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ARTICLE

Exploitation of *Ceiba pubiflora* flowers by birds

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ABSTRACT: This paper provides the first description of the exploitation of floral resources of *Ceiba pubiflora* by birds in the Neotropical region. We sampled five different specimens of *C. pubiflora,* focusing on plant-bird and bird intra/interspecific aggressive interactions. We recorded thirteen species of birds exploiting its floral resources. Only hummingbirds are potential pollinators by feeding effectively on the flower corolla. *Hylocharis chrysura* and *Heliomaster furcifer* were considered the best potential pollinators and dominated the agonistic interactions. On the other hand, *Icterus cayanensis* and tanagers pierced the flower at the base of the corolla, drinking the nectar directly, without contacting the pollen. Psittacidae (*Aratinga nenday*, *Brotogeris chiriri* and *Amazona aestiva*) and *Saltator coerulescens* destroyed the flowers by feeding on petals. Although they are ineffective pollinators, the nectar and petals are valuable food resources for these birds, when fruits are scarce during the dry season.

KEY-WORDS: floral resources, florivorous birds, flower exploitation, nectarivorous birds, potential pollinators.

INTRODUCTION

Birds play an important role in the reproductive success of tropical plants (Snow 1981) by pollinating Neotropical angiosperms (Gilbert 1989, Marzluff *et al*. 2001, Mendonça & Anjos 2003), aiding in seed dispersal (Howe 1977, Wunderle-Jr 1997, Muller-Landau *et al*. 2008), or negatively interfering by consuming and destroying the flowers (Galetti 1993, Ragusa-Netto 2002, Sazima & Sazima 2007).

Flowers and nectar are valuable food resources for frugivorous and omnivorous birds in highly seasonal habitats, when resources such as fruits are seasonally scarce (Pettet 1977, Terborgh 1986). Birds, especially hummingbirds, defend these floral resources by vocalizing and attacking other birds in intraspecific and interspecific agonistic behavior (Previatto *et al*. 2013).

Most *Ceiba* species (Malvaceae) have nocturnal anthesis and are mainly pollinated by bats, moths, and butterflies (Gribel *et al*. 1999, Gibbs & Semir 2003). There are several records of hummingbirds visiting flowers of *Ceiba jasminodora*, *C. schottii* and *C. speciosa*, but these birds are considered ineffective pollinators, because they do not touch the anthers/stigma (Gibbs & Semir 2003). In the Amazon rainforest, *Ceiba pentandra* was visited by seven hummingbird species and 26 other bird species (Toledo 1977), but only two species of bats acted as pollinators (Gribel *et al*. 1999).

Ceiba pubiflora is one of the most common tree species in the Corumbá region in Mato Grosso do Sul, western Brazil (Lima *et al.* 2010) occurring mainly in semi-deciduous woodlands, and particularly in calcareous soils (Gibbs & Semir 2003). Flowering occurs during the dry season, with a massive bloom that lasts several weeks and anthesis is diurnal (Gibbs & Semir 2003). These characteristics make *C. pubiflora* a tree with high feeding potential for birds. Besides, there is no study on the interactions between this plant and birds.

In this study, we observed birds that exploit floral resources of *C. pubiflora* to find out how birds use flowers as food resources. We focused on: 1) how often these birds exploit such resources; 2) how the nectar and floral parts are exploited by birds; 3) what are the intra and interspecific agonistic behaviors among birds that visit this plant.

METHODS

The study was conducted near the riparian forest of the Paraguay river, in Corumbá city, southern part of the Pantanal in western Brazil (19°00'00.8''S; 57°37'47.5''W,

135 m.a.s.l.). The climate is tropical of altitude, Awa type according to Köppen, with dry winters and rainy summers. The average temperature is around 25°C, with a minimum close to 0°C and the maximum around 40°C (Soriano 1997).

We sampled five specimens of *C. pubiflora* during their flowering period in June 2013. The observations were carried out during the daytime as follows: 1) morning (from 6:00 to 9:00 h); 2) afternoon (from 14:00 to 17:00 h). We performed 126 h of observation, 63 in the morning and 63 in the afternoon. The time of sampling was divided equally between the five plants studied. We defined the term event for each observation period, either in the morning or afternoon, totaling 42 events (21 in the morning and 21 in the afternoon).

We first identified the bird species and the frequency of occurrence of each species. We then checked how the flower resources were exploited (Figure 1), according to Machado (2009): a) legitimate visit: characterized by the insertion of the bird's beak in the corolla of the flower, possibly contacting the reproductive organs of the plant and taking pollen adhered to its beak, head or neck; b) illegitimate visit: the bird pierces the flower at the base of the corolla, taking the nectar directly without contact with the reproductive organs of the plant. We also used c) flower damaging: bird eats part of the flower, such as petals, sepals, anthers and stigma, most of the time damaging it in such a way that makes the flower unable to receive new pollinators or developing into a fruit. Lastly, we observed whether there were intraspecific and interspecific agonistic interactions, considering interactions only attacks or persecution, as proposed by Machado (2009).

To compare the proportion of bird visits in the morning and in the afternoon, as well as intraspecific and interspecific bird conflicts we used a χ^2 test. Plant species was identified according to Lorenzi (1998). Bird field guides (Erize *et al*. 2006, Gwynne *et al.* 2010) were used to identify bird species. Classification and taxonomy of bird species follows the list of the CBRO (Piacentini *et al.* 2015).

RESULTS

We recorded 13 bird species from four families exploiting the floral resources of *C. pubiflora* (Table 1). Birds were more frequent in the afternoon (χ^2 test = 4.94, p = 0.03, df = 1), but some species presented similar frequencies at both periods. None showed higher frequency in the morning, except *Polytmus guainumbi* recorded only during this period. We observed *Hylocharis chrysura* with the highest frequency of occurrence, exploiting the nectar of *C. pubiflora* in all samples. *Heliomaster furcifer* and *Tangara sayaca* also had high frequencies, both sampled at 40 events (95.24% of all events sampled).

Only six species, all of them hummingbirds (*Chlorostilbon lucidus*, *Eupetomena macroura*, *H. furcifer*,

TABLE 1. Frequency of occurrence of birds visiting *Ceiba pubiflora* according to the period of visits (events) and feeding behavior. Birds are arranged in decreasing order of occurrence . LV: legitimate visit; IV: illegitimate visit; FD: flower damage. Total of morning events: n = 21. Total of afternoon events: n = 21. Total of events: n = 42.

Species	Morning (%)	Afternoon (%)	Total of Events	Feeding behavior
Hylocharis chrysura	100	100	42	LV
Heliomaster furcifer	90.48	100	40	LV
Tangara sayaca	95.24	95.24	40	IV
Brotogeris chiriri	66.67	100	35	FD
Chlorostilbon lucidus	57.14	76.19	28	LV
Eupetomena macroura	19.05	71.43	19	LV
Tangara palmarum	9.52	42.86	11	IV
Icterus cayanensis	23.81	23.81	10	IV
Thalurania furcata	9.52	9.52	4	LV
Amazona aestiva	-	9.52	2	FD
Aratinga nenday	-	4.76	1	FD
Polytmus guainumbi	4.76	-	1	LV
Saltator coerulescens	-	4.76	1	FD

H. chrysura, *P. guainumbi* and *Thalurania furcata*), made legitimate visits. All other species made illegitimate visits (*Icterus cayanensis*, *Tangara palmarum* and *T. sayaca*) or destroyed the flowers (*Amazona aestiva*, *Aratinga nenday*, *Brotogeris chiriri* and *Saltator coerulescens*) (Table 1).

All hummingbirds hovered in front of flowers to feed and then inserted the head in the corolla of the flower to reach the nectar. In this process, parts of their body made contact with the anthers and stigma, possibly promoting pollination. Occasionally, some hummingbirds such as *H. chrysura* and *H. furcifer*, landed on the petals and inserted their beaks into the flowers to get the nectar. *Heliomaster furcifer* sometimes inserted its beaks underneath the anthers and stigma, never touching them.

Damage to the flower and illegitimate visits were recorded for parrots and passerines (Table 1), especially for *B. chiriri* and *T. sayaca* (Figure 1), both species common in our samples (83.33% and 95.24%, respectively, of all events sampled). Occasionally, *E. macroura* made illegitimate visits. *Brotogeris chiriri* visited the *C. pubiflora* trees in flocks of up to 30 individuals, and some quarreled with up to four *B. chiriri* engaged. The flocks of *B. chiriri* consumed pollen and petals, often tearing and consuming hundreds of flower buds. Similar behavior was recorded for *S. coerulescens*, but at a smaller scale. *Tangara sayaca* was less destructive, piercing the flowers at the base of the corolla, leaving the flower almost intact, except when the flower was old when it usually fell down.

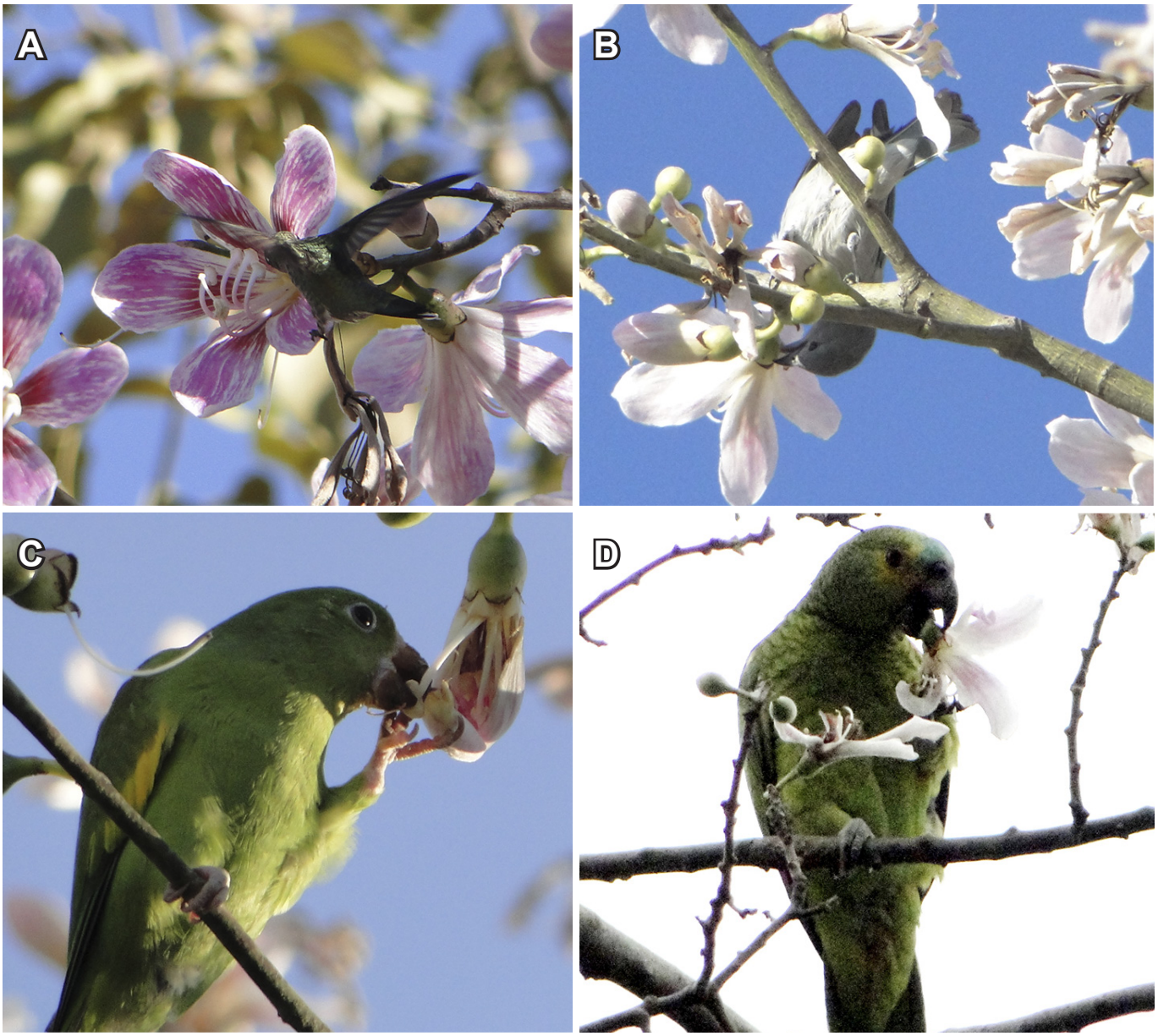

FIGURE 1. *Ceiba pubiflora* flower exploited by birds **A)** Legitimate visit: Insertion of the bird's beak in the corolla of the flower; **B)** Illegitimate visit: the bird pierces the flower at the base of the corolla, taking the nectar directly without contact with reproductive parts. **C)** and **D)** Damage to the flower: Birds eat parts of the flower, such as petals, sepals, anthers and stigma, likely damaging it in such a way that makes it unable to develop a fruit. **A)** *Heliomaster furcifer*; **B)** *Tangara sayaca*; **C)** *Brotogeris chiriri*; **D)** *Amazona aestiva.* Photos: Daniel Dainezi.

There was a difference between intra and interspecific agonistic interactions (χ^2 = 13.26, p < 0.001, df = 1). Interspecific agonistic interactions were more frequent (57.53%) than intraspecific interactions (42.46%). *Hylocharis chrysura* was the most frequent in territorial disputes and also the most aggressive species, present in 53% of all events. The second species was *H. furcifer*, present in 36.64% of all interactions. The other species accounted for 4% of agonistic interactions or less (Table 2).

Hylocharis chrysura showed high territorial behavior, fighting against individuals of the same species. However, its efficiency in chase away other birds was partial, as its assaults were occasionally unsuccessful in warding off the intruder. When *H. chrysura* attacked *H. furcifer* males, it was sometimes ignored or suppressed, so that *H. chrysura* succeeded in expelling only *H. furcifer* females and juveniles. All the attacks that *H. chrysura* made towards *E. macroura* were ignored or retaliated by the latter.

TABLE 2. Frequency of intra/interspecific agonistic interactions among birds visiting *Ceiba pubiflora* trees.

Species	Total of Interactions	Intraspecific	Interspecific
Hylocharis chrysura	310	164	146
Heliomaster furcifer	214	72	142
Chlorostilbon lucidus	26	3	23
Eupetomena macroura	20	-	23
Brotogeris chiriri	8	8	-
Tangara sayaca	3	1	2
Thalurania furcata	3	-	3

Heliomaster furcifer was the second species present in territorial disputes. Unlike *H. chrysura*, *H. furcifer* was more aggressive towards individuals of other species (66%). Males were dominant, while females and young were subordinate to other species such as *H. chrysura* and *E. macroura*.

DISCUSSION

There was a clear predominance (present in most samples) of *H. chrysura*, *H. furcifer*, *T. sayaca* and *B. chiriri*. *Hylocharis chrysura* was recorded in all samples and is a generalist that often feeds on nectar from plants with no ornithophilous syndrome (Snow & Snow 1986, Araujo & Sazima 2003). This bird was also one of the most common hummingbirds recorded in other studies taking the nectar of a variety of plants (Mendonça & Anjos 2005, Parrini & Raposo 2010, Polatto *et al*. 2012).

In this study, the three most common species of birds at *C. pubiflora* (*H. chrysura*, *H. furcifer* and *T. sayaca*) were recorded in both periods of the day and in almost all samples. These species consumed the nectar of the flowers without damaging flowers. In the afternoon, birds were recorded consuming petals and pollen.

Only hummingbirds made legitimate visits to *C. pubiflora* flowers in our study. In fact, these birds are responsible for 15% of the pollination in the Neotropical plants (Feinsinger 1983). In addition to making almost exclusively legitimate visits, they were also present in most or all sampling events (100% *H. chrysura* and 95.24% *H. furcifer*) and they showed a high potential for *C. pubiflora* pollination. *Heliomaster furcifer* has a long beak and it does not need to insert it deep into the flower to feed, and sometimes does not touch the anthers. Thus, it may be a less effective pollinator than other hummingbirds.

Parrots interfered negatively in the reproduction of *C. pubiflora* by damaging the flowers and consuming hundreds of flowers buds. The flower-damaging behavior of *B. chiriri* was already recorded by Marques (2012). Besides this, Stiles (1981) argues that birds, except hummingbirds, are often considered "floral parasites" exploiting floral resources in the Neotropical region and acting only as pollinator in moderate to low levels. Ragusa-Netto (2007) also observed the floral parasite behavior of large flocks of *A. nenday* exploiting the nectar of various plants in dry seasons in the Pantanal region.

According to McDade & Kinsman (1980), floral parasitism causes serious damage, due to the flowers exploited in such a way that they have fewer pollinators and lower potential for nectar recovery when compared to those exploited by effective pollinators. Moreover, due to the reduction of nectar in flowers, potential pollinators may partially or totally avoid plants that have their

nectar stolen by parasites. Thus, they directly influence the ecology and evolution of the pollination system of the plants (McDade & Kinsman 1980, Hargreaves *et al*. 2009).

The potential for damaging *C. pubiflora* flowers by *B. chiriri* is here emphasized. Although these psittacids were less frequent than other three bird species, they were often present in flocks of over ten individuals, feeding on flowers for hours over a single tree. Similar flocks of *B. chiriri* were observed by Parrini & Raposo (2010), who recorded these birds exploiting the flowers of *Erythrina fusca* in the Pantanal dry season in the state of Mato Grosso, western Brazil. Ragusa-Netto (2004) also noted a remarkable abundance of *B. chiriri* using nectar as their main food source and damaging flowers, claiming this feeding behavior was due to the scarcity of fruit during the dry season in the Pantanal.

Tangara sayaca was one of the most frequently observed species exploiting *C. pubiflora* flowers and nectar. Thraupidae birds have a generalist diet, with nectar as an important component in their diets (Feinsinger *et al*. 1979, Sazima *et al*. 1993). Our study shows that *C. pubiflora* can be an important food source for *T. sayaca*, as well as for other Thraupidae species. These birds can be considered parasites of *C. pubiflora*, due to thieving nectar from flowers.

Hylocharis chrysura was the most aggressive species, but its efficiency in scaring away birds of other species was low. On the other hand, *H. furcifer* was more aggressive with individuals of other species than *H. chrysura*. Males of *H. furcifer* showed dominance, winning almost all disputes with *H. chrysura*, while females and young birds were easily driven off by other species. The territorial behavior of *H. chrysura* was also observed by Faria & Araújo (2010), who recorded these birds defending territories around *Lophostachys floribunda* and *Ruellia angustiflora*. *Eupetomena macroura* is usually strongly territorial, with dominance over other birds (Mendonça & Anjos 2005, Toledo & Moreira 2008, Previatto *et al*. 2013). However, we did not observed territorial defense in this species, as it showed some aggressiveness only in cases in which it was attacked by other birds, always winning disputes.

Only *B. chiriri* showed exclusively intraspecific interactions. According to Marques (2012) *B. chiriri* interacted with at least 11 species of birds, but no hummingbirds. *Brotogeris chiriri* possibly did not attack other species while on *C. pubiflora* trees because hummingbirds, passerines and others psittacids did not pose a threat to this species of parakeet.

The exuberant flowering of *C. pubiflora* provided plentiful resources for at least 13 species of birds, which compete for flower resources and fed both on nectar and flower parts. All flower parts are consumed by Psittacidae (*A. nenday*, *B. chiriri* and *A. aestiva*). Hummingbirds, especially *H. chrysura*, are possibly the most effective pollinators of this tree, as they consume nectar without damaging flowers.

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REFERENCES

Araujo, A. C. & Sazima, M. 2003. The assemblage of flowers visited by hummingbirds in the "capões" of southern Pantanal, Mato Grosso do Sul, Brazil. *Flora*, 198: 427-435.

Erize, F.; Mata, J. R. & Rumboll, M. 2006. *Birds of South America*. Princeton: Princeton University Press.

Faria, R. R. & Araújo, A. C. 2010. Flowering phenology and pollination of ornithophilous species in two habitats of Serra da Bodoquena, Mato Grosso do Sul, Brazil. *Anais da Academia Brasileira de Ciências*, 82: 843-855.

Feinsinger, P. 1983. *Coevolution and pollination*. p. 283-310. *In*: D. Futuyma & M. Slatkin (Eds.). *Coevolution*. Sunderland: Sinauer Associates Publishers.

Feinsinger, P.; Colwell, R. K.; Terborgh, J. & Chaplin, S. B. 1979. Elevation and the morphology, flight energetics, and foraging ecology of tropical hummingbirds. *American Naturalist*, 113: 481-497.

Galetti, M. 1993. Diet of the Scaly-headed Parrot (*Pionus maximiliani*) in a semideciduous forest in Southeastern Brazil. *Biota Neotropica*, 25: 419-425.

Gilbert, O. L. 1989. *The ecology of urban habitats*. New York: Chapman and Hall.

Gibbs, P. & Semir, J. 2003. A taxonomic revision of the genus *Ceiba* Mill. (Bombacaceae). *Anales del Jardin Botánico de Madrid*, 60: 259-300.

Gribel, R.; Gibbs, P. E. & Queiróz, A. L. 1999. Flowering phenology and pollination biology of *Ceiba pentandra* (Bombacaceae) in Central Amazonia. *Journal of Tropical Ecology*, 15: 247-263.

Gwynne, J. A.; Ridgely, R. S.; Tudor, G. & Argel, M. 2010. *Aves do Brasil. v. 1. Pantanal & Cerrado*. São Paulo: Editora Horizonte.

Hargreaves, A. L.; Harder, L. D. & Johnson, S. D. 2009. Consumptive emasculation: the ecology and evolutionary consequences of pollen theft. *Biological Reviews*, 84: 259-276.

Howe, H. F. 1977. Bird activity and seed dispersal of a tropical wet forest tree. *Ecology*, 58: 539-550.

Lorenzi, H. 1998. *Árvores brasileiras. Manual de identificação e cultivo de plantas arbóreas do Brasil.* 2. ed. v. 2. Nova Odessa, SP: Editora Plantarum.

Machado, C. G. 2009. Beija-flores (Aves: Trochilidae) e seus recursos florais em uma área de caatinga da Chapada Diamantina, Bahia. *Revista Brasileira de Zoologia*, 26: 255-265.

Marques, C. P. 2012. *Psitacídeos (Aves: Psittaciformes) em praças de Uberlândia, MG: Um estudo sobre a exploração de recursos no ambiente urbano.* Dissertação de mestrado em ecologia e conservação de recursos naturais. Dissertação de Mestrado. Uberlândia: Universidade Federal de Uberlândia.

Marzluff, J. M.; Bowman, R. & Donnelly, R. 2001. *Avian ecology and conservation in an urbanizing world.* Norwell, MA, USA: Kluwer Academic Publishers.

McDade, L. A. & Kinsman, S. 1980. The impact of floral parasitism in two Neotropical hummingbird-pollinated plant species. *Evolution*, 34: 944-958.

Mendonça, L. B. & Anjos, L. 2003. Bird flower interactions in Brazil: a review. *Ararajuba,* 11: 195-205.

Mendonça, L. B. & Anjos, L. 2005. Beija-flores (Aves, Trochilidae) e seus recursos florais em uma área urbana do sul do Brasil. *Revista Brasileira de Zoologia*, 22: 51-59.

Muller-Landau, H. C.; Wright, S. J.; Calderón, O.; Condit, R. & Hubbel, S. P. 2008. Interspecific variation in primary seed dispersal in a tropical forest. *Journal of Ecology,* 96: 653-667.

Parrini, R. & Raposo, M. A. 2010. Aves explorando flores de *Erythrina fusca* (Leguminosae, Fabaceae) durante estação seca no Pantanal do Mato Grosso. *Iheringia, Série Zoologia,* 100: 97-101.

Pettet, A. 1977. Seasonal changes in nectar-feeding by birds at Zaria, Nigeria. *Ibis*, 119: 291-308.

Piacentini, V. Q.; Aleixo, A.; Agne, C. A.; Maurício, G. N.; Pacheco, J. F.; Bravo, G. A.; Brito, G. R. R.; Naka, L. N.; Olmos, F.; Posso, S.; Silveira, L. F.; Betini, G. S.; Carrano, E.; Franz, I.; Lees, A. L.; Lima, L. M.; Pioli, D.; Schunck, F.; Amaral, F. R.; Bencke, G. A.; Cohn-Haft, M.; Figueiredo, L. F. A.; Straube, F. C. & Cesari, E. 2015. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee. *Revista Brasileira de Ornitologia*, 23: 91-298.

Polatto, L. P.; Chaud-Netto, J.; Dutra, J. C. S. & Junior, V. V. A. 2012. Exploitation of floral resources on *Sparattosperma leucanthun* (Bignoniaceae): foraging activity of the pollinators and the nectar and pollen thieves. *Acta Ethologica*, 15: 119-126.

Previatto, D. M.; Mizobe, R. S. & Posso, S. R. 2013. Bird as potential pollinator of the *Spathodea nilotica* (Bignoniaceae) in the urban environment. *Brazilian Journal of Biology*, 73: 737-741.

Ragusa-Netto, J. 2002. Exploitation of *Erythrina dominguezii* Hassl. (Fabaceae) nectar by perching birds in a dry forest in western Brazil. *Brazilian Journal of Biology,* 62: 877-883.

Ragusa-Netto, J. 2004. Flowers, fruits, and the abundance of the Yellow-chevroned Parakeet (*Brotogeris chiriri*) at a gallery forest in the South Pantanal (Brazil). *Brazilian Journal of Biology*, 64: 867-877.

Ragusa-Netto, J. 2007. Nectar, fleshy fruits and the abundance of parrots at a gallery forest in the southern Pantanal (Brazil). *Studies on Neotropical Fauna and Environment*, 42: 93-99.

Sazima, I.; Buzato, S. & Sazima, M. 1993. The bizarre inflorescence of *Norantea brasiliensis* (Marcgraviaceae): visits of hovering and perching birds. *Botanica Acta*, 106: 507-513.

Sazima, I. & Sazima, M. 2007. Petiscos florais: pétalas de *Acca sellowiana* (Myrtaceae) como fonte alimentar para aves em área urbana no Sul do Brasil. *Biota Neotropica*, 7: 307-311.

Snow, D. W. 1981. *Coevolution of birds and plants. In*: Forey PL, Greenwood PH. (eds.). *The evolving biosphere. Part II. Coexistence and coevolution*, p. 169-178. Cambridge: Cambridge University Press.

Snow, D. W. & Snow, B. K. 1986. Feeding ecology of hummingbirds in the Serra do Mar, Southeastern Brazil. *Journal of Ornithology*, 123: 446-450.

Soriano, B. M. A. 1997. Caracterização climática de Corumbá-MS. Boletim de Pesquisa No. 11. Corumbá: EMBRAPA.

Stiles, F. G. 1981. Geographical aspects of bird-flower coevolution, with particular reference to Central America. *Annals of the Missouri Botanical Garden*, 68: 323-351.

Terborgh, J. 1986. Keystone plant resources in the tropical forest. (M. E. Soule, ed.). *In*: *Conservation biology, the science of scarcity and diversity*, p 330-344. Sunderland, MA: Sanauer.

Toledo, V. M. 1977. Pollination of some rain forest plants by non-hovering birds in Veracruz, Mexico. *Biotropica*, 9: 262-267.

Toledo, M. C. B. & Moreira, D. M. 2008. Analysis of the feeding habits of the Swallow-tailed Hummingbird, *Eupetomena macroura* (Gmelin, 1788), in an urban park in southeastern Brazil. *Brazilian Journal of Biology*, 68: 419-426.

Wunderle-Jr., J. M. 1997. The role of animal seed dispersal in accelerating native forest regeneration on degraded tropical lands. *Forestry Ecology and Management*, 99: 223-235.

Associate Editor: Marco A. Pizo