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Occurrence of florivory in edge species in an Atlantic Forest fragment

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ABSTRACT

The relationship between flowers and floral visitors can be mutualistic or antagonistic. Florivory is defined as floral damage to reproductive and/or sterile attributes. Some studies claim that floral attractants for pollinators also attract florivores. Therefore, the objective of this study is to analyze the occurrence of florivory in species from the edge of the Atlantic Forest, identifying the possible floral attributes associated with the attractiveness to florivores. Seven species were analyzed: *Tridax procumbens*, *Sphagneticola trilobata*, *Turnera subulata*, *Richardia grandiflora*, *Momordica charantia*, *Chrysanthellum* and *Commelina erecta*. Through direct observation, information was collected on floral attributes: color, shape, resource, symmetry and pollination unit. Visits were made to record the number of damaged flowers. All damaged flowers were photographed and the images submitted to the ImageJ program to calculate the consumed floral area. Flowers with inflorescences arranged in capitulum, yellow placement and UV reflection were more attractive to florivores. There was a weak correlation between the size of the flowers and the damaged floral area, in addition to a weak correlation between the number of flowers in the patches and the number of flowers damaged by the florivores. These data demonstrate the inefficiency of the display effect in reducing florivory and evidence that other traits besides floral size are attracting herbivores to the studied species.

RESUMO

A relação entre as flores e visitantes florais pode ocorrer de forma mutualística ou antagônica. A florivoria consiste em danos florais aos atributos reprodutivos e/ou estéreis, causados por animais. Alguns estudos afirmam que os atrativos florais para polinizadores, também atraem os florívoros. Diante disso, o objetivo deste estudo consiste em analisar a ocorrência da florivoria em espécies de borda de floresta Atlântica, identificando os possíveis atributos florais associados na atratividade aos florívoros. Foram analisadas sete espécies: *Tridax procumbens*, *Sphagneticola trilobata*, *Turnera subulata*, *Richardia grandiflora*, *Momordica charantia*, *Chrysanthellum* e *Commelina erecta*. Através de observação direta, foram coletadas informações sobre os atributos florais: cor, forma, recurso ofertado, simetria e unidade de polinização. Foram realizadas visitas para registro do número de flores danificadas. Todas as flores danificadas foram fotografadas e as imagens submetidas ao programa ImageJ para cálculo da área floral consumida. Flores com inflorescências dispostas em capítulo, colocação amarela e reflexão UV se mostraram mais atraentes para os florívoros. Houve correlação fraca entre o tamanho das flores e a área floral danificada, além de correlação fraca entre o número de flores nas manchas e o número de flores danificadas pelos florivoros. Esses dados demonstram a ineficiência do efeito display na redução da florivoria e evidencia que outros atributos, além do tamanho floral, estão atraindo os herbívoros para as espécies estudadas.

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Introduction

The dynamics between plants and animals correspond to a well-structured ecological network built over hundreds of years (Dáttilo *et al*., 2009). Studies based on fossils relate angiosperm radiation to the diversification period of several insects that act as floral visitors (Coleoptera, Diptera, Hymenoptera and Lepidoptera), thus showing the importance of these animals in the evolution of this important plant group (Grimaldi, 1999; Van De Kooi; Ollerton, 2020). The communication network between different species can occur mutualistically, that is, with the exchange of benefits between those involved, as occurs in the pollination process (Dáttilo *et al.*, 2009) or in an antagonistic way, where only one of the agents is benefited, as seen in cases of florivory (Costa *et al*., 2022). The insect-plant interconnection has undergone refinements over time and communication between the acting agents may involve defense or pollination (Ribeiro *et al*., 1994; Bagchi *et al*., 2014).

Florivory consists of a subtype of herbivory, defined as any partial or total damage to reproductive and/or sterile floral components caused by animals (Malo *et al.*, 2001; Mccall, 2008; Palacios-Mosquera *et al.*, 2019). These animals use flowers to meet one or more of their basic demands: a place for reproduction, feeding of floral tissues (when this is not offered) or shelter (Ribeiro *et al*., 1994; Malo *et al*., 2001; Bagchi *et al*., 2014). Florivores of the same species can be found at different stages of life in the same plant, so the plants consumed may be related to their life cycles (Malo *et al.*, 2001; Costa *et al.*, 2022). There are indications of coevolution of plant species evidenced by the promotion of responses to floral consummation events, such as the production of toxins, trichomes and thorns in the plant (Opitz; Müller, 2009). However, insects seek to circumvent these defenses, being able to metabolize or assimilate certain chemical components of plants, consisting of a competitive advantage in relation to other florivores, since these components do not prevent them from feeding on flowers (Mello; Silva-Filho, 2002).

As the flowers are sessile, most angiosperms need animals that act as vectors in transporting pollen to the stigma of another flower of the same species and for this transport to happen, the flowers have attractions that act as sensory cues that attract animals and, when visiting the flowers, they can perform this transport service that is pollination (Faegri; Pijl, 1971; Schiestl; Johnson, 2013). These attractants can be primary when they are related to the physiological needs of animals, such as nectar, or secondary when they involve the senses of floral visitors, such as the color of flowers (Faegri; Pijl, 1971). Therefore, when floral attributes, such as bracts, sepals or petals are damaged, there may be a decrease in pollinator visits due to the reduction or absence of sensory cues (Mccall; Irwin, 2006). With the exclusion of floral attractants, the chances of pollination service are reduced, which results in less fruit and/or seed formation (Krupnick; Weis, 1999).

When reproductive structures (stamen, pistils, pollen, and ovules) are the target of florivores, flowers can become reproductively nonviable (Krupnick; Weis, 1999; Mccall; Irwin, 2006; Gorden; Adler, 2016). Therefore, while damage to sterile parts has a negative impact on floral attractiveness, the consumption of reproductive parts and gametes impairs the physiological capacity of the flower to form fruit (Cunningham, 1995). The arrangement of the florivory is correlated with the identity of the insect causing the damage and the type of associated plant (Mccall; Irwin 2006; Mccall, 2008). The two most common groups of insects in florivory studies are suckers and chewers and they can act in different ways on the reproductive success of the plant, either by reducing floral attractiveness or by making the flowers unviable to form fruit (Ribeiro *et al*., 1994; Fernandes *et al*. 2005; Del-Claro; Torezan-Silingardi, 2009).

There are several studies mentioning damage to plants caused by florivores, resulting in a negative effect on the reproductive success of the plant (e.g. Krupnick; Weis, 1999; Mccall, 2008; Marquis, 2012; Ferreira, 2013; Costa *et al*., 2022). Studies carried out on the edge of the Atlantic Forest have shown greater reproductive success evidenced by fruit formation in species that have not been damaged by leaf-cutting ants (Barbosa, 2009; Ribeiro, 2009). Since floral attributes that act as sensory cues for pollinators can also attract florivores, it is still necessary to investigate the relationship between floral attractants and florivory (Barreto; Freitas, 2007; Tunes, 2017). Knowing this relationship contributes to understanding the predilection of florivores (Barreto; Freitas, 2007; Tunis, 2017). The objective of this study is to analyze the occurrence of florivory in seven species of Atlantic Forest edge, identifying the possible floral attributes associated with the attractiveness to florivores.

Material and Methods

Field of study

The study was carried out in an area on the edge of the forest in the “Parque Estadual Dois Irmãos” (PEDI) (8°7'30"S and 34°52'30"W) and on the Campus of the Federal Rural University of Pernambuco (*Universidade Federal Rural de Pernambuco* - UFRPE) (8º1'1.42" S and 34º56'47"), on the banks of the road that connects the various Sectors/Departments of

UFRPE. Both study areas are located in the Dois Irmãos neighborhood, Recife - PE. The visits took place weekly from November 2021 to January 2022 and April to June 2022. The two areas are neighboring and consist of ruderal areas remaining of Atlantic forest. Currently, these fragmented remnants form small green islands, revealing substantial territorial losses to urbanization, agricultural expansion and large enterprises within the scope of private companies or public institutions (Lima; Corrêa, 2008; Dantas *et al*., 2017). In many border areas surrounded by the urban landscape, the occurrence of plant species known as ruderals is common (Haigh, 1980), in the areas studied here. These species are subjected to different stress conditions, such as higher temperatures, incidence of solar radiation, soil compaction and organic components in extreme conditions (Haigh, 1980).

Selected species

The species were selected considering the occurrence of florivory, determined through direct observation. Four species located in the PEDI were analyzed: *Tridax procumbens* L. (8°00'51.5" S and 34°56'42.84" W), *Sphagneticola trilobata* (L.) Pruski (8°00'40.06" S and 34°56'48.36"W), *Turnera subulata* Sm. (8°00'51.66" S and 34°56'42.94"W), *Richardia grandiflora* (Cham. & Schltdl.) Steud (8°00'51.6"S and 34°56'42.94"W), and three along the road in the UFRPE: *Momordica charantia* L. (8°01'09.36" S and 34°56'46.32" W), *Chrysanthellum* sp. Rich. (8°01'11,60" S and 34°56'52.84" W) and *Commelina erecta* L. (58°01'13.73" S and 34°56' 56.36" W) (Figure 1). The core specimens are deposited in the "Herbário Vasconcelos Sobrinho" (PEURF/UFRPE) (No 55889, 55890, 55891, 55892, 55935, 55936 and 55937). To characterize the species, searches were carried out on the Reflora website (floradobrasil.jbrj.gov.br), about genus, species, common name, family, habit (herbaceous/subshrub/shrub/tree), origin and endemism (yes/no).

Figure 1.

Flowers of plant species selected for florivory analysis.

(a) *Tridax procumbens* L., (b) *Sphagneticola trilobata* (L.) Pruski, (c) *Turnera subulata* Sm., (d) *Richardia grandiflora* (Cham. & Schltdl.) Steud, (e) *Momordica charantia* L., (f) *Chrysanthellum* sp. Rich e (g) *Commelina erecta* L.

Floral attractions

Through direct observation, information was collected regarding floral attributes such as color (Araújo *et al.*, 2019), shape (tube or disc, etc.) (Weberling, 1992), resource offered (pollen, nectar or other) (Rech *et al.*, 2014), symmetry (zygomorphic, actinomorphic or asymmetric) (Lorenzi; Gonçalves, 2007) and pollination unit (isolated flower or inflorescence) (Ramirez *et al.*, 1990). With the aid of a ruler, the diameter of the corolla was measured (n=15). For each species, in intact (n=15) and flowering (n=15) flowers, tests were performed to identify areas of ultraviolet reflection, through submission of the flowers to ammonium hydroxide vapors (Scogin *et al*., 1977).

Florivory

The florivory analyses took place in a plot measuring 1.5 m x 1.5 m for the following species: *Tridax procumbens*, *Sphagneticola trilobata*, *Turnera subulata* and *Richardia grandiflora* and in a single patch for the species: *Momordica charantia*, *Chrysanthellum* sp. and *Commelina erecta*. Visits were carried out for five consecutive days to record the number of damaged flowers and buds, and the places where the damage occurred (corolla, stamens, pistil, etc.). During each visit, all the flowering flowers within the plots were photographed. The photos were taken in a superior view of the flowers for the purpose of calculating the floral area consumed, through the ImageJ program (Rasband, 1997). For floral longevity related to florivory, intact flower buds (n=20/species) were marked and monitored from flower opening, to record the number of flowering flowers per hour, from 7 a.m. to 12 p.m. This time window was considered critical because it corresponds to the period when the flowers are most attractive for floral visitation. The plants observed in the florivory record had morphological characteristics that indicated the first day of anthesis on the day of the visits, i.e., older flowers were not considered for the record.

Statistics

Pearson's correlation test was performed, where r (+ or -) values comprise: 0.00 indicates no correlation, 0.01 to 0.19 very weak correlation, 0.20 to 0.39 weak correlation, 0.40 to 0.69 moderate correlation, 0.70 to 0.89 strong correlation, 0.90 to 0.99 very strong correlation and 1.00 perfect correlation. In this analysis, the relationship between the following numerical variables was performed: 1) length and width of the flower (floral diameter) and number of damaged flowers; 2) length and width of the flower (floral diameter) and the percentage of flowering area of each species. To verify the influence of the display effect on florivory, we performed the relationship between: 1) number of damaged flowers for each species; 2) the damaged floral area and the total number of flowers in the plots of each species analyzed.

Results

Floral attractions related to florivory

The selected species belong to the families Asteraceae (n=3), Commelinaceae, Curcubitaceae, Rubiaceae and Turneraceae (n=1 each). Most of them have herbaceous size (n=4), with two shrub species and one vine. Three are native and four are naturalized. Four of the seven species analyzed have yellow flowers, while one has white color, one with lilac flowers and the other in blue (see Table 1). The predominant floral morphology is disc-shaped (n=5), with only one species having a short tube and one in the shape of a dish (see Table 1). The species *T. procumbens* has flowers with an average diameter of 1.4 ± 1.3, *S. trilobata* with 1.4 ± 2.7; *T. subulata* with 4 ± 5.1; *R. grandiflora* presented 1.6 ± 1.7; *M. charantia* with 3.126

± 3.2; *Chrysanthellum* 7.1 ± 6.98 and *C. erecta* with 1.36 ± 1.44. Most species present actinomorphic symmetry (n=6) with only one zygomorph, four of which offer nectar as a resource and three only pollen (Table 1).

Regarding the pollination unit, six have flowers arranged in inflorescences and one solitary (Table 1). The ultraviolet reflection test indicated the bracts and petals for the four species, while *R. grandiflora* and *C. erecta* showed reflection for reproductive structures (Table 1). In *M. charantia* there was no change in color and in *Crysanthellum* sp. slightly changed the color of the bracts and petals (of the ray) to a light shade of brown. There was no difference in the results of the test performed between intact and flowering flowers (Figures 2 and 3).

Table 1 - Floral attributes of the species analyzed at PEDI and at the UFRPE Campus.

Species	Color	Form	Floral diameter (Average ±sd)	Symmetry	Resource	Pollination Unit	UV Reflection Areas
Tridax procumbens L.	Yellow	Disk	1.4 ± 1.3	Actinomorph	Pollen	Inflorescence	Bracts
Sphagneticola trilobata (L.) Pruski	Yellow	Disk	1.4 ± 2.7	Actinomorph	Pollen	Inflorescence	Bracts and petals (from the ray)
Turnera subulata Sm.	White	Disk	4 ± 5.1	Actinomorph	Nectar	Inflorescence	Petals and nectar guides
Richardia grandiflora (Cham. & Schltdl.) Steud	Lilac	Short tube	1.6 ± 1.7	Actinomorph	Nectar	Inflorescence	All the flower
Momordica charantia L.	Yellow	Disk	3.126 ± 3.2	Actinomorph	Nectar	Lone	There was no change in color
Chrysanthellum sp. *Rich.*	Yellow	Disk	7.1 ± 6.98	Actinomorph	Nectar	Inflorescence	Bract and petals (from the ray)
Commelina erecta L.	Blue	Plate	1.36 ± 1.44	Zygomorph	Pollen	Inflorescence	All the flower

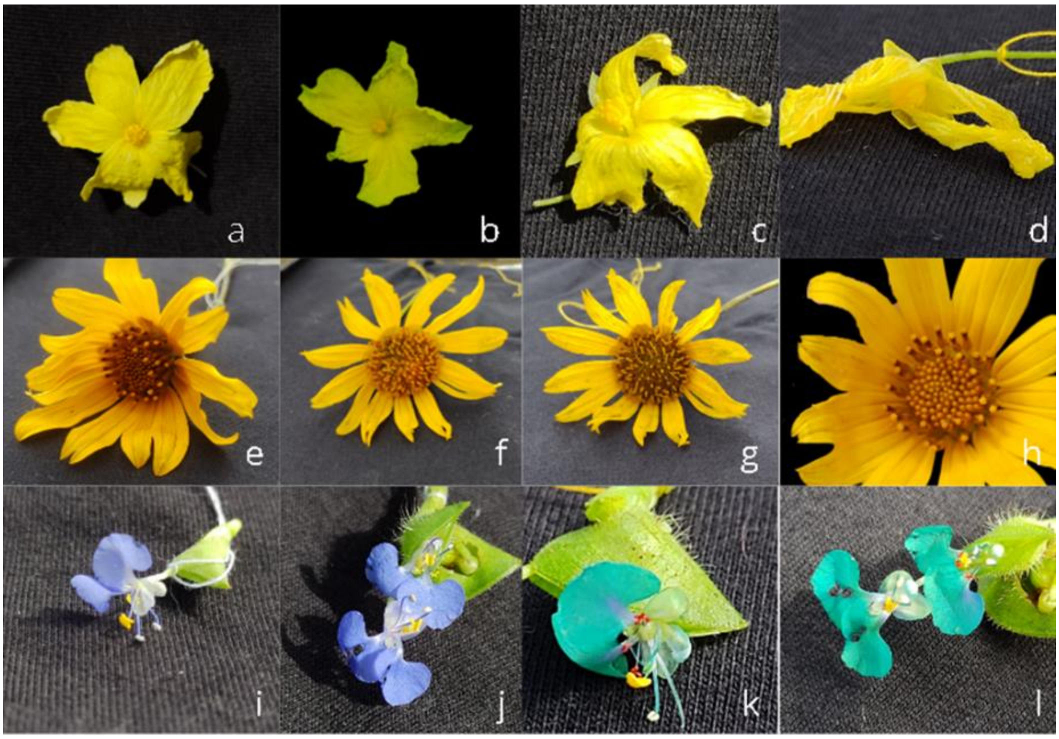
Figure 2.

Ultraviolet reflection test with exposure of flowers and capitula to ammonium hydroxide.

Flowers and capitula intact before the test: a - *T. procumbens*, e - *S. trilobata*, i - *T. subulata*, m - *R. grandiflora*.
Flowers and flowering capitula before the test: b - *T. procumbens*, f - *S. trilobata*, j - *T. subulata*, n - *R. grandiflora*.
Flowers and capitula after the test: c-d - *T. procumbens*, g-h - *S. trilobata*, k-l - *T. subulata*, o-p- *R. grandiflora*.

Figure 3.

Ultraviolet reflection test with exposure of flowers to ammonium hydroxide.



Momordica charantia: a - intact before testing, b - flowering before the test, c-d - after the test. Capitula of *Chrysanthellum* sp.: e - intact before testing, f - flowering before the test, g-h - after the test. *Commelina erecta*: i - intact before testing, j - flowering before the test, k-l - after the test.

Number of flowers and floral area damaged by florivores

The species *T. procumbens* and *T. subulata* had a higher number of flowering flowers (see Table 2). Four of the seven species analyzed, *T. procumbens*, *Chrysanthellum* sp. and *M. charantia*, did not show florivory in the bud phase and in the others, both buds and flowers were damaged. The damaged buds remained closed during floral anthesis. Four of the seven species analyzed, *T. subulata*, *R. grandiflora*, *Chrysanthellum* sp. and *C. erecta*, also presented leaf herbivory. Different floral organs were found as the target of florivory in the species analyzed, such as bracts, petals and stamens (Table 2).

Table 2.

Florivory data for the species analyzed at PEDI and UFRPE for five consecutive days.

Species	Flowers on the plot (N)	Flowering flowers (N)	Flowering buds (N)	Florivorated floral part	Flowering area (ImageJ - %)	Order of florivores
Tridax procumbens	600	81	0	Bracts	18	Orthoptera
Sphagneticola trilobata	83	47	10	Capitula	21	Coleoptera
Turnera subulata	172	81	10	Petals and stamens	15	Coleoptera, Orthoptera and Hemiptera
Richardia grandiflora	2,794	72	1	Petals and stamens	14	Coleoptera and Orthoptera
Momordica charantia	57	32	0	Petals	4.7	Coleoptera
Chrysanthellum sp.	101	13	0	Capitula	7.52	Orthoptera
Commelina erecta	351	17	1	Petals and stamens	8.87	Coleoptera

It was observed in *T. procumbens* e *Chrysanthellum* sp., florívoros of the order Orthoptera. Already in *T. trilobata*, *M. charantia* and *C. erecta* the damage was carried out by insects belonging to the Coleoptera and to *T. subulata* and *R. grandiflora*, were observed insects of the orders Coleoptera and Orthoptera, simultaneously (Table 2; Figure 4). The species *T. procumbens* was shown to be a hunting ground for spiders, which indicates the presence of a tritrophic relationship: pollinators, spiders, and florivores (Figure 4c). Florivores of the order Hemiptera were observed only in *T. subulata*. Although they do not have chewing mouthparts, the damage caused by suction of the fluids of the floral tissue compromises the architecture and consequently the floral attractiveness, which is why the hemiptera were considered as florivores (Figure 4d).

Figure 4.

Visitors in the species analyzed.

a - Orthoptera in *T. procumbens*, b - Coleoptera in *S. trilobata*, c - Spider in *T. procumbens*, d - Hemiptera in *T. subulata*, e - Orthoptera in *R. grandiflora*.

The species *S. trilobata* and *T. subulata* remained constant in the percentage of flowers damaged by florivores, while the other species showed variations over the days observed (Figure 5). The species belonging to the Asteraceae, having characteristics such as capitula inflorescence, pollen/nectar supply as a resource and UV reflection in the bracts, showed the highest percentages of flowering area and damaged flowers (21% and 18%), while species with lighter colored flowers and UV reflection concentrated in the petals, showed the lowest percentages of florivory (15% and 14%) (Figure 6). Yellow flowers with little or no ultraviolet reflection area had the lowest florivory rates (4.7% and 7.52%) (Table 2).

The species with capitula flowers, yellow coloration and ultraviolet reflection in more floral attributes, *Sphagneticola trilobata*, showed the highest average percentage of damage area (21%) and number of damaged flowers, which may indicate a greater predilection on the part of floral herbivores (Figure 6). There was a weak negative correlation between flower length and flowering area ($r = -0.4908$, $p = 0.2633$) and a very weak negative correlation between flower length and number of damaged flowers ($r = -0.3854$, $p = 0.3932$), between flower width and number of damaged flowers ($r = -0.2937$, $p = 0.5227$) and between flower width and flowering area ($r = -0.3077$, $p = 0.5020$).

Figure 5.

Percentage of flowers damaged during five days analyzed for each species.

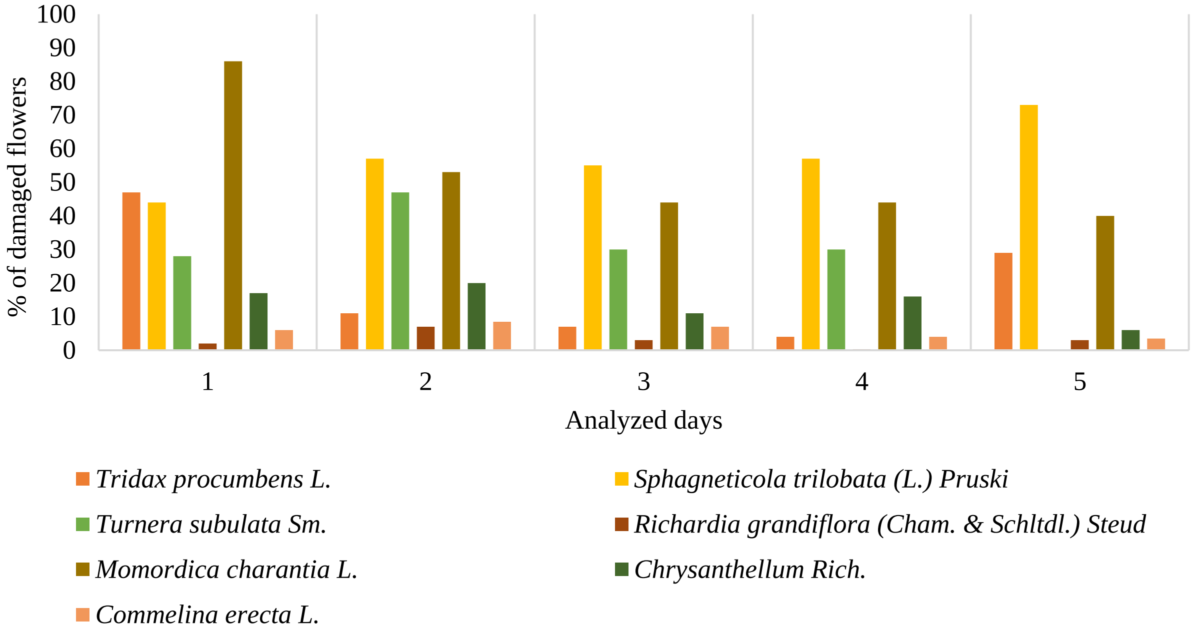
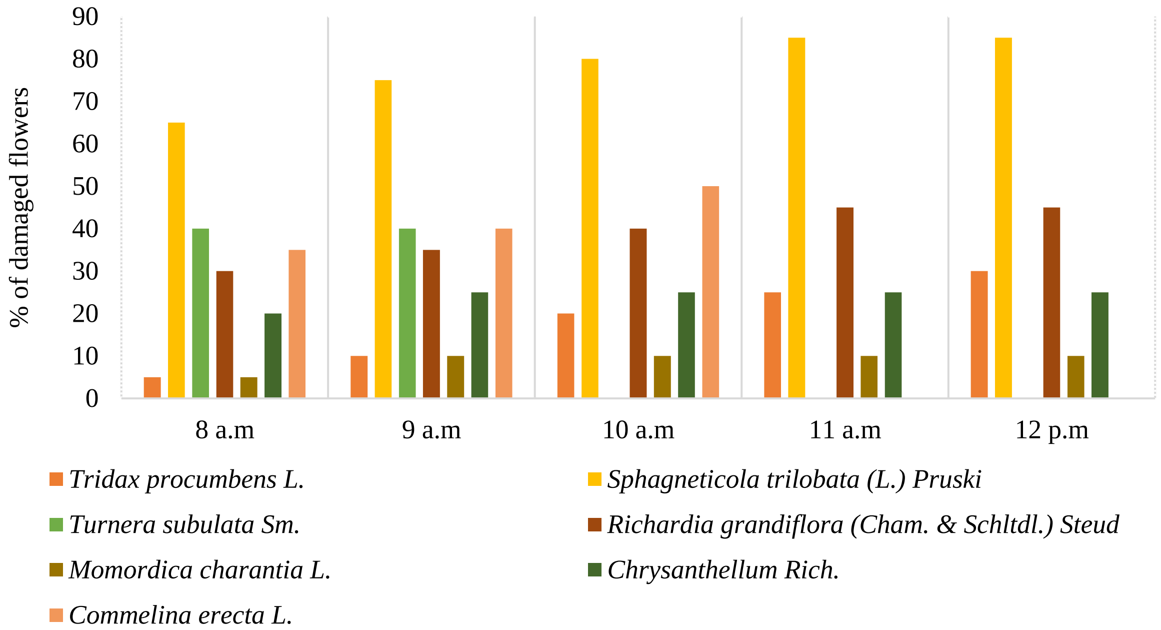


Figure 6.

Percentage of damaged flowers per species for the total of 20 flowers previously marked in a day, between 7 a.m. and 12 p.m.



Thus, the increase in these variables implies a decrease in the other, thus: 1) the increase in flower length is very weakly related to a smaller number of damaged flowers, 2) the increase in flower width is very weakly related to a smaller number of damaged flowers, 3) the increase in flower length is weakly related to a reduction in damaged flower area, 4) the increase in flower width is very weakly related to a reduction of damaged flower area. In addition, there was a weak positive correlation between the number of flowers in the plots and the number of damaged flowers ($r = 0.4180$, $p = 0.3506$) and between the number of flowers in the plots and the percentage of damaged floral area ($r = 0.1557$, $p = 0.7388$). Thus, the increase in the number of flowers in the plot is weakly related to the increase in the number of damaged flowers and the increase in damaged floral area.

Discussion

The results of this study show that: 1) florivory can affect different floral organs that compromise floral attractiveness, however, petals and bracts are the main targets, 2) most of the species analyzed showed damage to both reproductive and sterile attributes, 3) there is a weak relationship between flower size and the number of flowers and damaged floral area, 4) there is a weak relationship between the floral display and the number of damaged flowers, 5) species with inflorescences arranged in capitula had a higher number of damaged flowers and floral area consumed, 6) flowers with ultraviolet reflection in several floral attributes, including bracts, showed a higher percentage of floral area consumed and 7) the fact that there is no change in the UV reflection pattern between intact and flowering flowers demonstrates that florivory causes the loss of floral area related to UV reflection, compromising the recognition of flowers by pollinators.

Florivory can modify the morphology of the flower, making it less attractive to floral visitors, which can result in a low number of visits and consequently, less reproductive success (Penet *et al.*, 2009; Tsuji; Ohgushi, 2018). Several studies have shown that floral visitors tend to avoid damaged flowers (Mccall, 2008; Sõber *et al.*, 2010; Gorden; Adler, 2018; Vega-Polanco *et al.*, 2020). This is because the attractants are related to the recognition of the flower by pollinators (Costa *et al.*, 2022). The impact of florivory related to the reduction of pollinator visits can reach a 75% reduction in fruit formation (Tsuji; Ohgushi, 2018). The species analyzed in this study with the highest number of damaged flowers and floral area consumed, show UV reflection in several floral attributes and smaller flowers, arranged in a capitula, showing that the attractants directed to pollinators are also directed to florivores.

Florivory intensity may not be related to a larger floral size, so smaller flowers may exhibit higher florivory rates when compared to larger flowers (Oliveira *et al.*, 2021). Costly reproductive displays, such as the arrangement of flowers in inflorescences present a higher risk of being targeted by florivores, this statement corroborates with Lim and Ragusso (2017). Florivory can cause total loss of the inflorescence and causes low fruit formation even if the species is self-compatible (Orozco-Ibarrola *et al.*, 2015). In addition, the reduction in pollinator frequency favors autogamy, which compromises the gene flow of the species, favoring the establishment of populations with low genetic variability (Penet *et al*., 2009).

In addition, florivory can cause different consequences for the affected floral appendages, whether they are sterile or reproductive, considering the fact that they correspond to the male or female part of the flower (Carper *et al.*, 2016). For most of the species analyzed, the damage directly affects the reproductive structures, which can make the flowers unviable for reproduction as mentioned by Lim and Ragusso (2017) for *Tacca cristata*. In the present study, the main damaged structures were the petals and bracts. In this case, when damage occurs only in structures related to attractiveness, florivory can cause a direct reduction in the number of pollinator visits (Penet *et al*., 2009; Tsuji; Ohgushi, 2018).

The higher incidence of damaged flowers instead of buds in this study demonstrates florivores preference for the flower when open, as found by Cotarelli and Vieira (2009) and Cotarelli and Almeida (2015). The greater number of preyed flowers and beetles observed in the period between 10 a.m. and 12 p.m. may have a direct relationship with their activity, since the peaks of activity of these insects occur at higher temperatures (Southgate, 1979). Spiders can be attracted to plants that are undergoing florivory, as observed in this study for *T. procumbens*. Spiders are attracted to volatiles that the plant releases when it is undergoing florivory and these arachnids can act by defending the plant as they feed on florivores (see Knauer *et al.*, 2018). However, according to the previous study, spiders can also act by consuming pollinators, thus establishing a tritrophic relationship that also compromises the reproductive success of the plant (ver Costa *et al*. 2022).

The display effect consists of an increase in the production of buds and flowers, which end up keeping the plant as a whole attractive to pollinators and thus maintaining floral visitation and consequently reproductive success (Cotarelli; Almeida, 2015). In this study, we found a weak relationship between the display effect and the number of damaged flowers, showing a low influence of this effect on the reduction of florivory. A study for several species of *Tillandsia* confirms the efficiency of the display effect with the record of a lower rate of florivory for one of the species analyzed (Orozco-Ibarrola *et al.*, 2015). However, some studies question the efficiency of this effect, showing that there is no difference between floral abundance and florivory rates (Cotarelli; Almeida, 2015; Orozco-Ibarrola *et al.*, 2015). The display effect may not work for some species, because the same "decoy" of attracting pollinators can work for attracting herbivores (Lim; Raguso, 2017).

Conclusion

The species with capitula flowers and yellow color showed the highest number of damaged flowers and floral area consumed, which may indicate florivore preference. Petals and bracts were the most consumed floral attributes, demonstrating that the same attractants directed to pollinators are also attracting florivores. The consumption of these structures, usually related to UV emission, causes a reduction in the floral area for emission, which may compromise the recognition of flowers by pollinators. The data obtained in this study demonstrate that the length, width and number of flowers in a grouping weakly influence the number of damaged flowers and the floral area consumed by florivores, showing inefficiency of the display effect in reducing florivory.

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