



ATTACK OF A WIDE-RANGING NEOTROPICAL OWL (*Glaucidium brasilianum*) ON AN ABUNDANT SPECIES OF FRUIT BAT (*Carollia perspicillata*) IN THE BRAZILIAN CERRADO

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Abstract: The southern Neotropics harbour one of the largest diversity of bats and raptors in the world, however, few records on the predation of bats, especially by owls, are reported in the literature. Here we have expanded our knowledge on the feeding habits of the ferruginous pygmy owl (*Glaucidium brasilianum*) by describing its attack on a Seba's short-tailed fruit bat (*Carollia perspicillata*). Also, we compiled a list of 10 vertebrate species, including now three bat species, which are predated by this wide-ranging Neotropical owl. Thus, we recommend special attention to the monitoring of abundant bat populations and their predators, as much as their role in the ecosystem services, such as seed dispersal.

Keywords: interspecific interaction; Neotropical bats; predation; Phyllostomidae; Strigidae.

Neotropical bats are a highly-diverse group of flying mammals with morphological adaptations resulting in a taxonomic group with a wide range of feeding habits (López-Baucells *et al.* 2016), and capable of occupying several ecological roles in the ecosystems where they occur (Kunz *et al.* 2011). One of the most species-rich guild of bats are the

frugivores, which are key dispersers of seeds from several tropical plants (Carvalho-Ricardo *et al.* 2014). Among the 181 bat species occurring in Brazil (Garbino *et al.* 2021), *Carollia perspicillata* (Chiroptera, Phyllostomidae) is one of the most abundant (Brändel *et al.* 2020). They occur in all the Brazilian biomes and are well-adapted to foraging

and roosting, both in forests and urban zones (Reis *et al.* 2007, Silva & Anacleto 2011).

Besides providing several ecosystem services, bats also support a large biomass of predators, including reptiles (Carvalho *et al.* 2019), birds (Camargo & Laps 2016), and other mammals, including carnivorous bats (Castro *et al.* 2011). Among flying raptors, owls are one of the most important bat predators, including the mottled owl (*Strix virgata*, Strigiformes, Strigidae), barn owls (*Tyto alba*, Strigiformes, Tytonidae), and the tawny-bellied screech-owl (*Megascops watsonii*, Strigiformes, Strigidae) (Motta-Júnior & Taddei 1992, Vargas *et al.* 2002, Rocha & López-Baucells 2014, Serra-Gonçalves *et al.* 2017). Several events of bat predation by Stringidae owls were reported so far, including one predation of a *Nycticeius humeralis* (Chiroptera, Vespertilionidae) by a ferruginous pygmy owl (*Glaucidium brasilianum*, Strigiformes, Strigidae) in Mexico (Proudfoot & Beasom 1997). This small owl has a wide extent of occurrence, from the southern United States of America to southern Brazil and Argentina (König & Weick 2008). In spite of its wide distribution range in the southern Neotropics, this is the first record of a predation attempt of a Neotropical bat, namely the Seba's short-tailed fruit bat (*C. perspicillata*), by a ferruginous pygmy owl (*G. brasilianum*).

The predation attempt was recorded in the Brazilian Cerrado in Mato Grosso State, in the municipality of Poconé in a forest fragment (15° 56' 10,84" S, 56° 59' 47,6" W, datum SAD69) of 22.45 ha, predominantly formed by *Cerrado sensu stricto* vegetation, with the tallest trees reaching 9 m height. We sampled this forest fragment for two nights on the 7th and 8th of April 2020 using 10 mist nets (10 m × 3 m) from dusk (18 h) to midnight (0 h), in flight corridors in the understorey. This was part of a large research project sampling the ecotone between the Amazon and the Cerrado in the States of Mato Grosso and Rondônia (under the license SISBIO n° 65436 and the permission of Research Animal and Ethics Committee – authorisation number 013/2018). Bats were captured, sexed, and measured following a biometric protocol (Diaz *et al.* 2021) using scales (Pesola 100 g) and a calliper (resolution 0.01 mm). The species were identified using the available literature (Diaz *et al.* 2021). For specific identification of the *C. perspicillata*, we analysed the skull (Figure 1) and took specific



Figure 1. View of skull and mandible of *Carollia perspicillata* extracted (scale 10 mm). Morphometric characteristics (forearm: 40.9 mm; tibia: 16.8 mm; skull size: 23.3 mm; skull shape: little globular; rostrum: slightly flared and robust; sagittal crest: pronounced; maxillary dental row: wide and little divergent; upper molars: slightly stout).

measurements of the forearm and the skull (following some characteristics of Ruelas 2017, Lemos *et al.* 2020). The specimens were deposited in the didactic collection of the Instituto Federal de Mato Grosso, Pontes e Lacerda campus, which is in the process of assembling a scientific collection of Chiroptera. Also, we compiled the peer-reviewed publications reporting the predation of vertebrates by the ferruginous pygmy owl using the search tools: Google Scholar and ScieLO Brazil. For the search we used the keywords “pygmy owl”, “*Glaucidium brasilianum*”, “bat predation” and “*Carollia perspicillata*”. These searches were made in November 2021.

We found 786 results for our search and, after selecting scientific papers reporting predation events by ferruginous pygmy owls, we came to nine scientific papers (Table 1). In spite of its small body

Table 1. Records of vertebrates in the diet of the ferruginous pygmy owl (*G. brasilianum*)

Class	Prey species	Source
Reptilia	<i>Ameivula ocellifera</i>	Vieira <i>et al.</i> 2018
	<i>Iguana iguana</i>	Contreras-Lozano & Ballesteros-Medrano 2018
Mammalia	<i>Calomys expulsus</i>	Hannibal <i>et al.</i> 2016
	<i>Necomys urichi</i>	Quiroga-Carmona & Isasi-Catalá 2013, Carrera <i>et al.</i> 2008
	<i>Molossus molossus</i>	Proudfoot & Beasom 1997
	<i>Nycticeius humeralis</i>	
Bird	<i>Tyrannus savanna</i>	Motta-Junior 2007
	<i>Polytmus guainumbi</i>	Sazima 2015
	<i>Hylocharis chrysara</i>	
	<i>Turdus grayi</i>	Soto & Jiménez 2016

mass (61.4 – 75.1 g; Earhart & Johnson 1970), we found 10 vertebrate species in the diet records of the ferruginous pygmy owl, namely reptiles (2 spp), mammals (4 spp), and birds (4 spp), including two bat species (Table 1). For the first time, we report the predation attempt of a southern Neotropical bat (*C. perspicillata*) by a ferruginous pygmy owl (Table 1), based on the injuries and the death of the bat trapped in the mist net, close to a ferruginous pygmy owl, which was also trapped.

At 19:24 h, we found, in the middle pocket of the mist net, a dead adult female of *C. perspicillata* (Figure 2). It had blood over its body and perforations at its *left/right* wing, ventral, and dorsal region, moreover, it had lost its nasal leaf, and the wounds were still bleeding. In another pocket, about 30 cm below, there was a ferruginous pygmy owl caught in the lowest pocket. Another adult female *C. perspicillata* was about a meter from the owl, in the same pocket.

Based on a previous report of the predation of the ferruginous pygmy owl on a fast-flying bird, the fork-tailed flycatcher (*Tyrannus savanna*, Passariformes, Tyrannidae) (Motta-Junior 2007), we hypothesised that the bat was caught in flight and brought to the ground by the raptor, similar to the predation of the fork-tailed flycatcher (Motta-Junior 2007). On the ground, the bat must have been killed and had its nasal leaf torn off by the pygmy owl. Afterward, the pygmy owl was caught in the mist net, while flying to a feeding roost, and

dropped the bat. Both, bat and owl, were caught in the net. Alternatively, the pygmy owl could have attacked the short-tailed fruit bat opportunistically, while the latter was already netted, as observed by Rocha & López-Baucells (2014) who reported two predation attempts of Seba's short-tailed fruit bat by the crested owl (*Lophotrix cristata*, Strigiformes, Strigidae). However, it seems unlikely that the pygmy owl could grasp the bat firmly enough to kill it and to tear its nasal leaf off while hanging on the middle pocket, and, eventually, to get caught in the lowest pocket of the mist net, leaving the dead bat trapped above its head.

Previous reports on the predation of bats by ferruginous pygmy owls include only two species: *M. molossus* in the Argentinean Chaco (Carrera *et al.* 2008), and *N. humeralis* in Mexico (Proudfoot & Beasom 1997) (Table 1). It was suggested, however, that Seba's short-tailed fruit bat is preyed on by several other owl species, namely Barn (*T. alba*), Mottled (*S. virgata*), and Spectacled (*Pulsatrix perspicillata*, Strigiformes, Strigidae) owls (Cloutier & Thomas 1992, Motta- Jr. & Taddei 1992, Vargas *et al.* 2002).

Here, we present for the first time a predation attempts on one of the most abundant and wide-ranging Neotropical bats by a ferruginous pygmy owl. Both species have largely-overlapping distribution ranges and are able to occupy a wide array of habitat types, from pristine and degraded forests to urban zones (Pine 1972, Proudfoot &



Figure 1. (A) Mist net with two *C. perspicillata* and one *G. brasilianum*. (B) Detail of the raptor and its bat prey, (C) A ferruginous pygmy owl (*G. brasilianum*), (D) Frontal facial view of the Seba's short-tailed fruit bat (*C. perspicillata*), (E) Ventral wounds inflicted by the tallons of the raptor, (F) Detail of the fruit bat's nasal leaf torn off.

Johnson 2000, König & Weick 2008, Silva & Anacleto 2011). Considering the reduction of forest cover and the importance of Cerrado for food production in Brazil (Zaiatz *et al.* 2018), the species *C. perspicillata* has a highly-relevant role in seed dispersal (Salazar *et al.* 2013) and pest control (Russo *et al.* 2018), further studies on the trophic relations involving owls and bats are fundamental to the conservation strategies involving these animal populations and their environment.

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REFERENCES

- Brändel, S. D., Hiller, T., Halczok, T. K., Kerth, G., Page, R. A. & Tschapka, M. 2020. Consequences of fragmentation for neotropical bats: the importance of the matrix. *Biological Conservation*, 252, 108792. DOI: 10.1016/j.biocon.2020.108792
- Camargo, P. H. S. A. & Laps, R. R. 2016. Predation on lesser bulldog bat (*Noctilio albiventris* Noctilionidae) by great rufous woodcreeper (*Xiphocolaptes major* Dendrocolaptidae). *The Wilson Journal of Ornithology*, 128(4), 903-912. DOI: 10.1676/15-200.1
- Carrera, J. D., Fernández, F. J., Kacoliris, F. P., Pagano, L. & Berkunsky, I. 2008. Field notes on the breeding biology and diet of ferruginous Pygmy-owl (*Glaucidium brasilianum*) in the dry Chaco of Argentina. *Ornitologia Neotropical*, 19, 315-319.
- Carvalho, W. D., Silvestre, S. M., Mustin, K., Hilário, R. R. & Toledo, J. J. 2019. Predation of an American fruit-eating bat (*Artibeus* sp.) by an Amazon tree boa (*Corallus hortulanus*) in the northern Brazilian Amazon. *Acta Amazonica*, 49(1), 24-27. DOI: 10.1590/1809-4392201801921
- Carvalho-Ricardo, M. C., Uieda, W., Fonseca, R. C. B. & Rossi, M.N. 2014. Frugivory and the effects of ingestion by bats on the seed germination of three pioneering plants. *Acta oecologica*, 55, 51-57. DOI: 10.1016/j.actao.2013.11.008
- Castro, I. J., Silva, C. R., Costa, A. J. S. & Martins, A. C. M. 2011. Predação oportunista de *Artibeus planirostris* (Spix, 1823) e *Carollia perspicillata* (Linnaeus, 1758) (Chiroptera, Phyllostomidae) por marsupiais e anuro na APA do Rio Curiaú, Amapá, Brasil. *Acta Amazonica*, 41(1), 171-173. DOI: 10.1590/S0044-59672011000100020
- Cloutier, D. & Thomas, W. 1992. *Carollia perspicillata*. *Mammalian Species*, 417, 1-9.
- Contreras-Lozano, J. A. & Ballesteros-Medrano, O. 2018. Observation of a Ferruginous Pygmy-Owl (*Glaucidium brasilianum*) feeding upon a common green Iguana (*Iguana iguana*) in Vera Cruz, Mexico. *The Southwestern Naturalist*, 63(1), 81-83. DOI: 10.1894/0038-4909.63.81
- Díaz, M. M., Solari, S., Gregorin, R., Aguirre, L. F. & Barquez, R. M. 2021. Clave de Identificación de los murciélagos neotropicales. PCMA (Programa de Conservación de los Murciélagos de Argentina): p. 160.
- Earhart, C. M. & Johnson, N. K. 1970. Size dimorphism and food habits of North American owls. *The Condor*, 72(3), 251-264. DOI: 10.2307/1366002
- Garbino, G. S. T., Gregorin, R., Lima, I. P., Loureiro, L., Moras, L. M., Moratelli, R., Nogueira, M. R., Pavan, A. C., Tavares, V. C. & Peracchi A. L. 2021. Updated checklist of Brazilian bats: versão 2021. Comitê da Lista de Morcegos do Brasil—CLMB. Sociedade Brasileira para o Estudo de Quirópteros (Sbeq). <<https://www.sbeq.net/lista-de-especies>> acessado em: 14 dez 2021.
- Hannibal, W., Claro, W. P., Figueiredo, V. V. & Oliveira, R. F. 2016. Predation of *Calomys expulsus* (Rodentia: Cricetidae) by *Glaucidium brasilianum* (Strigiformes: Strigidae) in a semi-deciduous seasonal forest fragment. *Bol. Mus. Biol. Mello Leitão*, 38(3), 181-185.

- König, C. & Weick, F. 2008. *Owls of the World*. 2nd ed., Yale University Press: p. 528
- Lemos, T. H., Tavares, V. C. & Moras, L. M. 2020. Character variation and taxonomy of short-tailed fruit bats from Carollia in Brazil. *Zoologia (Curitiba)*, 37, e34587. DOI: 10.3897/zoologia.37.e34587
- Kunz, T., Torrez, E., Bauer, D., Lobo, T., Fleming, T. 2011. Ecosystem services provided by bats. *Annals of the New York Academy of Sciences*, 1223(1), 1-38. DOI: 10.1111/j.1749-6632.2011.06004.x
- López-Baucells, A., Rocha, R., Bobrowiec, P.E.D., Bernard, E., Palmeirim, J.M. & Meyer, C.F.J. 2016. *Field guide to Amazonian Bats*. 1st. ed., Manaus: Editora INPA: p. 168.
- Motta-Junior, J.C. & Taddei, V.A. 1992. Bats as prey of stygian owls in southeastern Brazil. *Journal of Raptor Research*, 26, 259-260.
- Motta-Junior, J.C. 2007. Ferruginous Pygmy-owl (*Glaucidium brasilianum*) predation on a mobbing Fork-tailed Flycatcher (*Tyrannus savana*) in South-east Brazil. *Biota Neotropica*, 7(2), 321-324. DOI: 10.1590/S1676-06032007000200038
- Pine, R.H. 1972. The bats of the genus *Carollia*. *Texas A & M University*: p. 125.
- Proudfoot, G.A. & Beason, S.L. 1997. Food habits of nesting ferruginous Pygmy-owls in Southern Texas. *The Wilson Bulletin*, 109(4), 741-748.
- Proudfoot, G.A. & Johnson, R.R. 2000. Ferruginous Pygmy-Owl (*Glaucidium brasilianum*). *The birds of North America*, 498, 20.
- Quiroga-Carmona, M. & Isasi-Catalá, E. 2013. Depredación de un ratón colicorto achocolatado (*Necromys urichi*) por una pavita ferrugínea (*Glaucidium brasilianum*) em la Cordillera de la Costa de Venezuela. *Huitzil*, 14(2), 101-104.
- Reis, N.R., Peracchi, A.L., Pedro, W.A. & Lima, I.P. 2007. *Morcegos do Brasil*. Universidade Estadual de Londrina, p. 253.
- Rocha, R. & López-Baucells, A. 2014. Opportunistic predation by crested owl *Lophotrix cristata* upon Seba's short-tailed bat *Carollia perspicillata*. *Revista Brasileira de Ornitologia*, 22, 35-37. DOI: 10.1007/BF03544230
- Ruelas, D. 2017. Diferenciación morfológica de *Carollia brevicauda* y *C. perspicillata* (Chiroptera: Phyllostomidae) de Perú y Ecuador. *Rev. Peru biol.*, 24(4), 363-382. DOI: 10.15381/rpb.v24i4.14063
- Russo, D., Bosso, L. & Ancillotto, L. 2018. Novel perspectives on bat insectivory highlight the value of this ecosystem service in farmland: research frontiers and management implications. *Agriculture, Ecosystems & Environment*, 266, 31-38. DOI: 10.1016/j.agee.2018.07.024
- Salazar, D., Kelm, D. H. & Marquis, R. J. 2013. Directed seed dispersal of *Piper* by *Carollia perspicillata* and its effect on understory plant diversity and folivory. *Ecology*, 94(11), 2444-2453. DOI: 10.1890/12-1172.1
- Sazima, I. 2015. Lightning predator: the ferruginous Pygmy Owl snatches flower-visiting hummingbirds in southwestern Brazil. *Revista Brasileira de Ornitologia*, 23, 12-14. DOI: 10.1007/BF03544283
- Serra-Gonçalves, C., López-Baucells, A. & Rocha, R. 2017. Opportunistic predation of a silky short-tailed bat (*Carollia brevicauda*) by a tawny-bellied screech-owl (*Megascops watsonii*), with a compilation of predation events upon bats entangled in mist-nets. *Barbastella*, 10(1).
- Silva, S. G. & Anacleto, T. C. S. 2011. Diversidade de morcegos entre áreas com diferente grau de alteração na área urbana do município de Nova Xavantina, MT. *Chiroptera Neotropical*, 17(1), 191-195.
- Soto, S. S. & Jiménez, M. M. 2016. Depredación de *Turdus grayi* (Aves: Passeriformes) por *Glaucidium brasilianum* (Aves: Strigiformes) em Tabasco, México. *Poeyana Revista Cubana de Zoología*, 503, 53-55.
- Vargas, J., Carlos Landaeta, A. & Simonetti, J.A. 2002. Bats as prey of barn owls (*Tyto alba*) in a tropical savanna in Bolivia. *Journal of Raptor Research*, 36(2), 146-147.
- Vieira, W. L. S., Bezerra, D. M. M. & Vieira, K. S. 2018. Predation on Spix's whiptail *Ameivula ocellifera* (Spix, 1825) by the Ferruginous Pygmy-owl *Glaucidium brasilianum* (Gmelin, 1788) in northeastern Brazil. *Hepertology Notes*, 11, 975-976.
- Zaiatz, A. P. S. R., Zolin, C. A., Vendrusculo, L. G., Lopes, T. R. & Paulino, J. 2018. Agricultural land use and cover change in the Cerrado/Amazon ecotone: a case study of the upper

Teles Pires river basin. *Acta Amazonia*, 48(2).
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