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First Fossil of *Rhinoclemmys* Fitzinger, 1826 (Cryptodira, Geoemydidae) East of the Andes

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Abstract. We describe the first undisputable fossil of *Rhinoclemmys* (Cryptodira, Geoemydidae) east of the Andes, represented by an isolated nuchal bone found in one of the most important paleontological sites with association of fauna and humans (Muaco site, western Venezuela) from the Late Pleistocene of the southern Caribbean. The nuchal is complete and slightly wider (4.8 cm) than long (4.2 cm), preserving well-defined sulci of the cervical, vertebral 1, marginal 1, and pleural 1. Comparisons with extant and fossil specimens of *Rhinoclemmys* allow us to attribute this nuchal to *Rhinoclemmys,* albeit as an indeterminate species. The occurrence of *Rhinoclemmys* in the southern Paraguaná Peninsula indicates that during the Late Pleistocene this region had environmental conditions that allowed the survival of these freshwater-terrestrially adapted reptiles, particularly of "paleo-springs" inside a semi-arid region.

Keywords. Late Pleistocene; Paleobiogeography; Testudines; Venezuela.

INTRODUCTION

The extant South American turtle fauna is the result of evolutionary endemism, particularly represented by the pleurodirans (side-necked turtles), and immigration from North and Central America and potentially Africa, represented by the cryptodirans (hidden-necked turtles; de la Fuente et al., 2014, and references therein). One of the groups of cryptodiran turtles that arrived in South America via the Isthmus of Panama were the geoemydids (Le and McCord, 2008; Cadena et al., 2012), represented by *Rhinoclemmys* Fitzinger, 1826, presently distributed in Central America and tropical regions of South America (Turtle Taxonomy Working Group, 2017). Despite its extensive current geographical distribution, the fossil record of *Rhinoclemmys* is scarce, remaining restricted to Central America in the Panama Canal region (Cadena et al., 2012) and the Pacific margin of northern South America at Talará, Peru (Seymour, 2015) and in Santa Elena province, Ecuador (Cadena et al., 2017, and references therein). A potential record of *Rhinoclemmys* listed by Campos and de Broin (1981), from the Pleistocene of Brazil is dubious considering that the authors did not provide descriptions, photos, or any additional diagnostic or morphological information; this report was also disregarded by de la Fuente et al. (2014).

Here we report the first undisputed fossil record of *Rhinoclemmys* east of the Andes, represented by an isolated nuchal bone found in the Late Pleistocene locality of Muaco, Falcón state, Venezuela, and we discuss its paleobiogeographical implications.

MATERIALS AND METHODS

Geographical settings, geology, and age

The fossil site of Muaco is located south of Paraguaná Peninsula, approximately 20 km east of the city of Coro (11°28′50″N, 69°32′42″W), in the vicinity of the towns of Carrizal and Muaco, Colina municipality, Falcon state, western Venezuela (Fig. 1). Muaco is ca. 1 km from the coast and corresponds to a continental accumulation characterized mainly by muddy sediments interpreted as a sedimentary environment influenced by a resurgent spring (Royo y Gómez, 1959, 1960). The site was excavated in the late 1960s by the renowned geologist José Royo y Gómez and the archaeologist José. M. Cruxent, and abundant vertebrate remains, evidence of human artifacts and marks of tools, and burned bones of megafauna were recovered (Royo y Gómez, 1960; Cruxent, 1961; Aguilera, 2006; Carrillo-Briceño, 2015). The

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vertebrate assemblage of Muaco includes turtles (*Chelonoidis* Fitzinger, 1835 and Podocnemididae Cope 1868 [indeterminate]), Crocodilia Owen 1842 (indeterminate), snakes, birds, marsupials, rodents, rabbits, terrestrial sloths, armadillos notoungulates, artiodactyls, perissodactyls, carnivores, and proboscideans (Royo y Gómez, 1959, 1960; Ochsenius, 1980; Aguilera, 2006; Rincón et al., 2006; Soibelzon and Rincón, 2007; Carlini et al., 2008; Chávez-Aponte et al., 2008a, b; Carrillo-Briceño, 2015). Two absolute ages ranging between 16,375 ± 400 and 14,300 ± 500 years before present (BP) were established for the Muaco site based on carbon-14 analysis of a glyptodont osteoderm and burned bones, respectively (Cruxent, 1961; Rouse and Cruxent, 1963). We measured the specimen using a digital caliper and compared its morphology with the extant and fossil specimens of *Rhinoclemmys* listed in Cadena et al. (2012: appendix 2) and Cadena et al. (2017).

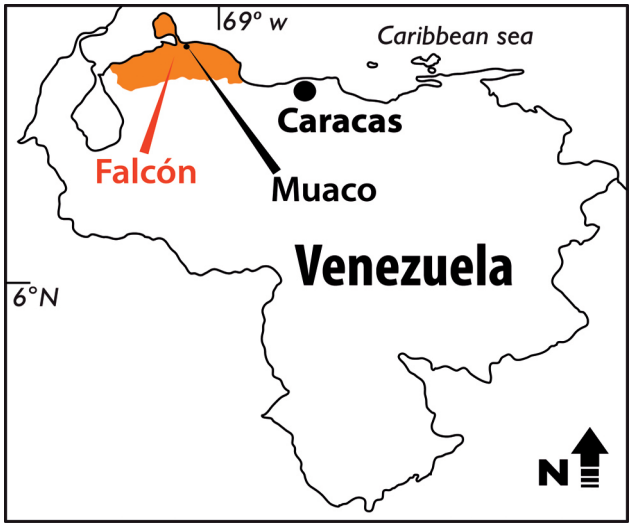

Figure 1. Map of Venezuela showing Falcón state (in orange) and the fossil locality of Muaco, where the fossil specimen described herein was found.

Referred material

PFCX VF-88, a complete and isolated nuchal bone, housed at the Paleontological Collection of the Museo Geológico Dr. José Royo y Gómez, Universidad Central de Venezuela (UCV), Caracas, Venezuela.

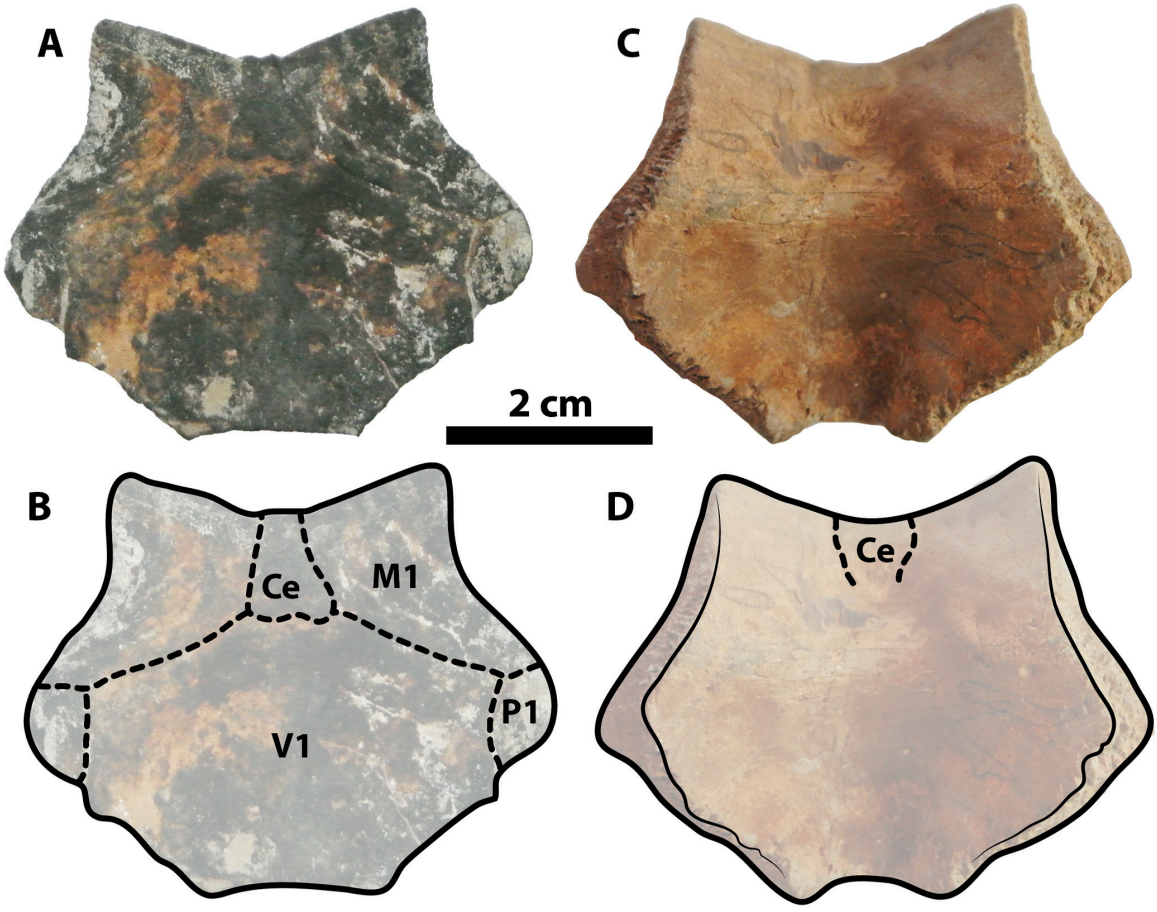

Figure 2. *Rhinoclemmys* sp. indet. PFCX VF-88 nuchal bone in **(A–B)** dorsal and **(C–D)** ventral views. Abbreviations: Ce, cervical scute; M, marginal scute; P, pleural scute; V, vertebral scute. Scale bar = 2 cm.

RESULTS

Systematic paleontology

Testudines Batsch, 1788
Cryptodira Cope, 1868
Geoemydidae Theobald, 1868
Rhinoclemmys Fitzinger, 1826
Sp. indet. (Fig. 2)

Description

Rhinoclemmys sp. indet. PFCX VF-88 corresponds to a complete and isolated nuchal bone (4.8 cm wide, 4.2 cm long). It is hexagonal, having anterior and anterolateral margins forming a wide, open V-shape. On the dorsal surface (Fig. 2A–B), the cervical scute sulci are well defined, indicating that it was rectangular, anteriorly narrower than posteriorly, with shallow medial anterior and posterior notches, and contacting marginal 1 laterally and vertebral 1 posteriorly. Marginal 1, as indicated by the sulci, is large, covering most of the anterolateral corner of the nuchal, and contacting the cervical medially, vertebral 1 posteromedially, and pleural 1 posteriorly. Vertebral 1, as indicated by the sulci, was anteriorly restricted to the nuchal without reaching peripheral 1, allowing pleural 1 to reach and cover the lateral-most corner of the nuchal. On the ventral surface (Fig. 2C–D), the nuchal is strongly concave, exhibiting well-defined lateral sulci between the cervical and marginal 1.

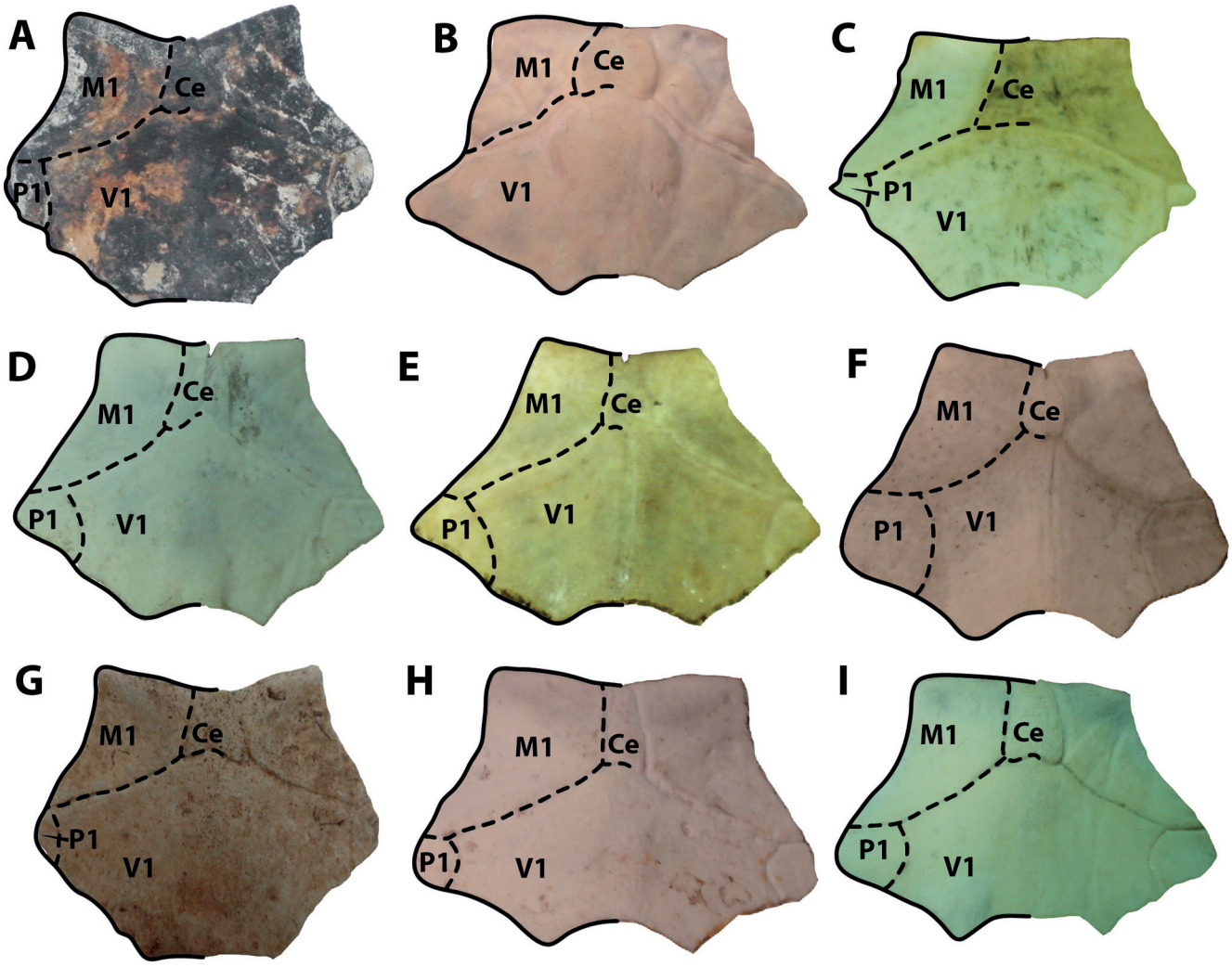

Figure 3. Nuchal bone in dorsal view of some extant *Rhinoclemmys* taxa and the fossil specimen described herein. **(A)** *Rhinoclemmys* sp. indet. PFCX VF-88. **(B)** *R. diademata,* CRI 1339 (Chelonian Research Institute, Oviedo, Florida, USA). **(C)** *R. annulata* Gray 1860, CRI 2774. **(D)** *R. punctularia,* CRI 2871. **(E)** *R. punctularia,* CRI 0345. **(F)** *R. punctularia,* CRI 3706. **(G)** *R. funereal,* UF 37163 (Florida Museum of Natural History, Herpetology collection, Gainesville, Florida USA). **(H)** *R. funérea,* CRI 5494. **(I)** *R. funérea,* CRI 4380. Abbreviations: Ce, cervical scute; M, marginal scute; P, pleural scute; V, vertebral scute. All specimens were fit to a unique scale.

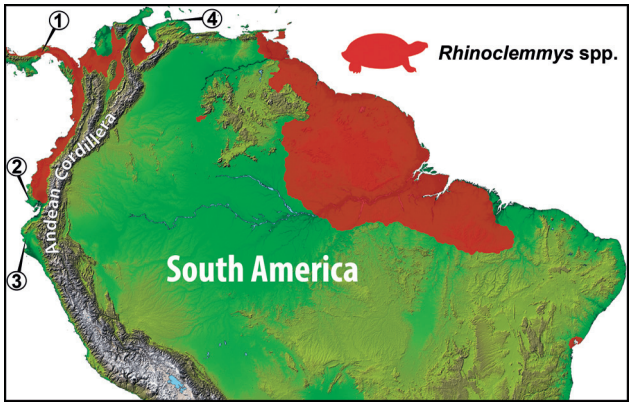

Figure 4. Geographical distribution of *Rhinoclemmys* species in South America based on for extant species (red regions; Turtle Taxonomy Working Group, 2017) and fossil records, numbered as follows: **(1)** *R. panamaensis* Cadena et al., 2012, Miocene, Panama Canal; **(2)** *Rhinoclemmys* sp. (Cadena et al., 2017), Pleistocene, Ecuador; **(3)** *Rhinoclemmys* sp. (Seymour 2015), Pleistocene, Peru; **(4)** *Rhinoclemmys* sp. Late Pleistocene, Venezuela, described herein. Map modified from original provided by NASA/JPL-Caltech.

DISCUSSION

Comparisons

Rhinoclemmys sp. indet. PFCX VF-88 resembles the nuchal of extant and fossil members of this genus in being slightly wider than long, having a cervical scute that is narrower anteriorly than posteriorly (Fig. 3; see also Cadena et al., 2012: fig. 3; Cadena et al., 2017: fig. 2). *Rhinoclemmys* sp. indet. PFCX VF-88 also shares with the majority of extant and fossil representatives of the genus pleural 1 covering the lateral-most corner of nuchal, with some exceptions (e.g., some specimens of *R. diademata* Mertens, 1954; Fig. 3B). The shape of the nuchal and relative proportions of the scutes exhibit high intraspecific variation, as shown in three specimens of *R. punctularia* Daudin, 1802 (Fig. 3D–F) and *R. funerea* Cope, 1876 (Fig. 3G–I). Taking into account this high morphological variability, we only identify the specimen described herein as *Rhinoclemmys* sp. indet.

Paleobiogeographical implications

The fossil record of turtles of Venezuela is abundant along the northern margin of the country, including several groups of pleurodires and reports of one lineage of cryptodires (Testudinidae, *Chelonoidis;* see Carrillo-Briceño and Sánchez-Villagra, 2016, and references therein). *Rhinoclemmys* sp. indet. described herein is not only the first record of geoemydids for Venezuela, but also the first fossil of this genus east of the Andes (Fig. 4).

Extant representatives of *Rhinoclemmys* inhabit northwestern Venezuela near Maracaibo Lake (*R. diademata*) and the northeastern corner of the country (*R. punctularia;* Fig. 4); however, they are currently absent in the north-central regions, particularly at the Falcon state, which is a semi-arid region today. According to Ochsenius (1980), ca. 15,000 BP the Falcón region was characterized by a negative water balance and an environment dominated by xerophytic plant associations, which could explain how concurrently many of the Late Pleistocene vertebrate sites in the region are associated with evidence of hunting by humans (see Aguilera, 2006; Carrillo-Briceño, 2015), coinciding with the existence of ascending springs that were probably supplied by aquifers from nearby mountainous areas. The occurrence of *Rhinoclemmys* sp. indet. and other taxa, such as podocnemidids and crocodilians in this "paleo spring" of Muaco, southern Paraguaná Peninsula, indicates that during the Late Pleistocene this region had environmental conditions that allowed the survival of this freshwater-terrestrially adapted reptiles.

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REFERENCES

Aguilera O. 2006. Tesoros paleontológicos de Venezuela. El Cuaternario del Estado Falcón. Ministerio de la Cultura, Caracas.

Batsch A.J. 1788. Anleitung zur Kenntniss und Geschichte der Thiere und Mineralien. Erster Theil. Allgemeine Geschichte der Natur; besondre der Säugthiere, Vögel, Amphibien und Fische. Akadmischen Buchhandlung, Jena. DOI

Cadena E.A., Bourque J.R., Rincón A.F., Bloch J.I., Jaramillo C.A., MacFadden B. 2012. New turtles (Chelonia) from the Late Eocene through Late Miocene of the Panama Canal basin. *Journal of Paleontology* 86:539–557. DOI

Cadena E.A., Abella J., Gregori M.G. 2017. New findings of Pleistocene fossil turtles (Geoemydidae, Kinosternidae and Chelydridae) from Santa Elena Province, Ecuador. *PeerJ 5:* e3215. DOI

Campos D.A., de Broin F. 1981. Tartarugas fósseis do Brasil. *Anais da Academia Brasileira de Ciências* 53:201–211.

Carlini A.A., Zurita A.E., Aguilera O.A. 2008. North American Glyptodontines (Xenarthra, Mammalia) in the Upper Pleistocene of northern South America. *Paläontologische Zeitschrift* 82:125–138. DOI

Carrillo-Briceño J.D. 2015. Bestias prehistóricas de Venezuela "Colosos de la Edad de Hielo". Río Verde, Caracas.

Carrillo-Briceño J.D., Sanchéz-Villagra M.R. 2016. Tortugas del pasado: una mirada al registro fósil en Venezuela. Pp. 10–25, in Trebbau P., Pritchard P.C.H. (Eds.). Venezuela y sus Tortugas. Oscar Todtmann Editores, Caracas.

Chávez-Aponte E.O., Alfonso-Hernández I., Finol H., Barrios C., Boada A., Carrillo-Briceño J.D. 2008a. Histología y ultraestructura de los osteodermos fósiles de *Glyptodon clavipes* y *Holmesina* sp. (Xenarthra Cingulata). *Interciencia* 33:616–619.

Chávez-Aponte E.O., Alfonso-Hernández I., Carrillo-Briceño J.D. 2008b. Morfología dentaria de los gonfoterios de la localidad de Muaco, Estado Falcón, Venezuela. *Interciencia* 33:771–775.

Cope E.D. 1868. On the origin of genera. *Proceedings of the Academy of Natural Sciences of Philadelphia* 20:242–300.

Cope E.D. 1876. On the batrachia and reptilia of Costa Rica. *Journal of the Academy of Natural Sciences* 2:93–154. DOI

Cruxent J.M. 1961. Huesos quemados en el yacimiento prehistórico de Muaco, Estado Falcón. *Boletín Informativo Departamento de Antropología* 2:20–21.

Daudin F.M. 1802. Histoire Naturelle, Générale et Particulière des Reptiles; ouvrage faisant suit à l'Histoire naturell générale et particulière, composée par Leclerc de Buffon; et rédigee par C.S. Sonnini, membre de plusieurs sociétés savantes, Tome 2. F. Dufart, Paris. DOI

de la Fuente M.S., Sterli J., Maniel I. 2014. Origin, evolution and biogeographic history of South American Turtles. Springer Earth System Sciences, Dordrecht and Heidelberg. DOI

Fitzinger L.J. 1826. Neue classification der Reptilien nach ihren natürlichen Verwandtschaften nebst einer Verwandtschafts-Tafel und einem Verzeichnisse der Reptilien-Sammlung des K.K. Zoologisch Museum's zu Wien. J.G. Heubner, Vienna. DOI

Fitzinger L.J. 1835. Entwurf einer systematischen Anordnung der Schildkröten nach den Grundsätzen der natürlichen Methode. *Annalen des Wiener Museums der Naturgeschichte* 1:105–128.

Gray J.E. 1860. Description of new species of *Geoclemmys* from Ecuador. *Proceedings of the Zoological Society of London* 1860:231–232.

Le M., McCord M. 2008. Phylogenetic relationships and biogeographical history of the genus *Rhinoclemmys* Fitzinger, 1835 and the monophyly of the turtle family Geoemydidae (Testudines:Testudinoidea). *Zoological Journal of Linnean Society* 153:751–767. DOI

Mertens R. 1954. Zur kenntnis der Schildkrötenfauna Venezuela. *Senckenbergiana Biologica* 35:3–7.

Ochsenius C. 1980. Cuaternario en Venezuela. Introducción a la paleoecología en el Norte de Sudamérica. Universidad Experimental Francisco de Miranda, Cuadernos Falconianos, Coro.

Owen R. 1842. Report on British fossil reptiles. Part II. *Reports of the British Association for the Advancement of Science* 11:60–204.

Rincón R.A.D., Alberdi M.T., Prado J.L. 2006. Nuevo registro de *Equus* (*Amerhippus*) *santaeelenae* (Mammalia, Perissodactyla) del pozo de asfalto de Inciarte (Pleistoceno Superior), Estado Zulia, Venezuela. Ameghiniana 43:529–538.

Rouse I., Cruxent J.M. 1963. Some recent radiocarbon dates for western Venezuela. American Antiquity 28:537–540. DOI

Royo y Gómez J. 1959. Geology and paleontology of the beds with artifacts at Muaco, state of Falcon. *Boletín Informativo de la Sociedad Venezolana de Geología, Minería y Petróleo* 2:257–258.

Royo y Gómez J. 1960. Características paleontológicas y geológicas del yacimiento de vertebrados de Muaco, Estado Falcón, con industria lítica humana. *Memorias del III Congreso Geológico Venezolano* 2:501–505.

Seymour K.L. 2015. Perusing Talara: overview of the late Pleistocene fossils from the Tar Seeps of Peru. Pp. 97–100, in Harris J.M (Ed.), La Brea and Beyond: The Paleontology of Asphalt-Preserved Biotas. *Natural History Museum of Los Angeles County,* Science Series 42:1–174.

Soibelzon L.H., Rincón A.D. 2007. The fossil record of the short-faced bears (Ursidae, Tremarctinae) from Venezuela: systematic, biogeographic, and paleoecological implications. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen* 245:287–298. DOI

Theobald W. 1868. Catalogue of reptiles in the Museum of the Asiatic Society of Bengal. *Journal of the Asiatic Society* 88:3–12. DOI

Turtle Taxonomy Working Group. 2017. Turtles of the world: annotated checklist and atlas of taxonomy, synonymy, distribution and conservation status (8th edition). *Chelonian Research Monographs* 7:1–292. DOI