

Mammalia, Chiroptera, Phyllostomidae, *Mimon crenulatum* (Geoffroy St.-Hilaire, 1803): First Record for the Cerrado Biome in the State of Mato Grosso, Brazil

Sérgio Lopes de Oliveira ^{1*}, Joaquim Manoel da Silva ², Ricardo Firmino de Sousa ², Karina de Cassia Faria ^{1,2}

¹ Universidade do Estado de Mato Grosso, Programa de Pós-Graduação em Ecologia e Conservação. BR 158, Km 148. CEP 78690-000. Nova Xavantina, MT, Brazil.

² Universidade do Estado de Mato Grosso, Departamento de Ciências Biológicas. BR 158, Km 148. CEP 78690-000. Nova Xavantina, MT, Brazil.

* Corresponding author. E-mail: sergiobiolopes@gmail.com

ABSTRACT: Two male individuals of *Mimon crenulatum* were captured in the Mario Viana Municipal Park, at Nova Xavantina, eastern Mato Grosso, Brazil. This record expands the species' distribution in West-Central Brazil, and represents the first record for the Cerrado of Mato Grosso. The specimens' morphometric data are presented and compared with those of specimens found in other biomes. Two predictive geographic distribution models were generated, indicating the expansion of the potential distribution of the species.

The genus *Mimon* (Gray, 1847) includes four species, two of which are present in Brazil: *Mimon bennettii* (Gray, 1838) and *Mimon crenulatum* (Geoffroy St.-Hilaire, 1803) (Williams and Genoways 2008). *M. crenulatum* is considered a medium-sized bat when compared with species of the other taxa in the same family (Peracchi *et al.* 2010). This species feeds mainly on insects, specifically Coleoptera, but may also eat small vertebrates, pollen, and nectar, in lower quantities (Giannini and Kalko 2005; Nogueira *et al.* 2007; Peracchi *et al.* 2011).

Mimon crenulatum is a widely distributed species, occurring from Mexico to Bolivia, including Venezuela, Trinidad, Guianas, Ecuador, Peru and Brazil (Simmons 2005; Williams and Genoways 2008). In Brazil, *M. crenulatum* has been recorded from the states of Amapá (Martins *et al.* 2006: 2°11'36" S, 54°35'15" W; 1°36'5" S, 52°29'25" W; 1°17'1" S, 51°35'19" W), Amazonas (Reis and Shubart 1979; Reis and Peracchi 1987; Sampaio *et al.* 2003: 2°25'0" S, 59°45'0" W; Bernard *et al.* 2011), Ceará (Gurgel Filho *et al.* 2009: 6°27'17" S, 40°38'46" W), Espírito Santo (Peracchi and Albuquerque 1993: 19°25'0" S, 40°3'0" W), Mato Grosso (Pine *et al.* 1970: 12°49'0" S, 51°49'0" W; Williams and Genoways 2008: 16°4'16" S, 57°40'44" W; Silva and Marques 2010: 16°15'0" S, 56°22'0" W), Mato Grosso do Sul (Camargo and Fischer 2005: 19°33'3" S, 56°12'43" W), Minas Gerais (Mares *et al.* 1989: 18°21'0" S, 45°19'0" W; Pedro and Taddei 1998: 18°40'0" S, 48°0'0" W; Stutz *et al.* 2004: 18°55'0" S, 48°17'0" W; Tavares *et al.* 2010: 17°2'0" S, 45°50'0" W; 19°44'0" S, 41°49'0" W), Pará (Mok *et al.* 1982; Bernard 2001: 2°24'52" S, 54°42'36" W), Pernambuco (Willig 1983: 7°30'0" S, 39°44'0" W) and Rio de Janeiro (Brito *et al.* 2004; Mello and Pol 2006: 22°30'0" S, 42°15'0" W). In the state of Mato Grosso, *M. crenulatum* has been recorded from three localities: two in the Pantanal Biome (Williams and Genoways 2008; Silva and Marques 2010) and one in Amazonia (Pine *et al.* 1970). In the Cerrado Biome, there are three records of *M.*

crenulatum in the southeastern portion of the country, in the state of Minas Gerais (Pedro and Taddei 1998; Stutz *et al.* 2004; Tavares *et al.* 2010) (Figure 1).

Two male individuals of *Mimon crenulatum* (Figure 2) were captured on 9 October 2010, around 20:00 h, in a gallery forest inside Mario Viana Municipal Park, at Nova Xavantina, eastern Mato Grosso (14°43'10.8" S, 52°21'35.4" W). This is the first record of the species for the Cerrado biome from the state of Mato Grosso (Figure 1).

Precipitation in the month of the capture was 152 mm, and temperature varied between 22.1°C and 36.5°C (Nova Xavantina Weather Station). Captures were made using mist nets of 12 x 2.5 m, placed across possible flight paths at sunset and removed after six hours of sampling effort per night. The specimens captured were measured, weighed and identified according to the key proposed by Vizzoto and Taddei (1973), Lim and Engstrom (2000) and Williams and Genoways (2008). Subsequently they were fixed in formaldehyde (10%), preserved in alcohol (70%), and deposited in the scientific collection of the Universidade do Estado do Mato Grosso (UNEMAT), campus of Nova Xavantina, under numbers RM 165 and RM 166. Selected measurements of our specimens and others are presented in Table 1: forearm (FA), ear length (EarL), greatest length of skull (GLS), basal length (BL), condylobasal length (CbL), condylar canine length (CCL), zygomatic breadth (ZB), length of maxillary tooththrow (LMaxT), greatest of length mandible (GLM), and length of mandibular tooththrow (LMantT).

Although *Mimon crenulatum* has been reported in different habitats, it is most frequently found near water courses (Mello and Pol 2006). Our captures also follow this pattern, since the specimens were collected near the Córrego do Bacaba, located in the municipal park. The municipal park has been sampled before, but there has never been any record of *M. crenulatum*. This suggests that

the captures reported here took place at foraging rather than roosting areas, since the species' activities may extend for up to one kilometer from the latter, as observed by Mello and Pol (2006).

The *Mimon crenulatum* specimens present typical characteristics of the taxon, such as dorsal stripe and nose leaf with pilose crenulated edges, as well as the dental formula described for the species (Nogueira et al. 2007; Williams and Genoways 2008). With regard to the morphometric pattern, the Mato Grosso Cerrado specimens' follows between the range of measurements described from specimens from other biomes described in literature (Table 1). There are no measurement data available in literature concerning the only three individuals previously captured in Mato Grosso state (Pine et al. 1970;

Williams and Genoways 2008; Silva and Marques 2010); therefore, it is not possible to make a comparison between specimens from different biomes inside the same state.

Although the species has already been captured in the state of Mato Grosso, the records are about 220 km and 460 km away from the record of this work, respectively in Amazonia (Pine et al. 1970) and Pantanal (Silva and Marques 2010). Inside the Cerrado, the four known records are in the state of Minas Gerais, the nearest being approximately 630 km away from our record (Stutz et al. 2004).

Two predictive distribution models using MaxEnt (Phillips et al. 2006) were generated, one with the 18 records previously described in the literature (model 1) and another with those 18 records together with our record

TABLE 1. Select measurements of *Mimon crenulatum* from four biomes. Asterisks indicate studies for which average measurements were included. Present study¹, Willig 1983², Gurgel Filho et al. 2009³, Camargo and Fischer 2005⁴, Mello and Pol 2006⁵.

Measurements (mm)	Cerrado ¹ *	Caatinga ²	Caatinga ³	Pantanal ⁴	Mata Atlântica ^{5*}
FA	46.11	45.87	45.1	48	52.2
EarL	24.9	26.25	21.5	-	-
GLS	20.4	20.01	20.7	22.8	23.6
BL	16.1	-	-	-	-
CbL	19.6	17.81	18.3	20.3	21.2
CCL	18.6	-	-	-	-
ZB	11.1	11.49	11.3	12.5	13.1
LmaxT	7.4	7.14	7.3	7.9	8.5
GLM	12.14	12.93	-	-	-
LmanT	8.2	7.8	-	8.8	9.3
Weight(g)	8.8	11.5	-	15	18

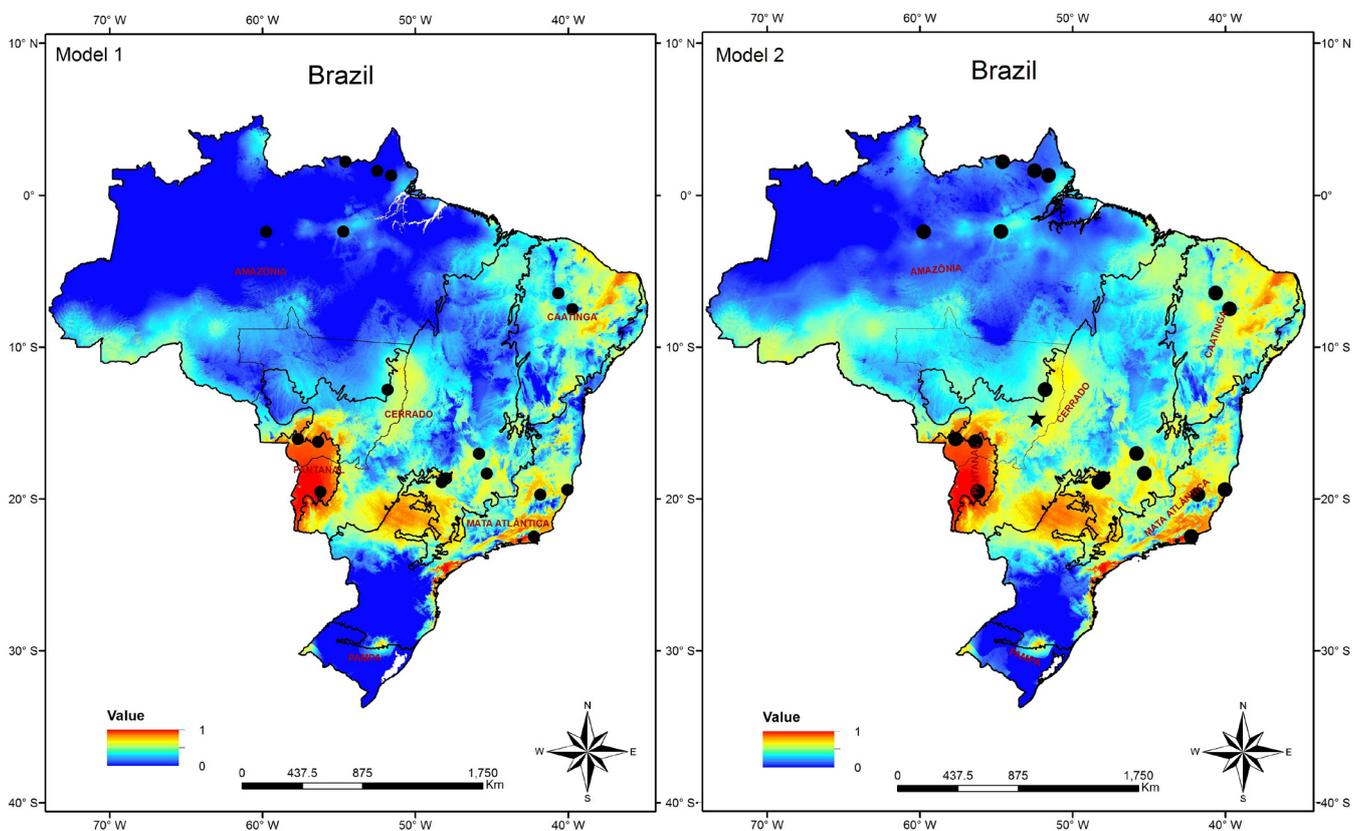


FIGURE 1. Geographic distribution of *Mimon crenulatum* in Brazilian biomes. Model 1 represents *M. crenulatum* potential distribution based on previous records from literature. Model 2 represents the species potential distribution based on previous records combined with the new record for the Cerrado Biome. The color gradient represents the species presence probability: colors closer to blue indicate absence, and colors closer to red indicate presence. The points represent previous records and the star represents the new record for the Cerrado Biome in the state of Mato Grosso (14°43'10.8" S, 52°21'35.4" W).

(model 2) (Figure 1). MaxEnt is a machine learning method that estimates a species' distribution across a study area by calculating the probability distribution of maximum entropy subject to the constraint that the expected value of each feature under this estimated distribution should match its empirical average (Phillips *et al.* 2006).

Nineteen bioclimatic variables were used as environmental variables, at a resolution of 30 seconds per pixel (from WorldClim, Hijmans *et al.* 2005). Eight replications of each model were run using jackknife, separating 30 % of the occurrences in a test set for evaluation purposes by measuring the area under the ROC curve (AUC) in each evaluation set, with a maximum number of iterations of 1000 and the logistic output format. The logistic output can be interpreted as an estimate of the probability of presence (ranging from 0 to 1), conditioned on the environmental variables in each grid cell (Phillips and Dudik 2008). This methodology has proven useful for species with small numbers of occurrence records (Burneo *et al.* 2009; Tirira *et al.* 2011). The average AUC for model 1 was 0.780 (minimum = 0.720, maximum = 0.890; SD = 0.063) and for model 2 was 0.769 (minimum = 0.695, maximum = 0.913; SD = 0.082). The model with our new record of *M. crenulatum* predicts the distribution of this species in areas not predicted by the model with only the previous records (Figure 1).

Three bioclimatic variables explained 55% of the variation seen in each model: precipitation of driest quarter, mean temperature of wettest quarter and annual precipitation in the model 1 and precipitation of driest quarter, mean temperature of wettest quarter and mean diurnal range (mean of monthly: max temp – min temp) in the model 2.

Although *Mimon crenulatum* is not in the Brazilian list of endangered species (Chiarello *et al.* 2008), records of its occurrence are scarce. The small number of studies about bats in the Cerrado areas, especially in Mato Grosso, may contribute to such poor record. This record in the Mato Grosso Cerrado expands the distribution of *M. crenulatum* in west-central Brazil.



FIGURE 2. Male *Mimon crenulatum* (RM 165) captured in Nova Xavantina, eastern Mato Grosso, Brazil (Photo: Oliveira S, L.).

ACKNOWLEDGMENTS: The authors wish to thank FAPEMAT (Fundação de Amparo à Pesquisa do Estado de Mato Grosso) for financial support. The specimens were collected under Permit No. 18276-1 issued by the IBAMA (Brazilian Institute of Environment and Renewable Natural Resources).

LITERATURE CITED

- Bernard, E. 2001. Species list of bats (Mammalia, Chiroptera) of Santarém area, Para state, Brazil. *Revista Brasileira de Zoologia* 18(2): 455-563.
- Bernard, E., V.C. Tavares, and E. Sampaio. 2011. Compilação atualizada das espécies de morcegos (Chiroptera) para a Amazônia Brasileira. *Biota Neotropica* 11(1): 35-46.
- Burneo, S.F., J.F. González-Maya and D.G. Tirira. 2009. Distribution and habitat modelling for Colombian Weasel *Mustela felipei* in the Northern Andes. *Small Carnivore Conservation* 41: 41-45.
- Brito, D., L.C. Oliveira, and M.A.R. Mello. 2004. An overview of mammalian conservation at Poço das Antas Biological Reserve, Southeastern Brazil. *Journal for Nature Conservation* 12(2004): 219-228.
- Camargo, G. and E. Fischer. 2005. Primeiro registro do morcego *Mimon crenulatum* (Phyllostomidae) no Pantanal, Sudoeste do Brasil. *Biota Neotropica* 5(1): 1-4.
- Chiarello, A.G., L.M.S. Aguiar, R. Cerqueira, F.R. Melo, F.H.G. Rodrigues and V.M.F. Silva. 2008. Mamíferos ameaçados de extinção no Brasil; 680-874. In A.B.M. Machado, G.M. Drummond and A.P. Paglia. (ed.) *Livro vermelho da fauna brasileira ameaçada de extinção*. (ed.2). Brasília, DF: MMA.
- Giannini, N.P. and E.K.V. Kalko. 2005. The guild structure of animalivorous leaf-nosed bats of Barro Colorado Island, Panama, revisited. *Acta Chiropterologica* 7(1): 131-146.
- Gurgel Filho, N.M., J.A. Feijó and L.G. Sales-Júnior. 2009. First Record of *Mimon crenulatum* E. Geoffroyi, 1810 (Phyllostomidae: Phyllostominae) in the Ceará state, Northeastern Brazil. *Chiroptera Neotropica* 15(2): 494-496.
- Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis. 2005. Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology* 25: 1965-1978.
- Lim, B.K. and M.D. Engstrom. 2000. Species diversity of bats (Mammalia: Chiroptera) in Iwokrama Forest, Guyana, and the Guianan subregion: implications for conservation. *Biodiversity and Conservation* 10: 613-657.
- Mares, M.A., J.K. Braun and D. Gettinger. 1989. Observations on the distribution and ecology of the mammals of the Cerrado grasslands of Central Brazil. *Annals of Carnegie Museum* 58(1): 1-60.
- Martins, A.C.M., R. Bernard and R. Gregorin. 2006. Inventários biológicos rápidos de morcegos (Mammalia, Chiroptera) em três unidades de conservação do Amapá, Brasil. *Revista Brasileira de Zoologia* 23(4): 1175-1184.
- Mello, M. and A. Pol. 2006. First record of the bat *Mimon crenulatum* (E. Geoffroy, 1801) (Mammalia: Chiroptera) in the state of Rio de Janeiro, southeastern Brazil. *Brazilian Journal of Biology* 66(1B): 295-299.
- Mok, W.Y., D.E. Wilson, L.A. Lacey and R.C.C. Luizão. 1982. Lista atualizada de quirópteros da Amazônia Brasileira. *Acta Amazônica* 12(4): 817-823.
- Nogueira, M.R., A.L. Peracchi, and R. Moratelli, 2007. Subfamília Phyllostominae; p. 61-98. In N.R. Reis, A.L. Peracchi, W.A. Pedro, and I.P. Lima (eds.). *Morcegos do Brasil*. Londrina: Nélio Roberto dos Reis.
- Pedro, W.A. and V.A. Taddei. 1998. Bats from southwestern Minas Gerais, Brazil (Mammalia: Chiroptera). *Chiroptera Neotropica* 4(1): 85-88.
- Peracchi, A.L. and S.T. Albuquerque. 1993. Quirópteros do Município de Linhares, Estado do Espírito Santo, Brasil (Mammalia, Chiroptera). *Revista Brasileira de Biologia* 53(4): 575-581.
- Peracchi, A.L., P.H. Gallo, D. Dias, I.P. Lima and N.R. Reis. 2010. Ordem Chiroptera; p. 293-462. In N.R. Reis, A.L. Peracchi, M.N. Fregonezi and B.K. Rossaneis (eds.). *Mamíferos do Brasil. Guia de identificação* (2nd ed.). Rio de Janeiro: Technical Books.
- Peracchi, A.L., I.P. Lima, N.R. Reis, M.R. Nogueira and H. Ortêncio-Filho. 2011. Ordem Chiroptera; p. 155-234. In N.R. Reis, A.L. Peracchi, W.A. Pedro and I.P. Lima (eds.). *Mamíferos do Brasil* (2nd ed.). Londrina: Nélio Roberto dos Reis.
- Phillips, S.J., R.P. Anderson and R.E. Schapire. 2006. Maximum entropy modelling of species geographic distributions. *Ecological Modelling* 190: 231-259.
- Phillips, S.J. and M. Dudik. 2008. Modeling of species distributions with Maxent: new extensions and a comprehensive evaluation. *Ecography* 31: 161-175.
- Pine, R.H., I.R. Bishop and R.L. Jackson. 1970. Preliminary list of mammals of the Xavatina/Cachimbo expedition (Central Brazil). *Transactions of the Royal Society of Tropical Medicine and Hygiene* 64(5): 668-670.
- Reis, N.R. and H.O.R. Schubart. 1979. Notas preliminares sobre os morcegos do Parque Nacional da Amazônia (Médio Tapajós). *Acta Amazônica* 9(3): 507-515.
- Reis, N.R. and A.L. Peracchi. 1987. Quirópteros da região de Manaus, Amazonas, Brasil (Mammalia, Chiroptera). *Boletim Museu Paraense Emílio Goeldi zoologia* 3(2): 161-182.
- Sampaio, E.M., E.K.V. Kalko, E. Bernard, B. Rodríguez-Herrera and C.O. Handley Jr. 2003. A biodiversity assessment of bats (Chiroptera) in a tropical lowland rainforest of central Amazonia, including

- methodological and conservation considerations. *Studies on Neotropical Fauna and Environment* 38(1): 17-31.
- Silva, A.P. and S.R. Marques. 2010. Morcegos; p. 169-182. In I.M. Fernandes, C.A. Signor, J. Penha (eds.). *Biodiversidade no Pantanal de Poconé*. Cuiabá: Centro de pesquisa do Pantanal.
- Simmons N.B. 2005. Order Chiroptera; p. 312-529 In D.E. Wilson and D.M. Reeder (eds.) *Mammal species of the world: a taxonomic and geographic reference*, 3rd ed. Baltimore: Johns Hopkins University Press.
- Stutz, W.H., M.C. Albuquerque, W. Uieda, E.M. Macedo and C.B. França. 2004. Updated list of bats from Uberlândia, State of Minas Gerais, Southeastern Brazil. *Chiroptera Neotropical* 10(1-2): 188-190.
- Tavares, V.C., L.M.S. Aguiar, F.A. Perini, F.C. Falcão and R. Gregorin. 2010. Bats of the state of Minas Gerais, southeastern Brazil. *Chiroptera Neotropical* 16(1): 675-705.
- Tirira, D.G., S.F. Burneo, C.E. Boada and S.E. Lobos. 2011. Mammalia, Chiroptera, Phyllostomidae, *Lonchophylla hesperia*: Second record of the Western Nectar Bat in Ecuador after 70 years. *Check list* 7(3):315-318.
- Vizotto, L.D. and V.A. Taddei. 1973. Chave para determinação de Quirópteros brasileiros. *Boletim de Ciências, Faculdade de filosofia, ciências e letras, São José do Rio Preto* 1: 1-172.
- Williams, S. L. and H.H. Genoways 2008. Subfamily Phyllostominae; p. 255-299. In A.L. Gardner (ed.). *Mammals of South America. Marsupials, Xenarthrans, Sherws, and Bats*. Chicago: The University of Chicago Press.
- Willig, M.R. 1983. Composition, Microgeographic variation, and sexual dimorphism in Caatingas and Cerrado bat communities from Northeast Brazil. *Bulletin of Carnegie Museum of Natural History* 23: 1-131.

RECEIVED: October 2012

ACCEPTED: April 2013

PUBLISHED ONLINE: June 2013

EDITORIAL RESPONSIBILITY: Paúl M Velazco