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Phenological evaluation methods in native plant species

Corresponding author
Arlindo Ananias Pereira da Silva
Unesp - Campus Ilha Solteira
arlindo.ananias@unesp.br

Dayane Bortoloto da Silva
Unesp - Campus Ilha Solteira

Franciele Muchalak
Universidade de São Paulo - Campus Piracicaba

Taisa Lopes Lacerda Pereira
Universidade Federal de Mato Grosso do Sul - Campus Chapadão do Sul

Walter Aparecido Ribeiro Júnior
Unversidade Estadual de Londrina

Kassia Maria Cruz Souza
Unesp - Campus Ilha Solteira

Douglas Garrio Carfane
Unesp - Campus Ilha Solteira

Leonardo Henrique Pereira de Brito
Unesp - Campus Ilha Solteira

Adriano Roberto Franquelino
Unesp - Campus Presidente Prudente

Abstract. Phenology is an important tool used for the knowledge and study of native species, being necessary that they are conducted in a uniform way and evaluated the same characteristics, both quantitative and qualitative. In this sense, this work aimed to gather the main studies, proposing a union in the methodology for this type of study. For effective work, five to ten individuals should be sampled by species, checking the presence or absence of phenophases, visually quantifying the percentage of canopy coverage and classifying them as to their occurrence and regularity and finally checking the synchronization of events in species within the community. To carry out phenological studies, five to ten individuals must be sampled, and the presence or absence of phenophases, defoliation, sprouting, leaf expansion and maintenance of foliage in the canopy, flower buds emission, flowering in progress, end of flowering, forming fruits, ripe fruits and falling fruits / dispersing seeds, visually quantify the percentage of canopy coverage, and then estimate its synchronization and classification as to the frequency and regularity of occurrence.
Keywords: Flowering, Native species, Phenology.

Introduction

There is an underutilization of the potential that the native flora offers due to the lack of research in Brazil and in the world (FISCHER et al., 2007; SILVA et al., 2020a) and, the urbanization process becomes one of the greatest threats to the disappearance of these species. In addition to the urbanization factor contributing to accelerate the

loss of ornamental flora, little is known about the species of the original ecosystem in urban areas of the country (SILVA et al., 2020b). The introduction of these in the landscaping is a way of valuing and conserving the local flora that shelters species still unknown by the population (MARTINI et al., 2010).

The native ornamental flora should be considered as a germplasm bank liable to commercial exploitation, however, despite its great potential, it remains practically absent from commercial nurseries (RENTES, 1986). The introduction of a native plant in cultivation can be an instrument for the conservation of these species. One solution could be to expand the supply of native species, as their trade would not only bring more profits to the country but also protect against the devastation of our flora. (CHAMAS E MATTHES, 2000).

One of the basic tools for the biological and reproductive knowledge of species is the phenological study (BIONDI et al., 2007). The knowledge of phenophases can serve both as a basis for the collection of fertile material, as well as for research on the reproduction of species that aim at the conservation of biomes and the recovery of degraded areas.

Phenology allows us to know how the temporal distribution of resources such as flowers and fruits is organized, to understand the dynamics of reproduction and regeneration of plants, and the relationship between plants and animals. (CALVIN; PIÑA-RODRIGUES, 2005). The phenological patterns of the cerrado tree vegetation, savannas, and other periodically dry forest formations are still poorly understood, as well as the causes of the observed periodicity, sometimes attributed to abiotic factors, sometimes to biotic factors, or both, or even determined by phylogenetic restriction. (BULHAO; FIGUEIREDO, 2002).

Generating information regarding the development of the plant in its environment is one of the basic tools to indicate its use and needs (MARTINI, et al., 2010). Through phenology, it is possible to determine the phases of the plant referring to flowering, fruiting, and foliation. In the Brazilian savannahs, there is a high diversity of phenological strategies, and the phenological studies carried out so far have indicated basic differences between the behavior of the herbaceous and sub-shrub strata and of the arboreal stratum in the vegetation. (OLIVEIRA, 2008).

The survey of native ornamental plants must follow systematized field procedures with registration and collection of biotic and abiotic data (CHAMAS E MATTHES, 2000). Potentiality analysis should be based on morphological, phenological, and rustic character, as well as the number of individuals or populations available, reproductive ease for cultivation, the term for applicability, and originality of the species.

There is a divergence in the works carried out so far, as there are few studies and there is no standard for conducting and conducting these researches, some evaluating in a quantitative way, others in a qualitative way, or combined. In this sense, this work aimed to carry out a bibliographic survey regarding the evaluation methods of phenological research.

Development

Fournier is one of the first researchers to study the phenology of tropical species, in his works he evaluated qualitative data (Table 1), sprouting, canopy cover, defoliation, flowering, and fruiting, and quantitative data (Table 2), evaluating the percentage of canopy cover (FOURNIER, 1974), this work, in addition to generating information regarding the plant phases, makes it possible to study the intensity of the event in the plant.

Table 1. Qualitative phenological variables (phenophases), proposed by Fournier (1974).

Code	Phenological event
1 – BF	Emission of flower buds
2 – FA	Floral anthesis
3 – FT	Anthesis ended
4 – FR	Growing fruits
5 – FM	Ripe fruits
6 – FC	Falling fruits / dispersing seeds
7 – DE	Defoliation
8 – LF	Sprouting
9 – FO	Most new leaves
10 – FV	Most old leaves

Table 2. Scale for quantitative assessment of phenophases proposed by Fournier (1974).

Code	Crown coverage (%)
0	Absence of the observed phenomenon
1	Presence of the phenomenon with an amplitude between 0 - 25%
2	Presence of the phenomenon with an amplitude between 26 - 50%
3	Presence of the phenomenon with an amplitude between 51 - 75%
4	Presence of the phenomenon with an amplitude between 76 - 100%

Another difficulty in these studies was to determine a minimum value of sample intensity in order to have reliable data regarding phenological studies and Fournier and Charpantier, studying a tropical forest in Costa Rica, tested several sample intensities in different species, concluding that from five to ten individuals per species it is sufficient to carry out phenological studies and obtain reliable data (FOURNIER; CHARPANTIER, 1975).

In addition to the identification and quantification of plant phenophases, Sarmiento and Monasterio studying the phenology of native species of African savannas realized the need for the classification of vegetative phenophases (SARMIENTO & MONASTERIO, 1983).

Subsequently, this classification was modified by Oliveira, being classified into vegetative phenological groups that determine, respectively, the degree of leaf deciduity and the moment of sprouting in relation to the rainy season. Being classified as always green with continuous growth (without evident deciduity and production of leaves for prolonged periods); always green with seasonal growth (without complete deciduousness, but with the replacement of the foliage in the transition between the dry and rainy period), brevideciduous (with complete deciduousness of the individuals in the dry season for a period of time less than two weeks); and deciduous (with complete deciduousness of individuals in the dry season for a period of time greater than two weeks) (OLIVEIRA, 2008).

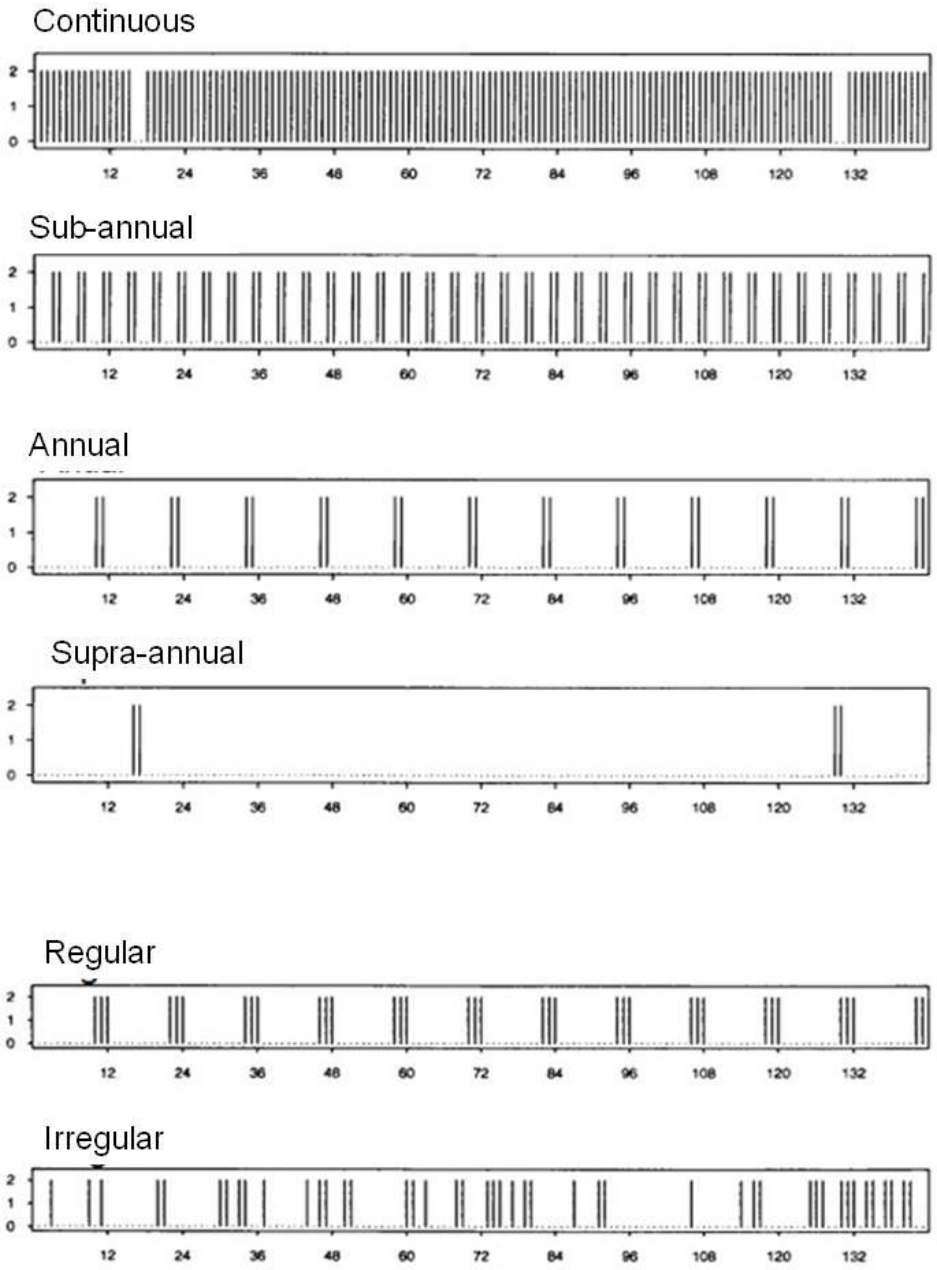

Figure 1. Classes of frequency and regularity of reproductive phenological events, proposed by Newstrom and Frankie (1994).

Newstrom and Frankie studying the phenology of tree species in a tropical rain forest in Costa Rica noted the need to classify these species according to their periodicity of flowering and fruiting. The studied species were classified according to their flowering amplitude (Figure 1), taking into account

two criteria, the first considering their frequency, which can be continuous (several times a year), sub-annual (twice a year), annual (once a year) and supra-year (several years without flowering) and the second criterion that considers its regularity, which can be regular or irregular (NEWSTROM & FRANKIE, 1994).

Bencke and Morellato studying the phenology of nine tree species in three types of Atlantic forest in southeastern Brazil, realized the need to know how this phenophase is expressed in the individuals of the community, estimating the synchronization of the studied phenological events, taking into account that, the greater the number of individuals manifesting the phenophase at the same time, the greater the synchrony of the population. A non-synchronous or asynchronous phenological event was considered for the value <20% of individuals in the phenophase; little synchronic or low synchrony for a value of 20-60% of individuals in the phenophase and high synchrony for a value> 60% of individuals manifesting the phenophase (BENCKE & MORELLATO, 2002).

Conclusion

To carry out phenological studies, five to ten individuals should be sampled, and the presence or absence of phenophases, defoliation, sprouting, leaf expansion and maintenance of foliage in the canopy, flower buds emission, flowering in progress, end of flowering, fruits in formation, ripe fruits and falling fruits / seeds dispersing, visually quantify the percentage of canopy cover, and then estimate its synchronization and classification as to the frequency and regularity of occurrence.

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