

APÊNDICE 3

Entrevista semi-estruturada para levantamento de dados etnoecológicos

Data: Comunidade:

Entrevistado:

Ocupação: Idade:

ID da propriedade (nº ou código a ser criado):

Ponto no GPS:

Latitude: Longitude:

Altitude:

1. O Sr.(a) conhece a Uva-do-Japão?

2. Possui a espécie em sua propriedade?

3. Sempre a teve em sua propriedade? (Histórico de introdução)

4. O que você conhece sobre a espécie?

5. Para que a uva do japão pode ser usada? (Madeireiro, melífero, barra vento, sombra para animais, consumo, etc...)

6. Já recebeu alguma orientação técnica sobre e/ou para o uso desta espécie?

7. Você conhece ou faz uso de outras árvores que ocorram na sua propriedade ou região?

8. Conhece alguma outra espécie arbórea que possua os mesmos usos da Uva-do-Japão?

9. Como você mantem a Uva-do-Japão? Plantio? Ou elas surgem espontaneamente?

10. Já presenciou algum animal alimentando-se da Uva-do-Japão em sua propriedade ou locais vizinhos?

11. Quais animais?

12. Estes mesmos animais alimentam-se de outras espécies de plantas presentes na propriedade também? Se sim, quais?

13. Você acha que os animais ajudam a “plantar” as espécies de plantas (como a Uva do Japão)? Se sim, de que forma você acha que isso acontece?

14. Na sua opinião a Uva-do-Japão traz benefícios ou prejuízos a propriedade?