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Postcranial skeletons of *Caipirasuchus* (Crocodyliformes, Notosuchia, Sphagesauridae) from the Upper Cretaceous (Turonian–Santonian) of the Bauru Basin, Brazil

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ABSTRACT

Caipirasuchus is a sphagesaurid crocodyliform genus known from Upper Cretaceous rocks (Turonian–Santonian) of the Bauru Basin, Brazil. Although their earlier descriptions were restricted to skull and mandible morphology, three species have been identified. In the present study, the skeletons of three specimens were analyzed from the collection of Prof. Antonio Celso de Arruda Campos Paleontology Museum: *Caipirasuchus montealtensis* (MPMA 68-0003/12), *Caipirasuchus paulistanus* (MPMA 67-0001/00) and *Caipirasuchus* sp. (MPMA 07-0011/00). These specimens are three individuals of a very similar size and have the same postcranial morphology. Analysis of the *Caipirasuchus* skeletons indicate the species were approximately 1.10 m in length and had slender-long bodies and hind limbs twice as long as the forelimbs. Regarding the general postcranial morphology of *Caipirasuchus* results indicate that these were agile animals and used speed as a defense mechanism against predators.

1. Introduction

The lithostratigraphic units in Bauru Basin, Brazil (Fig. 1), contain abundant fossils of distinct Late Cretaceous tetrapods, particularly testudines, crocodylomorphs and dinosaurs. The crocodylomorphs are the most widely studied and diverse group, with dozens of individuals including advanced notosuchians, baurusuchids, peirosaurids and trematochampsids (Price, 1945, 1950, 1955, 1959; Carvalho and Bertini, 1999; Campos et al., 2001, 2011; Carvalho et al., 2004, 2005, 2007; Nobre and Carvalho, 2006; Andrade and Bertini, 2008; Marinho and Carvalho, 2009; Iori and Carvalho, 2009, 2011; Nascimento and Zaher, 2010; Kellner et al., 2011, 2011a; Montefeltro et al., 2011; Iori and Garcia, 2012; Marinho et al., 2013; Godoy, et al., 2014; Pol et al., 2014).

Sphagesaurids are a clade of Late Cretaceous Crocodyliformes known from Adamantina (Bauru Basin, Brazil) and Cajones (Bolivia) formations. The sphagesaurids are primarily characterized by adapted teeth for herbivory/omnivory and a complex masticatory mechanism (Pol, 2003; Marinho and Carvalho, 2009; Iori and Carvalho, 2011; Iori et al., 2011). Six genera have been formally described: *Sphagesaurus*, *Adamantinasuchus*, *Armadillosuchus*, *Yacarerani*, *Caipirasuchus* and *Caryonosuchus* (Pol, 2003; Nobre and Carvalho, 2006; Andrade and Bertini, 2008; Marinho and Carvalho, 2009; Novas et al., 2009; Iori and Carvalho, 2011; Kellner et al., 2011; Iori et al., 2013).

Descriptive studies of sphagesaurids have focused on cranial material. The information regarding the postcranial structures of sphagesaurids is based on description of the dorsal armor of *Armadillosuchus arrudai* and the *Yacarerani boliviensis* skeleton (Marinho and Carvalho, 2009; Leardi et al., 2015).

A narrower skull and rostrum, and antorbital fenestra are some of the distinctive characteristics of *Caipirasuchus* (Andrade and Bertini, 2008; Iori and Carvalho, 2011; Iori et al., 2013; Pol et al., 2014). To date, three species have been identified: *Caipirasuchus paulistanus* (Iori and Carvalho, 2011); *Caipirasuchus montealtensis* (Andrade and Bertini, 2008; Iori et al., 2013) and *Caipirasuchus stenognathus* (Pol et al., 2014).

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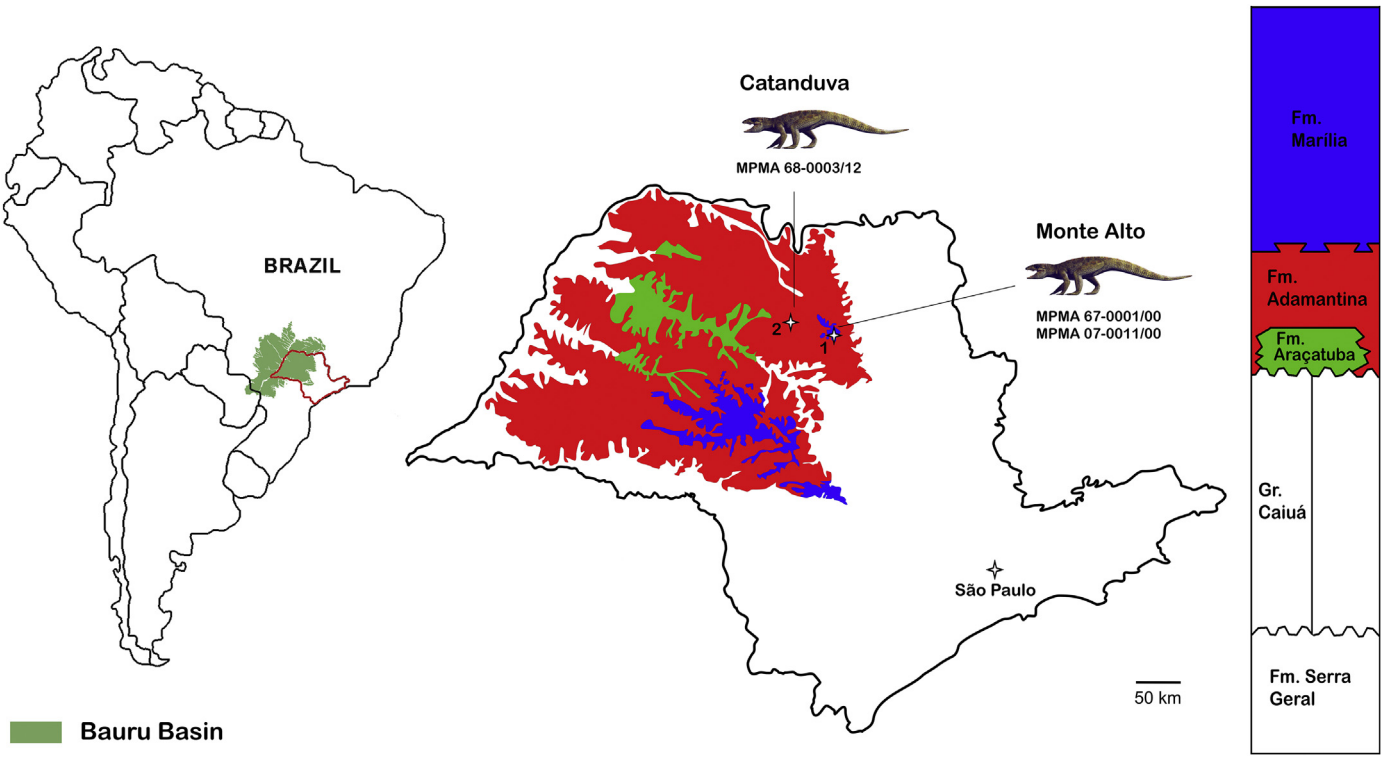

Fig. 1. The Bauru Group in São Paulo State, with the locations of the analyzed specimens: Municipalities of Monte Alto (1) and Catanduva (2). Stratigraphic column of the Bauru Group (modified from Batezelli et al., 2003).

The present paper presents descriptions and analyses of the postcranial remains of three specimens of *Caipirasuchus* (*C. montealtensis*, *C. paulistanus* and *Caipirasuchus* sp.), representing the first detailed description of an axial and appendicular skeleton of a sphagesaurid from the Bauru Basin.

1.1. Abbreviations of institutions:

MPMA – Museu de Paleontologia "Prof. Antonio Celso de Arruda Campos", Monte Alto, São Paulo State, Brazil.
UFRJ DG – Departamento de Geologia da Universidade Federal do Rio de Janeiro, Rio de Janeiro State, Brazil.

2. Materials and methods

The three specimens of *Caipirasuchus* analyzed in this study are in the collection of the Paleontology Museum Prof. Antonio Celso de Arruda Campos. They came from Monte Alto municipalities (MPMA 67-0001/00 and MPMA 07-0011/00) and Catanduva (MPMA 68-0003/12), located in the State of São Paulo, Brazil (Fig. 1).

These three specimens of *Caipirasuchus* are very similar in size. The postcranial structures of the specimens are nearly identical in morphology and only differ in bones size. The postcranial skeleton of *Caipirasuchus* was compared to *Armadillosuchus*, *Araripesuchus tsangatsangana*, *Yacarerani*, *Notosuchus*, *Mariliasuchus*, *Simosuchus* and *Baurusuchus albertoi* materials.

3. Systematic paleontology

Crocodylomorpha Walker, 1970
Crocodyliformes Hay, 1930
Mesoeucrocodylia Whetstone and Whybrow, 1983
Notosuchia Gasparini, 1971
Sphagesauridae Kuhn, 1968 *sensu* Marinho and Carvalho, 2007
Genus *Caipirasuchus* Iori and Carvalho, 2011

3.1. *Caipirasuchus montealtensis* (Andrade and Bertini, 2008)

Holotype. MPMA 15-0001/90: Almost complete skull and anterior portion of the mandible.

Locality and horizon. Municipality of Monte Alto, São Paulo State, Brazil, in the Adamantina Formation, Bauru Group (Turonian–Santonian of the Bauru Basin).

Referred specimen. MPMA 68-0003/12: Skull, mandible and part of the postcranial skeleton.

Locality and horizon. Municipality of Catanduva, São Paulo State, Brazil, in the Adamantina Formation, Bauru Group (Turonian–Santonian of the Bauru Basin).

3.1.1. Description and comparison

The skeleton of *Caipirasuchus montealtensis* was partially disarticulated as a result of biostratinomic processes, although the displaced bones remained associated. The preserved postcranial elements consist of several osteoderms, both coracoids, the right humerus, the proximal third of the left humerus, two cervical vertebrae and at least four fragmentary dorsal vertebrae and three ribs (Fig. 2). Also, there were preserved a distal articulated series of caudal vertebrae with various osteoderms and hemal arches. Hind limbs are represented by bones such as tarsals, metatarsals and phalanges (Figs. 3 and 4). Some bones were displaced from the set during specimen preparation and were isolated (Figs. 5 and 6).

Cervical vertebrae. The last two cervical vertebrae are present, the last one (C8) being better preserved (Figs. 2A and 2B). They are