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A NEW SPECIES OF TINAMOU (AVES: TINAMIFORMES, TINAMIDAE) FROM THE EARLY-MIDDLE MIOCENE OF ARGENTINA

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ABSTRACT

A new species of tinamou from the early-middle Miocene (Santacrusian), Santa Cruz Formation of Argentina is named. The new species is approximately 16 million year old and has an affinity with the modern genus *Crypturellus* based on the unique characteristics of the humerus, hence, the designation aff. *Crypturellus*. Fossil species and the zoarchaeological record of modern tinamous are given.

Introduction

In 1898-1899, Barnum Brown, assistant curator in the Department of Vertebrate Paleontology at the American Museum of Natural History, represented the AMNH as a member of the third Patagonian expedition led by John Bell Hatcher of Princeton. As told by Simpson (1984: 118-121), this was not a happy partnership and eventually Brown was left behind in Patagonia. However, Brown preferred to be in the field alone and returned to New York with a good collection of Santacrusian vertebrate fossils.

Among the fossils collected by Brown is an almost complete left humerus of a tinamou. In recent years, tinamou fossils have been collected in other Santacrusian (South American Land Mammal Age, SALMA) localities from both the coastal and northwestern areas (Bertelli & Chiappe, 2005) of Santa Cruz Province (figure 1). Additional records of this Neotropical family are abundant in the Pliocene and Pleistocene deposits of the Pampean region (Tambussi, 1987) and other South American localities (Cuellar, 1988), and also are known from late Miocene deposits (Tonni & Tambussi, 1986; Tambussi, 1987).



Map of the general region of the Santa Cruz Province, showing localities (solid circles) where fossil tinamous have been collected. Modified from Marshall (1976) by Linda D. Chandler.

All assignable fossils have been referred to extant genera with the exception of one species in the poorly represented extinct genus *Tinamisornis* (Brodkorb, 1961; Tonni, 1977; Tambussi, 1987).

The middle Miocene (Santacrucean) tinamou reported here is the earliest record for a tinamou with an affinity to the genus *Crypturellus*. Additional described tinamou fossils have been collected in the middle Miocene formations of Santa Cruz Province (Bertelli & Chiappe, 2005; Chiappe, 1991). Three different localities in the Santa Cruz Formation have yielded tinamou fossils (figure 1). In addition to the humerus of the new species (named herein) from Cañadón de las Vacas, another humerus and several coracoids have been found at Monte Observación, and a humerus and a tibiotarsus at Monte León. Furthermore, a tinamid tibiotarsus was found in continental deposits of the Pinturas Forma-

tion (Bertelli & Chiappe, 2005; Chiappe, 1991) in northwestern Santa Cruz Province. The Pinturas Formation is slightly older in age than the typical Santacrucean beds of the Santa Cruz Formation (Marshall, *et al.* 1983; Bown & Fleagle, 1993).

Institutional Abbreviations

AMNH, FAM, American Museum of Natural History, Frick American Museum;
 FMNH, Field Museum of Natural History;
 KU, Charles Bunker Memorial Osteological Collection, Museum of Natural History, University of Kansas;
 LSU, Museum of Natural Science, Louisiana State University;
 MACN-SC, Museo Argentino de Ciencias Naturales, Colección Santa Cruz;
 SDSNH, San Diego Society of Natural History;

UF, Florida Museum of Natural History, University of Florida;
 UMMZ, University of Michigan, Museum of Zoology.

Geological Occurrence

The holotype was collected by Barnum Brown from beds of the Santa Cruz Formation in a wash at Cañadón de las Vacas, southeastern Santa Cruz Province, Argentina (figure 1). In Brown's personal Patagonian field notebook (Brown, 1899, AMNH Archives) he states that Cañadón de las Vacas is "40 miles south of Santa Cruz [Puerto Santa Cruz], ... North and south Vacas the Santa Cruzian [sic] has been eroded back from the sea a distance of three miles" This geographic reference is in agreement with the locality given for Cañadón de las Vacas clarified by Marshall (1976).

The Santa Cruz Formation is a rich fossiliferous continental deposit, largely exposed in the Argentinean Province of Santa Cruz (Ameghino, 1889; Simpson, 1940; Marshall, 1976; Marshall *et al.*, 1986). Traditionally, the age of the Santa Cruz Formation has been considered as early Miocene (Marshall, 1976; Marshall *et al.*, 1977; 1983). However, recent radiometric dates suggest a younger age for these deposits (Marshall *et al.*, 1986; Bown & Larriestra, 1990; MacFadden, 1990). Marshall *et al.* (1986) considered the age of the Santa Cruz Formation to be between 18 and 15 Ma. New radiometric dates confirm this younger age, with dates ranging from 16.6 to 16.4 Ma for the lower part of the formation (Bown & Fleagle, 1993; Flynn & Swisher, 1995).

Methods

The monophyletic nature of the genera of the Tinamiformes, Tinamidae used in this study is based on the work of other Bertelli & Chiappe (2005). For purposes of identification and looking for informative phylogenetic characteristics, I have compared the fossil with representatives of all nonpasserine bird orders and in particular with the extinct paleognathous bird *Lithornis* (*L. plebius* and *L. promiscuus*) and with several species of cracids (*Crax globulosa*, *Mitu mitu*, *Ortalis garrula*, *O. poliocephala*, *O. vetula*, *Penelope jacquagu*, *Pipile cumanensis*). The relationships between *Lithornis*, cracids, and the Tinamidae are controversial (Cracraft,

1988; Houde, 1988), but there is a broad consensus that both *Lithornis* and galliforms are basal neornithine birds (Olson, 1985; Cracraft, 1988; Houde, 1988; Sibley & Alquist, 1995).

The anatomical terminology used in this study is that of Baumel *et al.* (1979) with the exception that the Latin terms were replaced with the English equivalents.

Comparative materials used in this study are as follows: *Lithornis plebius* (AMNH:FAM 21902), *L. promiscuus* (AMNH:FAM 21903), *Crax globulosa* (UF 24052, 24053), *Mitu mitu* (UF 24051), *Ortalis garrula* (UF 33148), *O. poliocephala* (UF 33147), *O. vetula* (UF 33145, 33146), *Pipile cumanensis* (UF 24048), *Crypturellus bartletti* (LSU 109286; KU 84731), *C. boucard* (LSU 23333), *C. cinereus* (KU 85127), *C. cinnamomens* (KU 41861; SDSNH 41693), *C. obsoletus* (LSU 83940), *C. parvirostris* (LSU 125624), *C. soui* (KU 34657), *C. tataupa* (LSU 125626), *C. transfaciatus* (LSU 93849), *C. undulatus* (FMNH 320358; KU 84742), *Eudromia elegans* (KU 78065), *Nothocercus bonapartei* (UMMZ 155485), *N. julius* (LSU 120893), *N. nigrocapillus* (LSU 99310), *Nothoprocta cinerascens* (FMNH 314655), *N. ornata* (UMMZ 209964), *N. pentlandii* (LSU 79742), *Nothura darwini* (KU 77981), *N. maculosa* (KU 77978; SDSNH 38630), *Rhynchotus rufescens* (FMNH 105649; KU 84358), *Tinamotis ingoufi* (SDSNH 38632), *T. pentlandi* (FMNH 105919), *Tinamus guttatus* (LSU 121484), *T. solitarius* (UMMZ 203318), *T. tao* (FMNH 330220).

Systematic Paleontology

Order Tinamiformes (Huxley, 1872)
 Family Tinamidae Gray, 1840
 aff. *Crypturellus* Brabourne & Chubb, 1914
Crypturellus reai, new species

Figure 2

Holotype – AMNH:FAM 9151, left humerus.

Type locality – Wash at Cañadón de las Vacas, southeastern Santa Cruz Province, Argentina (figure 1).

Type horizon – Santacrucian SALMA, early-middle Miocene, 16.3-17.5 Ma, Santa Cruz Fm. (see Flynn & Swisher, 1995).

Measurements holotype – Total length: 50.2 mm; proximal breadth: 13.0 mm; depth and width of shaft at mid-point: 8.5 x 9.8 mm; distal breadth: 10.2 mm.

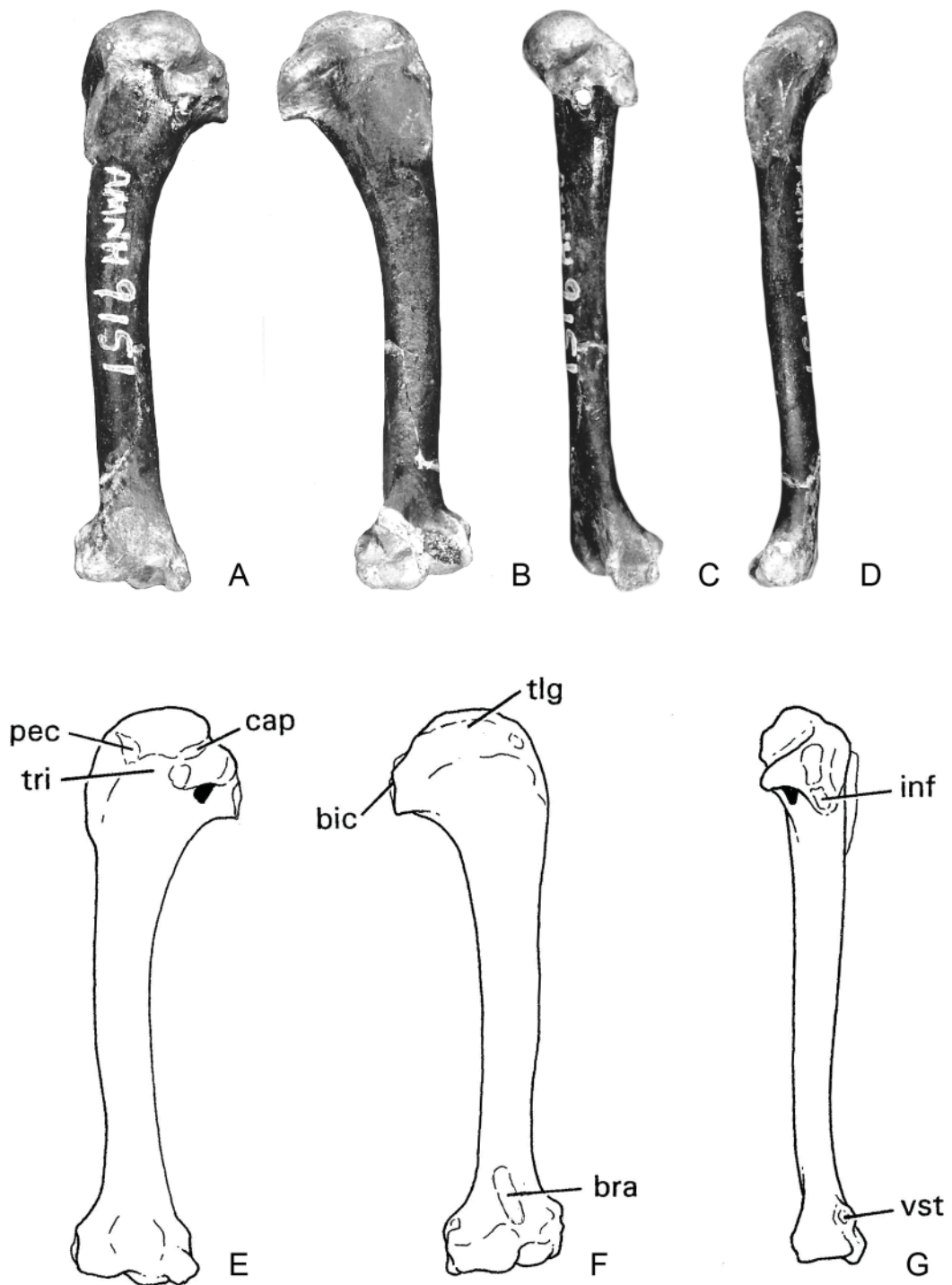


Figure 2. *Crypturellus reai*, AMNH:FAM 9151. A) Anconal; B) Palmar; C) Internal; D) External; E) Anconal; F) Palmar; G) Internal; H) External views. Abbreviations are: M. brachialis fossa (bra), bicipital crest (bic), capital incision (cap), M. infraspinatus attachment (inf), M. pectoralis attachment (pec), transverse ligamental groove (tlg), M. triceps brachii (tri), and ventral supracondylar tubercle (vst). Scale equals 1cm. Photography by the author. Drawing by Linda D. Chandler. Courtesy of AMNH: FAM.

Etymology – This new species is named in honor of Amadeo M. Rea, a consummate educator, mentor, and friend. Amadeo's passion for birds, living and fossil, botany, and ethnobiology first sparked a desire in me to study fossil birds.

Diagnosis – The holotype humerus (AMNH: FAM 9151), *Crypturellus*, *Tinamus*, and *Rhynchotus* have the distal border of the head of the humerus extending distad, medially occluding the capital incision; *Nothocercus*, *Nothura*, *Eudromia*, *Nothoprocta*, and *Tinamotis* have a distinctly rounded distal border with a medially open incision. The holotype, *Crypturellus*, and *Tinamotis* share the attachment for the M. infraspinatus oriented ventrally, not caudally as in *Tinamus*, *Rhynchotus*, and the other tinamid genera examined.

Within *Crypturellus*, *C. reai* differs from all other species examined in having the head of the humerus more deeply undercut medially. *Crypturellus reai* also differs from all other species of *Crypturellus* examined in that the fossa of the M. brachialis is nearly straight and extends diagonally across the shaft. *Crypturellus reai* has the attachment for the ventral collateral ligament (ventral supracondylar tubercle) slanted more caudally, and not located in the plane of the long axis of the humerus as in all the examined species of *Crypturellus* and other tinamid genera.

Description and comparison – *Crypturellus reai* is a tinamou of medium size similar to the pale-browed, *C. transfaciatus*, and slaty-breasted, *C. boucardi*, tinamous. The nearly complete left humerus is missing the lateral condyle and the dorsal epicondyle. It is from an adult individual and is heavily mineralized.

The new species has an affinity with species in the genus *Crypturellus* based on two characters: 1) the direct ventral orientation of the M. infraspinatus attachment; and 2) the head of the humerus extends distad occluding the capital incision medially (figure 2). Individually, these characters are found in three other genera (see Diagnosis), but not together in any genus other than *Crypturellus*. A caudally oriented M. infraspinatus attachment and a non-obstructed capital incision is present in *Nothocercus*.

Crypturellus reai has several unique features. The head of the humerus is more deeply undercut by the head of the M. triceps brachii than in any other species of *Crypturellus*. The head

of the humerus extends distad only far enough to occlude the capital incision medially (figures 2A, E), unlike other species of *Crypturellus* where it extends farther distad and is broader. In addition, the attachment of the M. infraspinatus is concave (figures 2C, G), which differs from the condition of a flat or slightly convex attachment as is exhibited in the other species of *Crypturellus*. *Crypturellus reai* also differs from all other species examined in having the proximal end of the attachment for the ventral collateral ligament (ventral supracondylar tubercle) slanted more distally (figures 2D, H). The attachment is more cranial in position in the other genera.

In *Crypturellus reai* the transverse ligamental groove is deep and extends ventrally almost to the bicipital crest (figures 2B, C, F, G), a condition approached only by *C. bartletti* and *C. transfaciatus*. In *Tinamotis* and *Nothocercus*, the transverse ligamental groove forms a shallow pit. Both *C. reai* and *C. tataupa* have a distinct groove ascending proximad from the attachment of the M. pectoralis medially across the head of the humerus (figures 2A, E).

A nearly straight diagonal fossa of the M. brachialis is present in *C. reai* (figures 2B, F) and the other genera of tinamous. The other species of *Crypturellus*, however, have a crescent-shaped impression.

Comparisons with *Crypturellus reai* can be made with humeri from extinct species from two other localities, Monte Observación and Monte León. The two fossils (MACN-SC 1449 and MACN-SC 3608) both are the distal ends of right humeri. They virtually are identical to each other in size and appearance with the exception that one has an additional bony spur above the dorsal epicondyle, which is a pathological artifact. Both humeri have a shorter and broader crescent-shaped fossa of the M. brachialis, whereas *C. reai* has a longer and narrower impression. Also, the attachment for the ventral collateral ligament is flat in cranial view, which differs from the unique condition of the holotype. The late Pliocene extinct genus and species *Tinamisornis parvulus* does not have a humerus referred to it. Therefore, it cannot be directly compared to *C. reai*. (See Tambussi, 1987 for a review of this genus).

Pleistocene records of modern species of tinamous have been reported by Brodkorb (1963), Tambussi (1987; see table 1), and Cuellar (1988).

Genus	Miocene	Pliocene	Pleistocene	Reference
<i>Tnamus</i>			x	Brodkorb (1963)
<i>Crypturellus</i>	x		x	Brodkorb (1963); this paper
<i>Rhynchotus</i>			x	Brodkorb (1963)
<i>Nothoprocta</i>			x	Brodkorb (1963)
<i>Nothura</i>		x	x	Brodkorb (1963); Tambussi (1987)
<i>Eudromia</i>	x	x	x	Tambussi (1987); Cuello (1988)
<i>Taoniscus</i>			x	Brodkorb (1963)
<i>Tinamisornis</i>		x		Tambussi (1987)

Table 1. Chronology of the fossil tinamid genera.

Discussion

Crypturellus reai is an early tinamou with an affinity to the genus *Crypturellus*. It is reported from the early-middle Miocene, Santacrucian, continental deposits of Cañadón de las Vacas, Santa Cruz Province, Argentina. In addition, there is at least one more species of tinamou from the same deposit from two localities, Monte Observacion and Monte Leon, which are in close proximity. Also, there is an undescribed tinamou from the slightly older Pinturas Formation (Bertelli & Chiappe, 2005).

Living congeners of *Crypturellus reai* are all found in tropical or subtropical environments (Blake, 1986). Previous analyses of the vertebrate fauna indicate tropical-subtropical climatic conditions during the deposition of the Santa Cruz Formation (Pascual, 1984; 1986; Pascual & Ortiz Jaureguizar, 1990). The occurrence of *C. reai* supports such an inference.

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of Natural History, San Diego, California; Museum of Zoology, University of Michigan, Ann Arbor, Michigan. I received a Collection Study Grant from the AMNH to conduct this study. I thank Linda D. Chandler for skillfully preparing the illustrations and for proof-reading the manuscript. I especially would like to thank Luis Chiappe for his early participation, helpful comments, and use of tinamou fossils in his care. Also, I thank James L. Knight, Bradley C. Livezey, Alfred J. Mead, and S. David Webb for critically reviewing this paper.

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