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**A New Distribution Record for the Brazilian Pantanal and a Predictive Niche Model of *Ammophila hevans* Menke 2004 (Hymenoptera: Sphecidae)**

Author: Rodrigo Aranda

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# A NEW DISTRIBUTION RECORD FOR THE BRAZILIAN PANTANAL AND A PREDICTIVE NICHE MODEL OF *AMMOPHILA HEVANS* MENKE 2004 (HYMENOPTERA: SPHECIDAE)<sup>1</sup>

Rodrigo Aranda<sup>2,3</sup>

**ABSTRACT:** This is the first report for the Pantanal of *Ammophila hevans* Menke 2004. The species was recorded with the sample of one female in a natural floodplain area and the predictive niche model provides the major expected areas of occurrence, predicting that the warmest and driest regions fit the model.

**KEY WORDS:** Ammophilinae, Caterpillar-hunter wasp, Ecological niche, Thread-waisted Wasp, Wetland

## INTRODUCTION

*Ammophila* (Sphecidae: Ammophilinae) is a cosmopolitan sand wasp genus with more than 200 species (Bohart and Menke, 1976), mostly occurring in warmer regions. These are hunting solitary wasps that provision their nests with caterpillars in most cases (Gonzales, 2006). In the Neotropical Region, nine species are recognized including *Ammophila hevans* (Menke, 2004). *A. hevans* was described by Menke (2004) for Argentina, Bolivia and Paraguay from Chacoan and Rondonian biogeographic provinces (Menke, 2004) and recently was reported from Brazil for the first time (Trad et al., 2016) in the south of Mato Grosso do Sul state, in a transitional area of Cerrado province. The species showed unique characteristics: thorax without erect setae; meso and metapleuron with well-defined bands of appressed silver setae along metapleural suture and metapleural sulcus, rest of meso and metapleura asetose; thorax often with extensive reddish areas, extensively red legs (Menke, 2004). Except for the type material used in the description, it is infrequent in surveys. This paper provides a range extension and first record of *Ammophila hevans* from the Brazilian Pantanal and presents a niche distribution model for the species.

## METHODS

The Pantanal is one of the largest flood plains in the world and presents two distinct periods, flood and dry. The flood period is characterized by the entrance, permanence and exit of the waters in the floodplain. This process in the region lasts approximately 4 months. The drought period is characterized by the absence

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<sup>2</sup> Universidade Federal de Mato Grosso do Sul, Curso de Ciências Biológicas, CEP 79200-000, Aquidauana, MS, Brazil.

<sup>3</sup> Laboratório de Ecologia de Comunidade de Insetos, Universidade Federal de Mato Grosso, Departamento de Ciências Biológicas, Rondonópolis, MT, Brazil. E-mail: rodrigoaranda.biologo@gmail.com

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of waters on the plain, except for temporary and permanent lagoons that form in the depressions. The region is characterized by flooded fields and “capões”. Usually, capões are elongated or rounded patches of herbaceous and arboreal vegetation found in flooded fields (Nunes da Cunha et al., 2007; Pott et al., 2011). During the flooding season, capões remain isolated due to water in the surrounding flooded fields. The natural fields are dominated by native grasses and in flood season remain under water up to 60 cm deep in conventional flooding periods.

One female specimen of *Ammophila hevans* was collected (Fig. 1), using an entomological net, in a livestock farm located in the municipality of Corumbá,

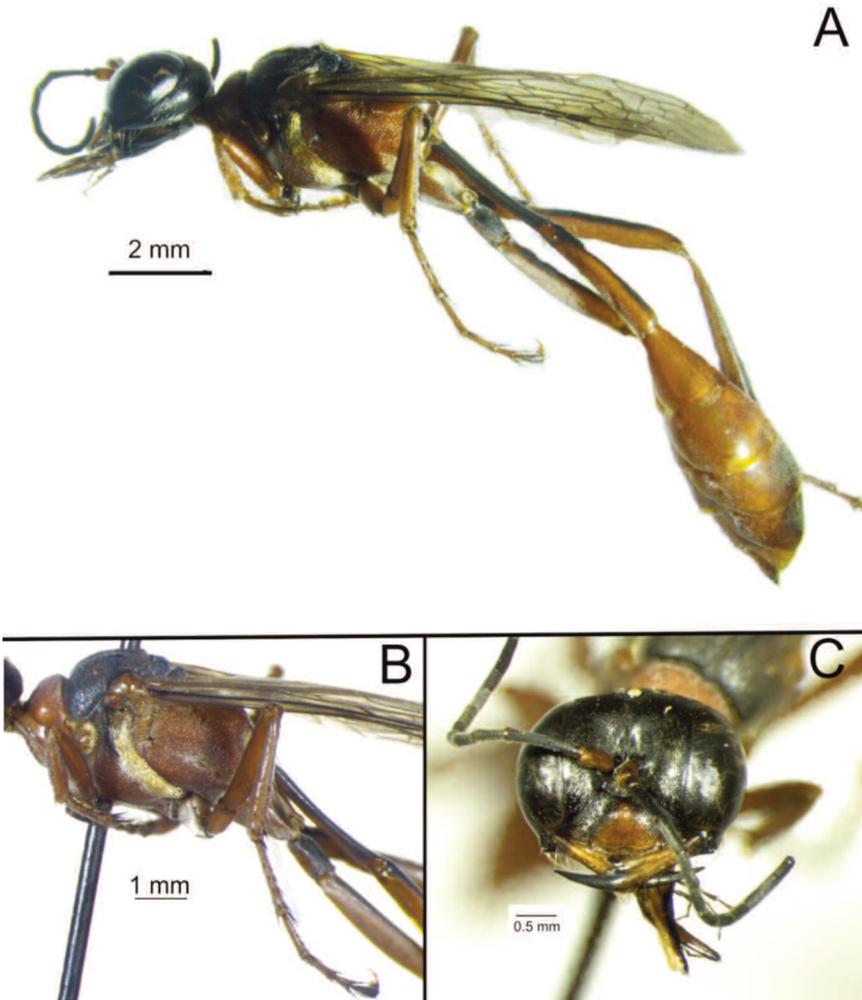


Fig. 1. *Ammophila hevans* Menke, 2004 ♀. Lateral habitus (A), Pronoto evidence bands of silver setae (B), and head details (C).

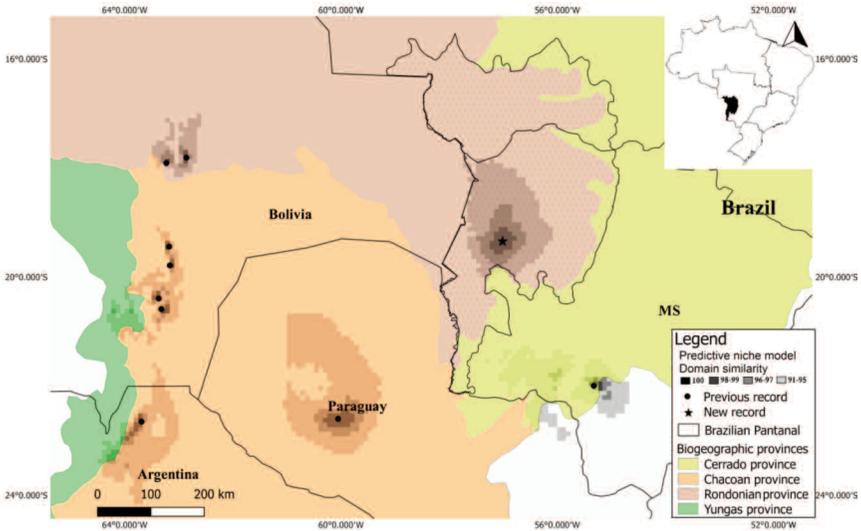


Fig. 2. Previous and new record from Brazilian Pantanal and potential niche model of *Ammophila hevans* (Hymenoptera: Sphecidae). From black to light gray indicating a greater chance of occurrence.

Mato Grosso do Sul (19°20'56"S, 057°00'60"W, 90 meters above sea level (a.s.l.)) between 19/01/2016 and 22/01/2016 (Fig. 2). The voucher specimen was deposited in the Coleção Zoológica of the Universidade Federal de Mato Grosso do Sul (ZUFMS), Campo Grande, Brazil under voucher number ZUFMSHYM 343. This work was carried out under collection authorization permission from MMA and ICMBio (n: 48939-3 issued in 11/05/2015).

The niche modeling was generated with software DIVA-GIS (version 7.5.0.0; Hijmans et al., 2012) using the geographic coordinates of the previous and the new record with a bioclimatic model using 19 bioclimatic variables (Table 1) from the worldclim database (<http://worldclim.org/>), using the algorithmic model Domain (Carpenter et al., 1993) with a spatial resolution of 2.5 minutes of arc (~5 km<sup>2</sup>) for generating the predictive niche. The Domain procedure calculates the Gower distance statistic between each point based on the similarity of bioclimatic variables. In DIVA, the Domain value that is a good match is a high number (e.g. above 95; Hijmans et al., 2012). To validate the performance of the niche model, the area was calculated under the receiver operating characteristic (ROC) curve. The ROC curve is created by plotting the true-positive fraction against the false-positive fraction for all test points across all possible probability (Fielding and Bell, 1997). One hundred percent of the record points were used to fit the model with 50 repetitions.

## RESULTS AND DISCUSSION

In Brazil, this record expands the known distribution of *A. hevens* 350 km north from Dourados municipality (429m a.s.l.), a transitional Cerrado/Parana forest province where the species was first recorded, and from Rondonian province (Bolivia) expanding 670 km east. In Pantanal the species is recorded at the lowest known altitude, 90 meters a.s.l. In Rondonian province (Bolivia), the same biogeographical formation as Pantanal, it was reported in a gradient between 290-350 meters a.s.l. From Chacoan province the altitude ranged from 102 (Paraguay) to 130 (Argentina) meters a.s.l. at low altitudes and 750-990 meters a.s.l. in Chacoan province in Bolivian range mountains.

Table 1. Range and frequency of records in bioclimatic variables used to predict niche modeling of *Ammophila hevens* Menke, 2004.

Bioclimatic variables	Range		Frequency
			(%)
1 Annual mean temperature (°C)	21.8	23.4	60
2 Mean monthly temperature range (°C)	12.9	13.5	50
3 Isothermality ((2/7)*100)	61.1	64.2	40
4 Temperature seasonality (STD *100)	223.5	262.6	40
5 Max temperature of warmest month (°C)	31.5	33.9	80
6 Min temperature of coldest month (°C)	9	13.7	70
7 Temperature annual range [5-6] (°C)	16.5	24.9	90
8 Mean temperature of wettest quarter (°C)	24.7	26.3	60
9 Mean temperature of driest quarter (°C)	19.2	20.4	60
10 Mean temperature of warmest quarter (°C)	25.1	27.3	80
11 Mean temperature of coldest quarter (°C)	16.9	20.4	70
12 Annual precipitation (mm)	672	966	70
13 Precipitation of wettest month (mm)	119	188	80
14 Precipitation of driest month (mm)	4	12.4	60
15 Precipitation seasonality	78	88	50
16 Precipitation of wettest quarter (mm)	321	533	90
17 Precipitation of driest quarter (mm)	18	46.8	50
18 Precipitation of warmest quarter (mm)	419	520	60
19 Precipitation of coldest quarter (mm)	19	52	50

According to the predictive niche model, in spite of the greater number of individuals collected from the mountain range in Bolivia (27 females, 11 males; Menke, 2004) the largest areas with better chances of finding the species are in the Paraguayan Chacoan province and in the Brazilian Pantanal (both with only

one individual collected). This difference in the amount of material is associated with the greater sampling effort in Bolivia, as mentioned by Menke (2004) who received the large collection primarily using Malaise traps from the area. The areas with the greatest probabilities and even the “gaps” between the extreme points of the distribution are associated with the lack of inventory and monitoring. The evaluation of the model using AUC indicates that the model can discriminate perfectly the true/false possibility of discrimination niche condition (AUC = 1). The model is preliminary and speculative until it is tested by actual sampling to reveal *A. hevans* presence.

The principal climatic variables responsible for niche model were: annual Temperature range and Precipitation of wettest quarter with 90% of records; Max. temperature of warmest month and Mean temperature of warmest quarter with 80% of records; and Mean temperature of coldest quarter, and Annual precipitation and Min. temperature of coldest month with 70% of records (Table 1). The set of these variables and others on a smaller scale describe sites with high temperature, low precipitation and consequently more open plant community, the typical environment used by many *Ammophila* spp.

As reinforced by Trad et al. (2016), the presence of *A. hevans* in a biotic transitional area has fundamental importance for elucidating the evolutionary history of the group, and the report of this species in Brazilian Pantanal and the potential niche model help to understand the aspects of biology, also providing additional information to trace the biogeographic profile of the constituent elements of the wasp fauna in the Pantanal, which still requires greater sampling effort to describe the insect fauna in general. Understanding habitat occupation by native wildlife species is a rapid method to predict conservation status and makes up the basic requirements for management, once the Pantanal is considered a priority area for conservation (Harris et al., 2005; Junk et al., 2006).

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