

## Scientific Note

# New distributional records and natural history data of *Vates phoenix* Rivera et al., 2020 (Mantodea: Mantidae)

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**Abstract.** *Vates phoenix* Rivera et al., 2020 (Mantodea: Mantidae) is endemic to the Atlantic Rainforest of Brazil, known to the states of Rio de Janeiro and São Paulo. Integrating field collection and records from iNaturalist, the species' distribution is extended further south, west and north, with confirmed new occurrences to the states of Paraná, Santa Catarina, Minas Gerais, Espírito Santo, and Bahia. The observations provide insights into the species' natural history and the importance of combining multiple data sources, including citizen science, to provide greater information on elusive species.

**Keywords:** praying mantis, iNaturalist, Vatini, citizen science.

The order Mantodea Latreille, 1802 comprises around 2494 species of hemimetabolous insects popularly known as praying mantises (Wieland & Svenson 2018). All known species are obligatory predators, presenting morphological and behavioral adaptations for preying, such as the first pair of raptorial legs (Oufiero 2020), stereopsis vision (Nityananda et al. 2018), and cryptic strategies (Svenson & Whiting 2009).

In the Neotropical region the group is represented by over 470 species (Agudelo et al. 2007). Due to their low population density, conspicuous camouflage, little-known habits for most species, and lack of a single ideal trap to collect specimens across their diversity of species and life phases, praying mantises are difficult to sample in large quantities (Rafael et al. 2024).

Moreover, a complex historical taxonomy hampers researchers' interest in studying the group in the Neotropics, even though interest has grown in the past decades (Rivera 2010). The first proposed phylogeny based on molecular data (Svenson & Whiting 2004) revealed that few taxonomic groups of Mantodea are monophyletic.

Brazil is home to the greatest diversity of praying mantises in the world, with records of 230 species (Agudelo & Ferraz 2024), 11 families, and estimates that the country's true diversity reaches up to 1,000 species (Agudelo & Ferraz 2024; Rafael et al. 2024).

The Atlantic Rainforest is the second largest on the country, with more than eight thousand endemic species, and considered as a hotspot of biodiversity (Myers et al. 2000). The diversity of praying mantises in the biome is high, with around 48 species from all families found in the country (Agudelo & Ferraz 2024).

The tribe Vatini Stål, 1877 comprises medium to large insects that display disruptive camouflage with homochromy through striped patterns in coloration and disruptive structures such as foliaceous lobes on the legs and ocellar processes (Svenson et al. 2016). Little information is known on the group's biology and distribution.

The genus *Vates* Burmeister, 1838 (Mantodea: Mantidae) is the second most diverse within the Vatini tribe. Species of this genus can be distinguished from other Vatini by i) pectinate antennae in males, ii) thoracic tibia with two median lobes, iii) divergent conical ocellar projections and iv) male genitalia with posterior process of the left ventral sclerite acuminate (Svenson et al. 2016). Males (and less often, females) tend to be collected through light traps (Dantas et al. 2008).

The rarity of nymphs, oothecae and adult individuals in active search methods leads to the speculation that many species must inhabit the forest canopy (LML, pers. obs.).

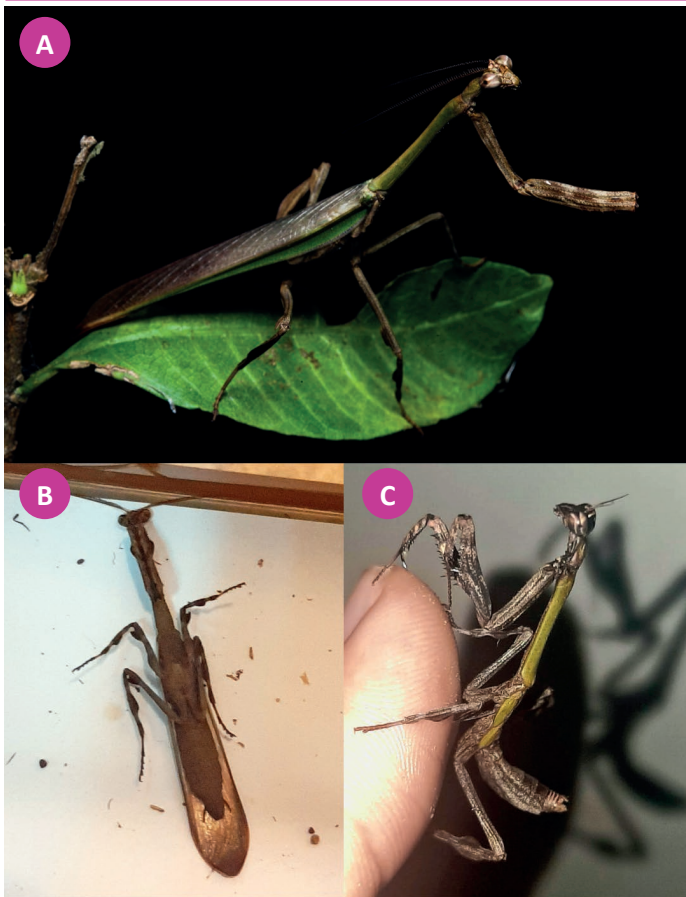
*Vates phoenix* Rivera et al., 2020 (Mantodea: Mantidae) (Fig. 1A) is an endemic species of the Atlantic Rainforest described for the states of Rio de Janeiro and São Paulo (Rivera et al. 2020).

The Atlantic Rainforest is the second largest on the country, with more than eight thousand endemic species of vascular plants, amphibians, reptiles, birds and mammals (Myers et al. 2000).

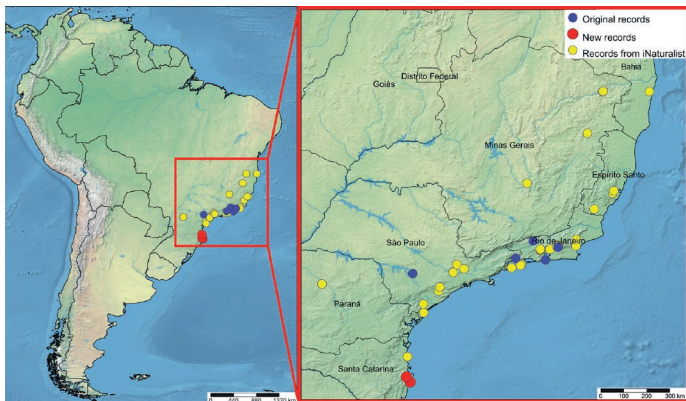
Through field collection by active search on November 5<sup>th</sup>, 2022, a male adult of *V. phoenix* was found in a swampy region at Lagoa do Peri Municipal Park (27°43'45.0"S, 48°30'36.5"W), Florianópolis, Santa Catarina (SC), Brazil, between 21h and 21h30min. The individual was perched on the abaxial portion of the leaf, approximately two meters high, with its head towards the tree trunk. The individual was collected and reared in the laboratory. It lived 26 days, and died with no signs of injuries. It was fed with arthropods found on green patches in urban areas such as flies, katydids, grasshoppers, wild cockroaches, and moths, which it accepted promptly. When disturbed by touch, the male performed a thanatosis behaviour, dropping from its perch and remaining motionless until touched again (Fig. 1B). To our knowledge, this is the first time thanatosis behaviour is recorded in Vatini, showing the lack of natural history information about these insects. After death, the genitalia was extracted and clarified following Brannoch et al. 2017, and the specimen was mounted and deposited in the Mítia Heusi Silveira Entomological Collection (CE-MHS).

On August 11, 2023, a female nymph of the species (Fig. 1C) was found during the morning in a country house in Biguaçu (SC), Brazil (27°25'23.88"S, 48°45'46.39"W). The nymph was perched on a wooden pillar at approximately seven meters high. The individual was collected and reared, but did not survive to adulthood. After death, the specimen was mounted and deposited at CE-MHS.

The morphology of both specimens, including male's genitalia, was congruent with *V. phoenix* description. The conspicuous and unique leg lobes of the species among the genus, combined with other diagnostic characters, allows its clear identification on adult stages and later stages of nymphal development. Previously described for the states of Rio de Janeiro and São Paulo, the finding expands the species' known distribution further South (Fig. 2).



**Figure 1.** Live specimens of *Vates phoenix*. **A.** Adult male from Rio de Janeiro. **B.** Adult male from Santa Catarina in thanatosis. **C.** Female nymph from Santa Catarina.



**Figure 2.** *Vates phoenix* distribution in Brazil, integrating records from original description, new field collections and iNaturalist database.

The platform iNaturalist was used as a tool to better understand *V. phoenix* distribution and provide more insights into its natural history. iNaturalist is a citizen science application and database that allows users to upload and share photographs and sounds of organisms, add the location, date, time, and notes of the recorded organism (Nugent 2018). When an organism is registered in the application, users can suggest identifications. When an observation has consensus from at least 2/3 of the community, with a location, date, and precise identification, the record is automatically deposited on the GBIF platform and marked as "research grade". The application has been used for biodiversity studies of several clades (Di Cecco 2021) and "research grade" identifications have an accuracy of 95% (Loarie 2024).

Online records for *Vates* and *V. phoenix* registered on the platform until January 2024 were analyzed and the research grade level records of the species were organized in a spreadsheet, available in the Supplementary Material.

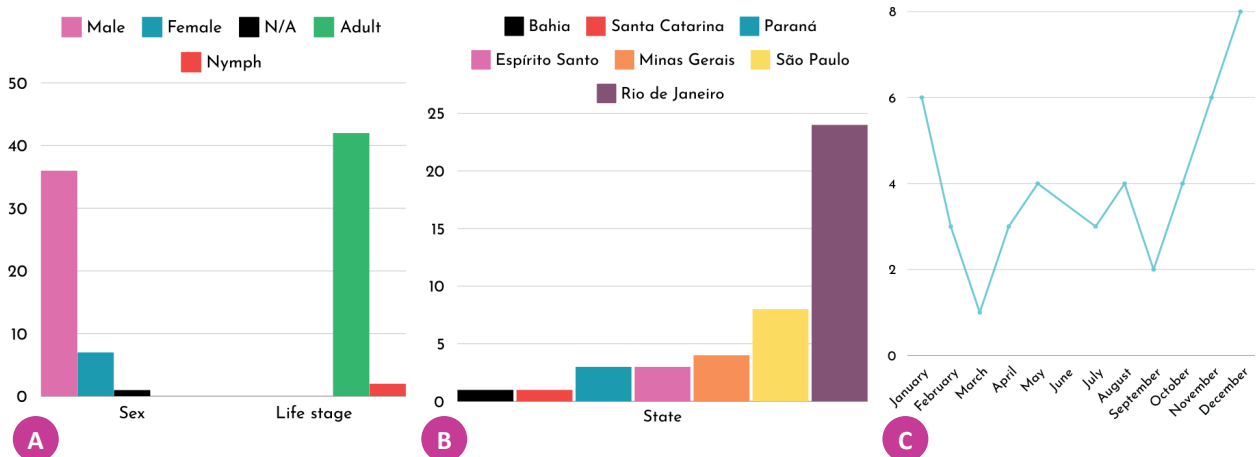
A total of 44 records of *V. phoenix* were confirmed on iNaturalist. The records reveal new occurrences in the Northeast and Southeast regions, in the states of Espírito Santo, Minas Gerais, Paraná, Santa Catarina, and Bahia (Fig. 3B).

The months with the highest number of records on iNaturalist were December (eight records) and January (six records), suggesting summer as the peak season for the species, although it can be found throughout the year (Fig. 3C). Summer is the holiday season in Brazil, so the high number of observations could be due to more users engaged in outdoor activities.

The species has records in seven adjacent states: 24 in Rio de Janeiro, seven in São Paulo, four in Minas Gerais, three in Paraná, two in Espírito Santo, one in Santa Catarina and one in Bahia (Fig. 3B). The city Cachoeiras de Macacu had the highest number of records, with 9 records.

Of the organisms recorded, 42 of the 44 were adults, and only two were nymphs. The records represent 36 males, and seven females (Fig. 3A). The observations support the hypothesis of a canopy dwelling species, in which nymphs and adult females, which are not attracted to lights, are seldom spotted while males are frequently lured by lights (LML, pers. obs.). 22 out of the 36 adult male observations at iNaturalist are individuals in artificial environments, probably lured by lights to the place. One of the nymphs did not have its sex identified due to poor quality on the photo. This record (<https://www.inaturalist.org/observations/31227695>) shows structures growing from the dead body that appear to indicate infection from a fungal parasite similar to *Ophiocordyceps* Petch (1931). However, the quality of the photo makes it difficult to identify the structure.

Although there are several challenges on using online photographs as data for research in citizen science projects (Campos et al. 2023), iNaturalist has already proven to be effective for biodiversity studies (e.g., Rosa et al. 2022; Yu et al 2022). In the order Mantodea, iNaturalist has been used to study the distribution and life cycle of *Sphodromantis gastrica* Stål, 1858 (Mantodea: Mantidae) (Greyvenstein 2022), to monitor invasive species of praying mantises (Sevgili & Yılmaz 2022),



**Figure 3.** iNaturalist records in graphics. **A.** Records of *Vates phoenix* by sex and life stage. **B.** Records of *V. phoenix* by state. **C.** Records of *V. phoenix* by month showing its occurrence throughout the year.

and to study the distribution of *Choeradodis rhombicollis* (Latreille, 1833) (Mantodea: Mantidae) in Mexico (de Luna et al. 2024). These and several works show that iNaturalist is a powerful tool for science if used correctly. In the case of *V. phoenix*, combining data from the original description, the new samples and iNaturalist, it was possible to draw a much deeper panorama of its life history and distribution.

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## Authors' Contributions

GAPG: Writing - original draft, Data curation, Investigation and Methodology. LML: Writing - review & editing, Supervision, Methodology and Project administration. LCP: Writing - review & editing, and Resources.

## Conflict of Interest Statement

The authors declare no potential conflict of interest.

## Supplementary Material

Supplemental data for this article can be accessed data doi: [10.6084/m9.figshare.26322154.v1](https://doi.org/10.6084/m9.figshare.26322154.v1)

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