

# *Plumarius brasiliensis* Penteado-Dias & Scatolini, 2003 (Hymenoptera, Plumariidae): notes on its temporal variation in the Cerrado and new distribution records in Brazil

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**Abstract.** This study is focused on the parasitic wasp *Plumarius brasiliensis* Penteado-Dias & Scatolini, 2003 (Hymenoptera, Plumariidae). Data assembled from 12 consecutive months of systematic samplings at Parque Nacional Grande Sertão Veredas, in Minas Gerais, Brazil, indicate that the largest populations of *P. brasiliensis* occur there in the dry season, with few specimens collected in the rainy season, which may indicate that this group or its hosts have a seasonal pattern. This species is also reported for the first time in areas of Cerrado, in the states of Minas Gerais and Maranhão; in the core of Caatinga, in the state of Rio Grande do Norte; and in transition zone between Caatinga and Cerrado, in the state of Piauí, Brazil. The new distributional records in areas of Cerrado and Caatinga/Cerrado ecotone represent a significant increase in the geographic range of *P. brasiliensis* that can be present in about 35% of the Brazilian territory. Additionally, we provide digital images and diagnosis of this species and a map with the geographical distribution of the studied species based on the new records and literature data.

**Keywords.** Brazilian savannah; Chrysoidea; Neotropical Region; Parasitoid wasp; Xeric environment.

## INTRODUCTION

The geographic distribution of plumariid wasps (Hymenoptera, Chrysoidea, Plumariidae) is limited to the arid and semiarid areas of South America and southern Africa (Nagy, 1973; Day, 1977; Fennimore & Brothers, 1993; Penteado-Dias & Scatolini, 2003).

Knowledge of these wasps is based mainly on males, since only two females of Plumariidae have been described, one from Peru (Evans, 1966) and another from Chile (Perez D'Angello, 1974), both attributed to *Plumarius* Philippi, 1873 (Diez *et al.*, 2007). This group of insects exhibits extreme sexual dimorphism. Males of plumariids have slender bodies with long legs, large wings, and a huge pterostigma and are often collected with light or Malaise traps; the females are apterous, prognathous, with flat bodies, short legs with strong

spiniform setae, and stout femora (Evans, 1966; Brothers, 1974; Diez, 2008; Diez & Roig-Alsina, 2016), with hypogeic habits (Melo & Dal Molin, 2024). Larvae of plumariid wasps act as idiobiont ectophages (Hanson & Gauld, 1995) and are possibly idiobiont parasitoids of Coleoptera larvae that develop in the soil (Melo & Dal Molin, 2024). Nothing more is known about the biology of the group.

In South America, plumariid wasps occur from Ecuador, Peru, Brazil, Paraguay, Uruguay, Chile, and Argentina (Bradley, 1972; Diez & Roig-Alsina, 2016), with higher diversity in the xeric regions of the latter two countries (Quintero & Cambra, 2010; Brothers, 2011; Diez *et al.*, 2012); on that continent, the family is represented by four endemic genera from the xeric regions of western Argentina, namely: *Plumaroides* Brothers, 1974, *Maplurius* Roig-Alsina, 1994, *Mapluroides* Diez, Fidalgo & Roig-Alsina, 2007 and *Pluroides* Diez, Fi-

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dalgo & Roig-Alsina, 2010 (Diez & Roig-Alsina, 2016) and by *Plumarius*, a Neotropical genus that currently includes about 40 described species (Nagy, 1973; Perez D'Angello, 1974; Papp, 2000; Pentead-Dias & Scatolini, 2003; Diez et al., 2012, 2013; Diez & Roig-Alsina, 2016).

*Plumarius brasiliensis* was described by Pentead-Dias & Scatolini (2003) from specimens collected in the state of Rio Grande do Norte, northeastern Brazil. Ten years later, its geographical distribution was expanded to the states of Ceará and Bahia, also in northeastern Brazil (Waichert et al., 2013) and, recently, the species was recorded to the state of São Paulo (Melo & Dal Molin, 2024). So far, no other species of *Plumarius* have been recorded in Brazil.

Here we present data about the temporal variation of *P. brasiliensis* at Parque Nacional Grande Sertão Veredas, in Minas Gerais, Brazil. *Plumarius brasiliensis* is also reported for the first time in areas of Cerrado in the states of Minas Gerais and Maranhão, as well as in areas of Caatinga vegetation in the state of Rio Grande do Norte and in a Caatinga-Cerrado ecotone in the state of Piauí, Brazil.

## MATERIAL AND METHODS

The studied specimens of *P. brasiliensis* from the state of Minas Gerais were collected in samplings performed from June 2018 to May 2019 in areas of the Cerrado at Parque Nacional Grande Sertão Veredas (PNGSV) (~550 m above sea level) (Fig. 1), in Central Brazil. In the PNGSV the climate is Köpen AW (tropical with wet summers and dry winters) with a total annual precipitation of 1,172 mm concentrated between October and April and an average annual temperature of 23.3°C (Climate-Data.org, 2023).

At PNGSV five Townes' style Malaise traps (Townes, 1972) with 96% ethanol solution as a preservative were installed and managed continuously throughout the study period. The traps were separated from each other by about 50 m. The insects were removed every two weeks.

At the same site, samplings were also carried out with: (A) four light traps equipped with compact fluorescent lamps (40W, 6,400K) on the new moons of May, September, and November 2018 and February 2019. The light traps, separated from each other by about 100 m, were fixed on trees in the forest core at approximately four meters above ground and remained active for three days from dusk to dawn the following day; a solution of 96% ethanol was used as a preservative; and (B) 300 Moericke traps (yellow disposable plastic dishes, 15 cm in diameter and 4.5 cm high with saline solution and neutral detergent as a preservative) separated from each other by two meters, remained active for three days. The collected insects that were taken out of light and Moericke traps by the end of the third day of collection. The collections were done under a Brazilian Biodiversity Information and Authorization System (SISBIO) license #16473-1.

In the laboratory, specimens of *P. brasiliensis* were separated from other Hymenoptera, preserved in 96% alcohol, and then dried using the amyl acetate technique (Pérez-Benavides et al., 2023). Subsequently they were mounted on entomological pins, labeled, and deposited in the Coleção Entomológica do Laboratório de Sistemática e Bioecologia de Predadores e Parasitoides, Instituto Biológico, Ribeirão Preto, São Paulo, Brazil (LRRP).

Images of the specimens of *P. brasiliensis* collected at PNGSV were taken using a Leica MC170 HD digital camera connected to a Leica M205C APO stereomicroscope; the specimens were illuminated with a Leica LED5000



**Figure 1.** Parque Nacional Grande Sertão Veredas, state of Minas Gerais, Brazil. View of the Cerrado.

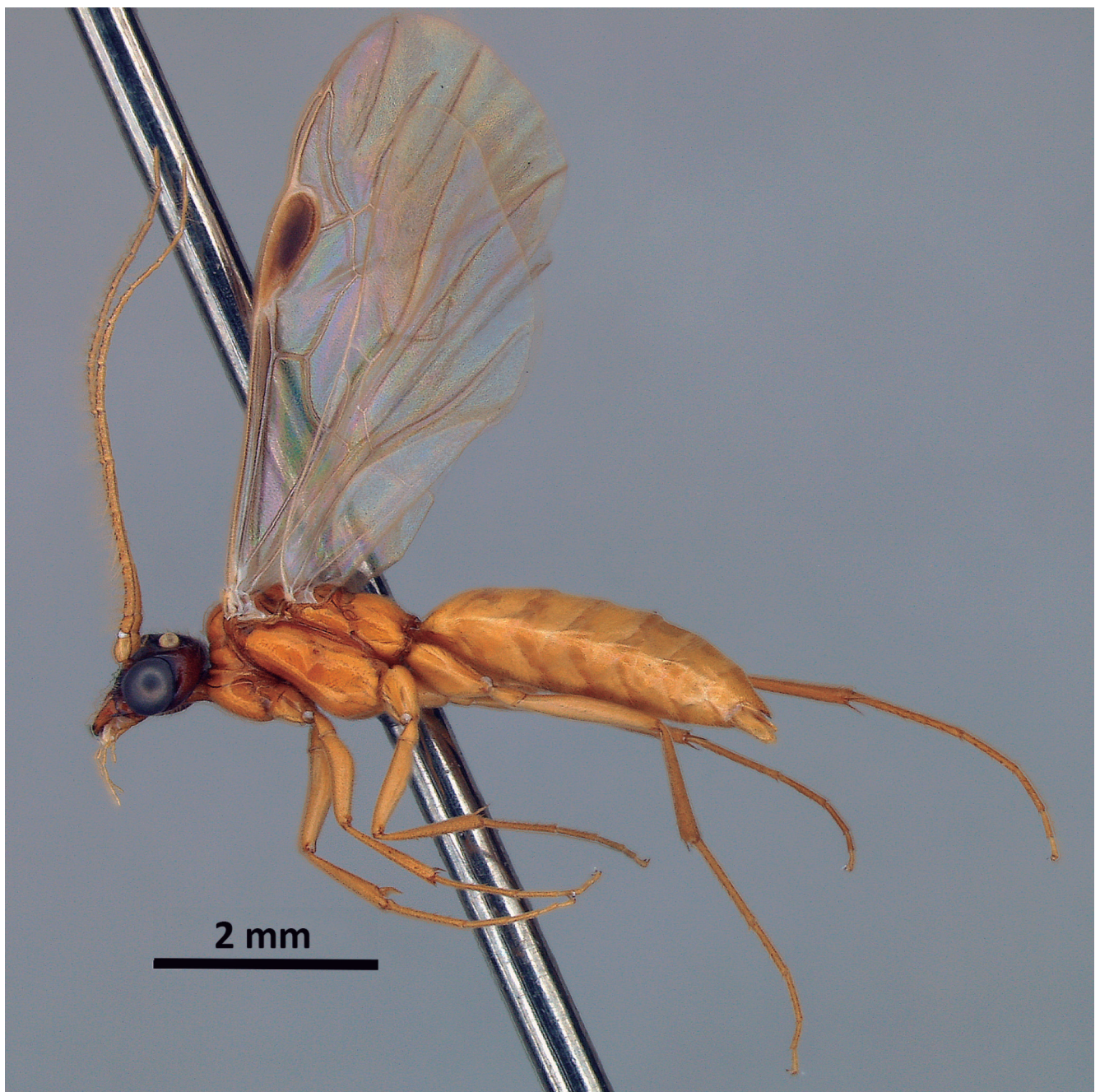
HDI high diffuse dome illumination. Helicon Focus (version 5.3) software was used to stack the images and Adobe Photoshop (version 11.0) software to prepare them. In addition, specimens of *P. brasiliensis* deposited in the following Brazilian institutions were examined: Instituto Biológico (LRRP), Universidade Estadual de Feira de Santana, Feira de Santana, Bahia (UEFS) and Universidade Estadual do Maranhão, Caxias, Maranhão (CZMA). The specimens of *P. brasiliensis* were identified based on the original description (Penteado-Dias & Scatolini, 2003).

The provided map with the geographical distribution of *P. brasiliensis* was made using SimpleMappr online software (Shorthouse, 2010) and is based on data from literature and new records. Abbreviations used for the Brazilian states are: MA = Maranhão, PI = Piauí, RN = Rio Grande do Norte, CE = Ceará and MG = Minas Gerais.

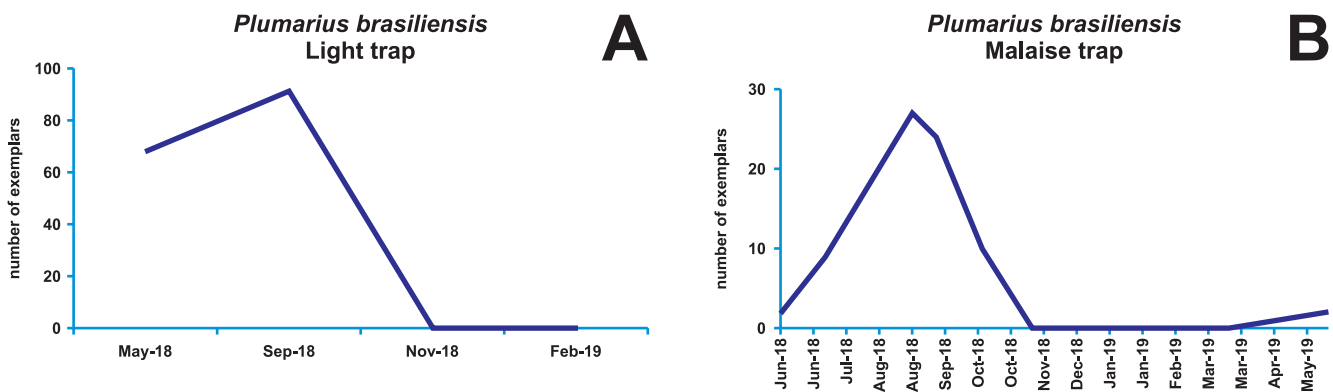
The information on the labels of the specimens examined was transcribed in the section "Material examined" as follows: the symbol backslash ( \ ) indicates the different lines on the label and two quotation marks ( " ") indicate different labels on the same specimen.

## RESULTS

At PNGSV, 236 males specimens of *P. brasiliensis* were collected (Fig. 2), of which 159 (67.4% of total) were obtained with light traps (Fig. 3A), 75 (31.8% of total) with Malaise traps (Fig. 3B) and two (0.8%) with Moerike traps. Therefore, light traps are the most suitable method for the capture of these insects. The large number of males of *P. brasiliensis* collected using light traps confirms the



**Figure 2.** *Plumarius brasiliensis* Penteado-Dias & Scatolini, 2003 (Hymenoptera, Plumariidae), male, lateral habitus.



**Figure 3.** Population fluctuation of *Plumarius brasiliensis* Pentead-Dias & Scatolini, 2003 (Hymenoptera, Plumariidae) collected at Parque Nacional Grande Sertão Veredas, state of Minas Gerais, Brazil, between June 2018 and May 2019. (A) Light traps, (B) Malaise traps.

statements that males of Plumariidae have nocturnal habits and can be collected easily using that kind of trap (Gauld, 2006; Brothers, 2006; Diez & Roig-Alsina, 2008). All specimens of *P. brasiliensis* collected with light traps were obtained in the collections carried out in June and September 2018; no specimens of *P. brasiliensis* were captured in the collections carried out in November 2018 and February 2019.

**Material examined:** 347 males. **Brazil, Minas Gerais**

**(196):** "BRA, MG, Chapada Gaúcha \ PARNA Grande Sertão Veredas \ 15°10'28.7"S / 45°43'22.4"W \ cerrado, arm. luminosa \ 17/V/2018 \ NW Perioto & RIR Lara cols.," *Plumarius brasiliensis* \ Pentead-Dias & Scatolini \ NW Perioto, det. 2023", 11 males (LRRP#23000-23010); same data except 15°10'25.3"S / 45°43'17.9"W, 12/IX/2018, 20 males (LRRP#23011-23030); *idem* 15°10'30.1"S / 45°43'24.5"W, 12/IX/2018, 8 males (LRRP#23031-23038); *idem* 15°10'25.3"S / 45°43'17.9"W, 17/V/2018, 31 males (LRRP#23053-23083); *idem* 15°10'30.1"S / 45°43'24.5"W, 17/V/2018, 26 males (LRRP#23084-23109); *idem* 15°10'28.7"S / 45°43'22.4"W, 12/IX/2018, 25 males (LRRP#23159-23183); *idem* 15°10'19.7"S / 45°43'01.3"W, arm. Moericke, 17/V/2018, 1 male (LRRP#22989); *idem* 15°10'19.7"S / 45°43'01.3"W, arm. Moericke, 12/IX/2018, 1 male (LRRP#22988); *idem* 15°10'32.0"S / 45°43'13.5"W, arm. Malaise, 31/VII/2018, 1 male (LRRP#22990); *idem* 15°10'32.0"S / 45°43'13.5"W, arm. Malaise, 28/VIII/2018, 1 male (LRRP#22991); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 09/X/2018, 3 males (LRRP#22992-22994); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 31/VII/2018, 2 males (LRRP#22995-22996); *idem* 15°10'29.6"S / 45°43'17.6"W, arm. Malaise, 14/VIII/2018, 3 males (LRRP#23039-23041); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 23/X/2018, 1 male (LRRP#23042); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 09/XI/2018, 10 males (LRRP#23043-23052); *idem* 15°10'30.6"S / 45°43'16.6"W, arm. Malaise, 14/VIII/2018, 4 males (LRRP#23110-23113); *idem* 15°10'32.0"S / 45°43'13.5"W, arm. Malaise, 09/X/2018, 2 males (LRRP#23114-23115); *idem* 15°10'29.6"S / 45°43'17.6"W, arm. Malaise, 09/X/2018, 3 males (LRRP#23134-23136); *idem* 15°10'31.7"S / 45°43'14.9"W, arm. Malaise, 11/IX/2018, 3 males (LRRP#22997-22999); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 28/VIII/2018, 9 males

(LRRP#23123-23131); *idem* 15°10'29.6"S / 45°43'17.6"W, arm. Malaise, 28/VIII/2018, 1 male (LRRP#23116); *idem* 15°10'30.6"S / 45°43'16.6"W, arm. Malaise, 07/V/2019, 1 male (LRRP#23117); *idem* 15°10'31.7"S / 45°43'14.9"W, arm. Malaise, 21/V/2019, 1 male (LRRP#23118); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 23/IV/2019, 1 male (LRRP#23119); *idem* 15°10'30.6"S / 45°43'16.6"W, arm. Malaise, 17/VII/2018, 3 males (LRRP#23120-23122); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 28/VIII/2018, 2 males (LRRP#23132-23133); *idem* 15°10'32.0"S / 45°43'13.5"W, arm. Malaise, 23/X/2018, 1 male (LRRP#23137); *idem* 15°10'31.7"S / 45°43'14.9"W, arm. Malaise, 28/VIII/2018, 6 males (LRRP#23138-23143); *idem* 15°10'28.4"S / 45°43'18.5"W, arm. Malaise, 25/IX/2018, 10 males (LRRP#23144-23153); *idem* 15°10'30.6"S / 45°43'16.6"W, arm. Malaise, 31/VII/2018, 3 males (LRRP#23154-23156); *idem* 15°10'30.6"S / 45°43'16.6"W, arm. Malaise, 19/VI/2018, 2 males (LRRP#23157-23158). **Piauí (48):** "Brasil (PI) Caracol, \ Parq. Nac. Serra Confusões, \ Riacho dos Bois, 575 m, \ 09°13'11.9"S / 43°29'26.2"W" "CZMA \ Armadilha de Malaise, \ 05-07.vi.2015, J.A. Rafael, \ F. Limeira-de-Oliveira & \ A.A. Santos cols.", 2 males (CZMA); *idem* 15-31.vii.2013, J.A. Rafael, \ F. Limeira-de-Oliveira & \ T.T. Silva, cols., 3 males (CZMA); *idem* 01-10.ix.2014, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 1 male (CZMA); *idem* 15-30.vi.2013, J.A. Rafael, \ F. Limeira-de-Oliveira & \ T.T.A. Silva, cols., 2 males (CZMA); *idem* 20-30.ix.2013, J.A. Rafael, \ F. Limeira-de-Oliveira & \ T.T.A. Silva, cols., 1 male (CZMA); *idem* 01-10.vii.2014, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 2 males (CZMA); *idem* 10-20.vii.2014, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 8 males (CZMA); *idem* 10-20.vii.2014, J.A. Rafael, \ F. Limeira-de-Oliveira & T.T. \ Silva, cols., 2 males (CZMA); *idem* 11-20.vii.2013, J.A. Rafael, \ F. Limeira-de-Oliveira & \ T.T. Silva, cols., 1 male (CZMA); *idem* 10-20.vii.2013, J.A. Rafael, \ F. Limeira-de-Oliveira, \ T.L. Rocha & G.A. Reis, cols., 1 male (CZMA); "CZMA / Brasil (PI) Guaribas, \ Parq. Nacional Serra das \ Confusões, Andorinha, 515 m, \ 09°08'27.8"S / 43°33'42.1"W" \ Armadilha de Malaise, \ 01-10.ix.2014, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 6 males (CZMA); *idem* 01-10.ix.2013, J.A. Rafael, \ F. Limeira-de-Oliveira & \ T.T.A. Silva, cols., 1 male (CZMA); *idem* 15-31.vii.2013, J.A. Rafael, \ F. Limeira-de-Oliveira & \ T.T.A. Silva, cols., 1 male (CZMA); *idem* 07-15.vii.2013, J.A.

Rafael, \ F. Limeira-de-Oliveira & \ T.T.A. Silva, cols., 4 males (CZMA); *idem* 20-31.vii.2013, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 1 male (CZMA); *idem* 10-20.vii.2014, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 5 males (CZMA); *idem* 20-30.ix.2014, J.A. Rafael, \ F. Limeira-de-Oliveira, T.L. \ Rocha & G.A. Reis, cols., 6 males (CZMA); "CZMA / Brasil (PI) Piracurucu, \ P.N. de Sete cidades, \ Posto do ICMBio, 04°05'57"S / 41°42'34"W" CZMA \ Armadilha Malaise, \ 01-15.xii.2012, F. Limeira-de-Oliveira, J. \ S. Pinto Júnior cols.", 1 male (CZMA). **Maranhão (5):** "CZMA / Brasil (MA) Miradors (*sic*), \ Parq. Est. Mirador, \ Base Geraldina, 419 m, \ 06°37'25"S / 45°52'08"W" CZMA \ Armadilha Malaise, \ 01-13.viii.2013, F. Limeira \ -de-Oliveira, L.L.M. \ Santos & L.S. Santos", 1 male (CZMA); *idem* 01-13.viii.2013, F. Limeira \ -de-Oliveira, A.A. Santos & C.F. Barros, 1 male (CZMA); *idem*, Armadilha Suspensa, \ 13-19.viii.2012, F. Limeira \ -de-Oliveira, L.L.M. \ Santos & L.S. Santos, 1 male (CZMA); *idem*, Armadilha Luminosa, \ 13-19.viii.2012, L.L. \ M. Santos, J.S. Pinto \ Júnior & L.S. Santos, 1 male (CZMA); *idem* 15-31.viii.2014, F. Limeira \ -de-Oliveira, L.L.M. \ Santos & L.S. Santos, 1 male (CZMA). **Rio Grande do Norte (33):** "BRA, RN, Mossoró \ Campus da UFRS \ 05°11'S / 37°20'W \ Armadilha Malaise \ 04/I/2007 \ D.R.R. Fernandes e eq. cols.", 33 males (LRRP). **Bahia (65):** "Brazil, BA, Aracatu, Fazenda Lagoa do Tamburí, 14.4619°S, 41.4619°W, 22-23.xii.2012, A. Ferreira & M. França, armadilha luminosa", 10 males (UEFS); *idem* 21-22.xii.2012, 15 males (UEFS); *idem* 07-08.vi.2013, 12 males (UEFS); *idem* 08-09.v.2013, 10 males (UEFS); *idem* 11-12.vii.2013, 13 males (UEFS);

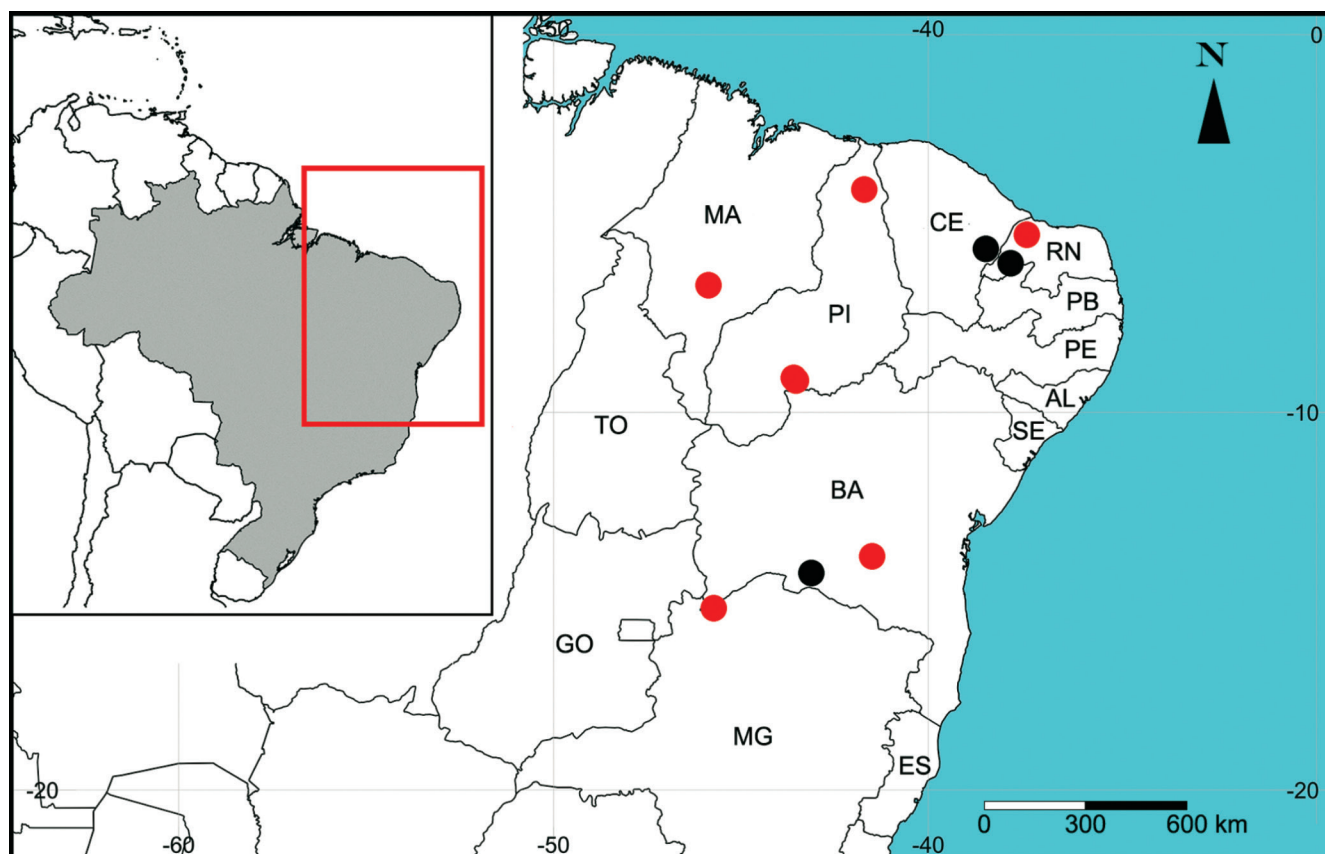
*idem* 10-11.v.2013, 8 males (UEFS); *idem* 12.vii.2013, 2 males (UEFS); *idem* 09-10.iii.2013, 2 males (UEFS); *idem* 12-13.iv.2013, 1 male (UEFS); *idem* 11-12.i.2013, 1 male (UEFS); *idem* 18-19.viii.2012, 1 male (UEFS); *idem* 08-09.iii.2013, 1 male (UEFS); *idem* 07-08.vi.2013, 1 male (UEFS).

## DISCUSSION

The PNGSV data, based on one year of sampling, indicate that the highest frequencies of *P. brasiliensis* occur in the dry season, with few specimens collected in the rainy season. This suggests a strong seasonality for this group or its possible hosts. These data support that *Plumarius* species have a preference for xeric environments (Quintero & Cambra, 2010; Brothers, 2011; Diez et al., 2012).

*Plumarius brasiliensis* can be recognized, among other characters, for presenting body yellowish to light brown; mandible with three teeth; malar space slightly shorter than width of scape; antenna with pedicel and flagellomeres with conspicuous erect bristles; wings hyaline, fore wing with m-cu arising directly in line with 2RS, (RS+M)b absent, veins 1M and 1cu-a separated by a short vein 1CUa and, aedeagus with lateral projections apically (Penteado-Dias & Scatolini, 2003).

*Plumarius brasiliensis* has been found previously in areas of Caatinga vegetation in the Brazilian states of Rio Grande do Norte and Ceará and Bahia (Penteado-Dias & Scatolini, 2003; Waichert et al., 2013; Fernandes, 2023) and, recently, in state of São Paulo (Melo & Dal Molin, 2024).



**Figure 4.** Geographic distribution of *Plumarius brasiliensis* Penteado-Dias & Scatolini, 2003 (Hymenoptera, Plumariidae) (red circles = new records, black circles = known records).

Our findings extend the geographical distribution of *P. brasiliensis* to states of Maranhão (Mirador municipality), Piauí (Caracol, Guaribas and Piracuruca) and Minas Gerais (Chapada Gaúcha) and for the municipalities of Mossoró (RN) and Palmas de Monte Alto (BA) (Fig. 4). The new distributional records in areas of Cerrado in the states of Minas Gerais and Maranhão and in a Caatinga/Cerrado ecotone in the state of Piauí represent a significant increase in the range of distribution of this species. It's reasonable to assume that *P. brasiliensis* populations could be spread across an area of about 2.8 million hectares, given that Cerrado and Caatinga's vegetation covers roughly 35% of the Brazilian territory.

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## REFERENCES

- Bradley, J.C. 1972. Notes on the distribution of the genus *Plumarius* (Hymenoptera, Plumariidae). *Entomological News*, 83(5): 135-139.
- Brothers, D.J. 1974. The genera of Plumariidae, with description of a new genus and species from Argentina (Hymenoptera: Bethyloidea). *Journal of Entomological Society of Southern Africa*, 37(2): 351-356.
- Brothers, D.J. 2006. Familia Plumariidae. In: Fernández, F. & Sharkey, M.J. (Eds.). *Introducción a los Hymenoptera de la región Neotropical*. Bogotá, Sociedad Colombiana de Entomología y Universidad Nacional de Colombia. p. 389-390.
- Brothers, D.J. 2011. A new late Cretaceous family of Hymenoptera, and phylogeny of the Plumariidae and Chrysoidea (Aculeata). *ZooKeys*, 130: 515-542. <https://doi.org/10.3897/zookeys.130.1591>.
- Climate-Data.org. 2023. *Clima, Chapada Gaúcha*. Available: <https://pt.climate-data.org/search/?q=chapada+ga%C3%BAcha>. Access: 10/08/2023.
- Day, M.C. 1977. A new genus of Plumariidae from southern Africa, with notes on Scolebythidae (Hymenoptera: Chrysoidea). *Cimbebasia (A)*, 4: 171-177.
- Diez, P.A. 2008. A new species of the genus *Plumaroides* Brothers (Hymenoptera, Chrysoidea, Plumariidae) from Santiago del Estero, Argentina: male and female descriptions. *Zootaxa*, 1891: 25-30. <https://doi.org/10.11646/zootaxa.1891.1.2>.
- Diez, P.A. & Roig-Alsina, A. 2008. A new species of the genus *Plumaroides* Brothers (Hymenoptera: Chrysoidea, Plumariidae) from Argentina. *Zootaxa*, 1676: 45-50. <https://doi.org/10.11646/zootaxa.1676.1.4>.
- Diez, P.A. & Roig-Alsina, A. 2016. Revision of *Plumarius* Philippi 1873 (Hymenoptera: Chrysoidea, Plumariidae) from Argentina north of Patagonia, with description of eighteen new species. *Zootaxa*, 4098(3): 442-470. <https://doi.org/10.11646/zootaxa.4098.3.2>.
- Diez, P.A.; Fidalgo, P. & Roig-Alsina, A. 2007. A new genus and species of Plumariidae (Hymenoptera, Chrysoidea) from western xeric Argentina. *Zootaxa*, 1467: 35-41. <https://doi.org/10.11646/zootaxa.1467.1.3>.
- Diez, P.A.; Fidalgo, P. & Roig-Alsina, A. 2012. Systematics of the South American genus *Plumarius* Philippi, 1873, with descriptions of new species (Hymenoptera, Plumariidae). *Zoosystema*, 34(3): 635-650. <https://doi.org/10.5252/z2012n3a6>.
- Diez, P.A.; Fidalgo, P. & Roig-Alsina, A. 2013. Revision of the ocellatus species-group of the genus *Plumarius* Philippi 1873 (Hymenoptera, Chrysoidea, Plumariidae), with description of three new species from Argentina. *Zootaxa*, 3721(1): 85-91. <https://doi.org/10.11646/zootaxa.3721.1.5>.
- Evans, H.E. 1966. Discovery of the female *Plumarius* (Hymenoptera, Plumariidae). *Psyche*, 73(4): 229-237. <https://doi.org/10.1155/1966/31937>.
- Fernandes, D.R.R. 2023. Plumariidae In: Catálogo Taxonômico da Fauna do Brasil. PNUD. Available: <http://fauna.ibjr.gov.br/fauna/faunadobrasil/6361>. Access: 29/11/2023.
- Finnamore, A.T. & Brothers, D.J. 1993. Superfamily Chrysoidea. In: Goulet, H. & Huber, T.J. (Eds.). *Hymenoptera of the world: an identification guide to families*. Ottawa, Agriculture Canada. p. 130-160.
- Gauld, I.D. 2006. Familia Plumariidae. *Memoirs of the American Entomological Institute*, Gainesville, 77: 529-530.
- Hanson, P.E. & Gauld, I.D. 1995. The chrysoideid families. In: Hanson, P.E. & Gauld, I.D. (Eds.). *The Hymenoptera of Costa Rica*. Oxford, Oxford University Press. p. 464-503. <https://doi.org/10.1093/oso/9780198549055.003.0013>.
- Melo, G.A.R. & Dal Molin, A. 2024. Hymenoptera Linnaeus, 1758. In: Rafael, J.A.; Melo, G.A.R.; Carvalho, C.J.B.; Casari, S.A. & Constantino, R. (Eds.). *Insetos do Brasil: diversidade e taxonomia*. Manaus, Editora INPA. p. 484-545. <https://doi.org/10.61818/56330464c27>.
- Nagy, C.G. 1973. Revisionary studies on the family Plumariidae Bischoff (Hymenoptera, Heterogynoidea). *Folia Entomologica Hungarica (Series nova)*, 26(Suppl.): 255-267.
- Papp, J. 2000. *Plumarius tumidulus* sp. n. from Argentina (Hymenoptera: Plumariidae). *Folia Entomologica Hungarica*, 61: 157-160.
- Penteado-Dias, A.M. & Scatolini, D. 2003. A new species of the genus *Plumarius* Philippi (Hymenoptera: Plumariidae) from Brasil. *Zoologische Mededelingen*, 77(33): 545-550.
- Perez D'Angello, V. 1974. *Plumarius coquimbo* n. sp. y primer registro de la hembra de *Plumarius* para Chile (Hymenoptera: Plumariidae). *Revista Chilena de Entomología*, 8: 139.
- Pérez-Benavides, A.L.; Ospina-Peñuela, E.; Gamboa, J. & Duran-Bautista, E.H. 2023. Amyl acetate: an alternative technique to dry mount Chalcidoidea (Hymenoptera) from alcohol, faster and inexpensively. *Journal of Insect Science*, 23(2): 1-6. <https://doi.org/10.1093/jisesa/iead010>.
- Philippi, R.A. 1873. Chilenische Insekten. *Stettiner Entomologische Zeitung*, 34: 296-316.
- Quintero, A.D & Cambra, T.R. 2010. First records of Plumariidae (Hymenoptera) from Paraguay and comments on the females of *Plumaroides tiphilus* Diez and *Plumarius coquimbo* Perez D'Angello. *Entomological News*, 121: 41-44. <https://doi.org/10.3157/021.121.0108>.
- Shorthouse, D.P. 2010. *SimpleMappr, an online tool to produce publication-quality point maps*. Available: <https://www.simplemappr.net>. Access: 15/12/2023.
- Townes, H.A. 1972. A light-weight Malaise trap. *Entomological News*, 83: 239-247.
- Waichert, C.; Azevedo, C.O.; Ferreira, R.B. & Williams, K.A. 2013. Range extension of *Plumarius brasiliensis* Penteado-Dias and Scatolini, 2003 (Hymenoptera: Plumariidae) in Northeastern Brazil. *Check List*, 9(3): 626-627. <https://doi.org/10.15560/9.3.626>.