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Artigo Original

Reproductive phenology of understory species in a Semideciduous Seasonal Forest in São Pedro da Aldeia, RJ, Brazil

Fenologia reprodutiva de espécies de sub-bosque numa Floresta Estacional Semidecidual em São Pedro da Aldeia, RJ, Brasil

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ABSTRACT Studies on the phenology of understory species, especially in Seasonal Semideciduous Forests in the state of Rio de Janeiro, are very scarce. We aim here to describe the reproductive phenology of eight understory species in a Seasonal Semideciduous Forest in São Pedro da Aldeia, RJ, and to compare the flowering and fruiting of these species with three abiotic factors. We evaluated the presence of flowers and/or fruits between 2018-2019 with the direct qualitative method. This is the first information on the flowering and fruiting periods of Actinostemon verticillatus and Algernonia leandrii. Half of the species flowered in the onset of the rainy season, after the colder winter months and with increasing day length. There was no significant relationship between flowering and precipitation or temperature, but there was a significant positive relationship between flowering and day length. There was no significant relationship between fruiting and precipitation, but there was a significant negative relation with temperature and day length. This study presents new data on the phenology of understory species in a Seasonal Semideciduous Forest in the state of Rio de Janeiro.

KEYWORDS: *Phenology, Flowering, Fruiting*

RESUMO Estudos sobre a fenologia de espécies de sub-bosque, especialmente em Florestas Estacionais Semideciduais do estado do Rio de Janeiro, são muito escassos. Objetivamos aqui descrever a fenologia reprodutiva de oito espécies de sub-bosque em uma Floresta Estacional Semidecidual em São Pedro da Aldeia, RJ, e comparar a floração e frutificação dessas espécies com três fatores abióticos. Avaliamos a presença de flores e/ou frutos entre 2018-2019 com o método qualitativo direto. Esta é a primeira informação sobre os períodos de floração e frutificação de Actinostemon verticillatus e Algernonia leandrii. Metade das espécies floresceu no início da estação chuvosa, após os meses mais frios do inverno e com o aumento da duração do dia. Não encontramos relação significativa entre floração e precipitação ou temperatura, mas houve relação positiva significativa entre floração e duração do dia. Não houve relação significativa da frutificação com a precipitação, mas encontramos relação negativa significativa com a temperatura e duração do dia. Este estudo apresenta dados inéditos sobre a fenologia de espécies de sub-bosque em uma Floresta Estacional Semidecidual do estado do Rio de Janeiro.

PALAVRAS-CHAVE: Fenologia, Floração, Frutificação

INTRODUÇÃO

The study of the seasonal events of life cycle defines the field of phenology (Rathcke; Lacey, 1985). Seasonal flowering and fruiting may be related to exogenous (e.g. pollinators, seed dispersers, seed predators) and endogenous factors (e.g. plant's morphological and physiological adaptations), and abiotic factors such as precipitation, temperature and day-length (Frankie et al., 1974; Borchert, 1983; Rathcke; Lacey, 1985). Over 300 papers of plant phenology have addressed several kinds of vegetation in Brazil, particularly the Atlantic Forest (Morellato et al., 2013).

Semideciduous Seasonal Forests (SSF) have been well studied with phenological surveys (e.g. Bianchini et al., 2015; Valentin-Silva et al., 2018; Perina et al., 2019), but SSF of Rio de Janeiro state have received far less attention (Villela et al., 2006; Lins; Nascimento, 2010). Furthermore, understory species are still poorly included in those surveys (Morellato et al., 2013), with few studies focusing on shrubs, climbers, epiphytes and herbs (Marques et al., 2004).

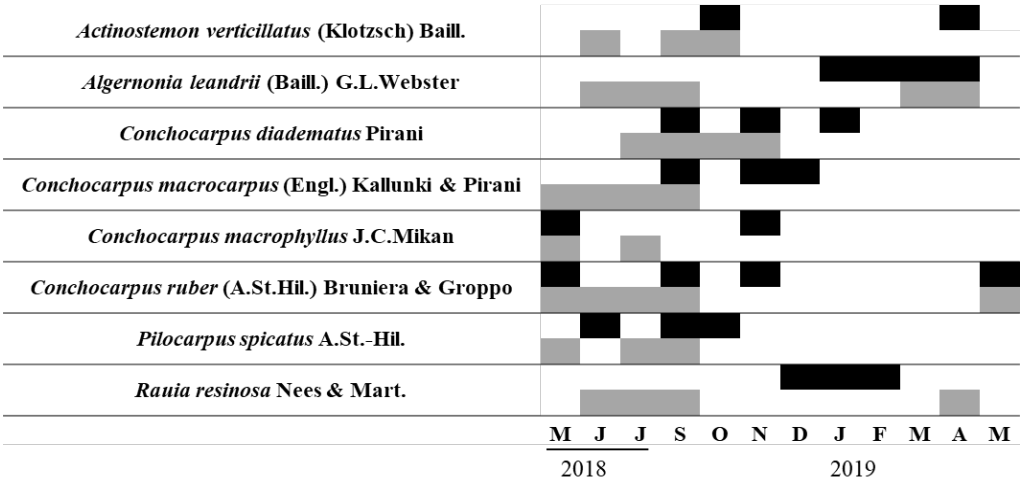
Thus, the present study aimed to: (a) describe the reproductive phenological patterns of understory species in a SSF; and (b) evaluate the relationship between reproductive phenology and precipitation, temperature and day-length.

The forest fragment studied (35.6 ha) is locally known as Ilha dos Macacos (22°43'20.02"S and 42°7'25.37"W) and located in São Pedro da Aldeia municipality, Rio de Janeiro, Brazil. The eight studied species are Rutaceae, except Actinostemon verticillatus and Algernonia leandrii (Euphorbiaceae). They are shrubs less than 3 m tall (Conchocarpus spp.) or treelets frequently found in the understory (Bastos et al., 2021). They are all endemic to Brazil and to the Atlantic Forest (except Rauia resinosa) and monoecious with diclamid flowers, except the monoclamid-aclamid flowers of Euphorbiaceae (Kubitski et al., 2010; Esser, 2012; Oliveira et al., 2013; Pirani; Groppo, 2020).

We analyzed field records during a floristic-phytosociological survey (Bastos et al., 2021) to detect the presence/absence of reproductive phenophases, with disregard to the number of individuals, between May 2018 to May 2019. August 2018 was excluded of the analyses because fieldwork was not possible due to logistic constraint. The evaluation method used was the direct qualitative one (d'Eça-Neves; Morellato, 2004). We compared the number of species flowering and fruiting with day length (https://www.sunrise-and-sunset.com/pt/sun/brasil/sao-pedro-da-aldeia/2019/maio), precipitation and mean temperature data for São Pedro da Aldeia, RJ (agritempo.gov.br), using the Spearman rank correlation Test performed in Microsoft Excel 2010. The analyses set α as 0.05. This is the first information on flowering and fruiting periods for A. verticillatus and A. leandrii to our knowledge (Figure 1), disregarding the herbaria records. Our observations for Rutaceae species agree to the information available in the literature and increase the knowledge on flowering period for C. macrocarpus and R. resinosa (Pirani; Groppo, 2020).

Half of the species flowered (S = 4) in the onset of the rainy season (September), after winter colder months and during the increase of day length (Figure 2a-c). We found no significant relation between flowering and precipitation (rho= 0.241, P= 0.449) and temperature (rho= 0.239, P= 0.453), but there was a significant positive relation between flowering and day length (rho= 0.629, P= 0.028). Wright; van Schaik (1994) stressed the importance of peaks of irradiance as triggers of flowering around the beginning of the rainy season in dry seasonal tropical forests. The seasonality suggested for flowering of understory species in Ilha dos Macacos could be tested in the future using circular statistics (Morellato et al., 2010). Fruiting increase in understory species (S = 7) during the dry season was limited due to growing precipitation in

Figure 1. Flowering (black cell) and fruiting (gray cell) periods of eight understory species in *Ilha dos Macacos* (São Pedro da Aldeia, RJ). August is absent as explained previously; solid line indicates the dry season.



September and decreased sharply with rising temperature and day lenght from Oct-Feb (Figure 2d-f). We expected a significant positive relation between fruiting and precipitation since rain drops act as triggers promoting ballistic dispersal on Euphorbiaceae (Griz; Machado, 2001) and possibly on Rutaceae species studied here (Kubitski et al., 2010; Pirani; Groppo, 2020), but it didn't happen (rho= -0.359, P= 0.251). On the other hand, there were significant but negative relations between fruiting and temperature (rho= -0.854, P< 0.001) and day length (rho= -0.793, P= 0.002). The fruiting seasonality suggested here may be clarified with future evaluation of possible endogenous biotic triggers (Borchert, 1987).

This brief study described the phenological patterns of eight understory species in a SSF of Rio de Janeiro state. We hope it might stimulate future phenological surveys using a bolder methodological approach to test the patterns observed here.

REFERENCE

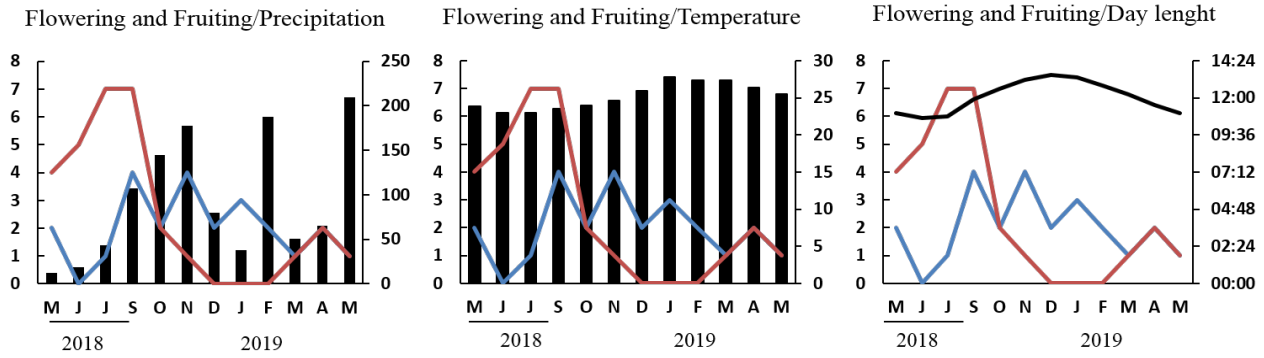
BASTOS F. M.; NEVES L. F. F.; KURTZ B. C. Florística e estrutura de uma Floresta Estacional Semidecidual (Ilha dos Macacos) em São Pedro da Aldeia/RJ como subsídio à criação de unidade de conservação municipal. **Revista Ineana**. Submitted.

BORCHERT R. Phenology and control of flowering in tropical trees. **Biotropica** 15: 81–89, 1983.

D'EÇA-NEVES F. F.; MORELLATO L. P. C. Métodos de amostragem e avaliação utilizados em estudos fenológicos de florestas tropicais. **Acta Botanica Brasilica** 18:99-108, 2004.

ESSER, H. J. The tribe Hippomaneae (Euphorbiaceae) in

Figure 2. Flowering (blue line) and fruiting (red line) of understory species in *Ilha dos Macacos* (São Pedro da Aldeia, RJ) compared to abiotic factors. Y left axis is number of species, Y right axis is abiotic factor, X axis is period of observation (months/year), solid line indicates the dry season. Precipitation is in mm; temperature is in ℃; and day length is in hours. August is absent as explained previously..



Brazil. **Rodriguesia** 63: 209–225, 2012.

FRANKIE G. W.; BAKER H. G.; OPLER P. A. Comparative phenological studies of trees in Tropical Wet and Dry Forests in the Lowlands of Costa Rica. **The Journal of Ecology** 62: 881-919, 1974.

GRIZ L. M. S.; MACHADO I. C. S. Fruiting phenology and seed dispersal syndromes in caatinga, a tropical dry forest in the Northeast of Brazil. **Journal of Tropical Ecology** 17:303–321, 2001.

KUBITZKI K.; KALLUNKI J. A.; DURETTO M.; WILSON P. G. Rutaceae. In: KUBITZKI K. (eds) Flowering Plants. Eudicots. **The Families and Genera of Vascular Plants**, vol 10. Springer, Berlin, Heidelberg, 2010.

LINS B. L. A.; NASCIMENTO M. T. Phenology of Paratecoma peroba (Bignoniaceae) in a seasonal semideciduous forest of Northeastern Rio de Janeiro, Brazil. **Rodriguésia** 61: 559-568, 2010.

MARQUES M. C.; ROPER J. J.; SALVALAGGIO A. P. B. Phenological patterns among plant life-forms in a subtropical forest in southern Brazil. **Plant Ecology** 173: 203– 213, 2004.

MORELLATO L. P. C.; ALBERTI L. F.; HUDSON I. L. Applications of circular statistics in plant phenology: a case studies approach. In: HUDSON I. L.; KEATLEY M. R. (eds) **Phenological research**. Springer, Netherlands, pp 339–359, 2010.

MORELLATO L. P. C.; CAMARGO M. G. G.; GRESSLER E. A Review of Plant Phenology in South and Central America. In: SCHWARTZ M. D. (eds.) Phenology: An **Integrative Environmental Science**. Springer, Dordrecht, 2013.

OLIVEIRA L. S. D.; SILVA M. J.; SALES M. F. Synopsis of the tribe Hureae (Euphorbioideae, Euphorbiaceae). **Brittonia** 65:310–329, 2013.

PERINA B. B.; LIBONI A. P.; MONTANHER D. R.; MESSETTI A. V. L.; PIMENTA J. A.; BIANCHI E. Phenology of the tree community in a seasonal forest in southern Brazil. **Brazilian Journal of Botany** 42: 477-490, 2019.

PIRANI J. R.; GROPPO M. Rutaceae In: Flora do Brasil 2020. **Jardim Botânico do Rio de Janeiro**. Available at <http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB449>. Access on 21 may 2021.

RATHCKE B.; LACEY E. P. Phenological patterns of terrestrial plants. **Annual Review of Ecology and Systematics** 16: 179-214, 1985.

VALENTIN-SILVA A.; STAGGEMEIER V. G.; BATALHA M. A.; GUIMARÃES E. What factors can influence the reproductive phenology of Neotropical Piper species (Piperaceae) in a semi-deciduous seasonal forest? **Botany** 96: 675–684, 2018.

VAN SCHAIK C. P.; TERBORGH J. W.; WRIGHT S. J. The phenology of tropical forests: adaptive significance and consequences for primary consumers. **Annual Review of Ecology and Systematics** 24: 353–377, 1993.

VILLELA D. M.; NASCIMENTO M. T.; ARAGÃO L. E. O. C.; GAMA D. M. Effect of selective logging on forest structure and nutrient cycling in a seasonally dry Brazilian Atlantic forest. **Journal of Biogeography** 33: 506-516, 2006.