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The first terror bird of Colombia: a giant rewriting the paleoecology and palaeobiogeography of La Venta Miocene

La primera ave del terror de Colombia: se reescribe la paleoecología y paleobiogeografía del Mioceno de La Venta

Following the last major extinction event 66 million years ago (M.y.), the sole surviving dinosaur lineage, the Neornithes birds, underwent a period of diversification into an array of new groups during the Paleocene and Eocene between 66 to 34 M.y. that would later become the modern avian species. The Cariamiformes birds and their family, Phorusrhacidae, are among these lineages. This family, colloquially designated as the "Terror Birds" on account of their considerable dimensions and robust beak heads, occupies ecological niches as predators in the Cenozoic ecosystems of South America (**Mayr**, 2016).

In contrast with the popular belief that these birds are direct descendants of the avian dinosaurs that survived the extinction, they are not an "ancestral" lineage in the context of modern birds. Conversely, they are related to other derived lineages that diversified in South America, such as the falcons (Falconiformes) and groups of significant representation and origin in the southern hemisphere, such as the parrots (Psittaciformes) or the songbirds (Passeriformes). Indeed, the most closely related extant taxa to the terror birds are other Cariamiformes (Family Cariamidae), the Seriemas or Chuñas, which inhabit open and semi-open dry environments in Brazil, Argentina, Uruguay, Paraguay, and Bolivia.

The terror bird family (Phorusrhacidae) has an evolutionary history of approximately 45 M.y., with findings dating back from the middle Eocene of Argentina (43 M.y.) (**Acosta-Hospitaleche & Jones**, 2024) to remains from Uruguay that support their presence in South America until the late Pleistocene (96,040 years ago) (**Jones *et al.***, 2018). Similarly, the discovery of fossils in southern Texas and Florida (USA) has enabled the description of *Titanis*, which was approximately 2 meters in height. This evidence suggests that this group migrated to North America during the Pliocene (approximately 3 million years ago), thereby participating in the Great American Biotic Interchange (GABI), a pivotal event in the evolution of Neotropical biodiversity (**Pelegrin *et al.*,** 2018).

The evolutionary history of the terror bird lineage is characterised by remarkable diversity, with five subfamilies emerging over time. The subfamilies Psilopterinae, Mesembriornithinae, Patagornithinae, Physornithinae, and Phorusrhacinae exhibited considerable variation in size and body mass among their constituent species. Notably, Physornithinae and Phorusrhacinae lineages exhibited pronounced tendencies towards gigantism. In terms of time, the Phorusrhacinae lineage appeared after the extinction of the Physornithinae, indicating a process of species turnover in the context of the apex predator niche (**LaBarge *et al.***, 2024). Consequently, during the Miocene, large Phorusrhacinae species coexisted with members of other subfamilies, such as Psilopterinae, which were of a smaller and medium size. This process suggests patterns of niche partitioning in the diversification of the terror birds (**LaBarge *et al.***, 2024).

In south-central Colombia, the region known as the Tatacoa Desert, an area noted for its important paleontological richness, was recently recognized by **UNESCO** (2024) as a site of world interest for geological heritage. This site and its famous locality of La Venta have been investigated for more than 100 years, shedding light on a highly complex

structure of vertebrate communities in northern South America during the middle Miocene (ca. 13 M.y.). A large number of fossil finds have made it possible to document the presence of a diversity of endemic lineages of fish, caimans, turtles, and mammals (**Carrillo *et al.*,** 2023). However, knowledge is still limited regarding the prehistoric avifauna (**Pelegrin *et al.*,** 2023).

In the context of Neotropical avifaunal knowledge, the recent discovery of the first bird of terror for Colombia is of considerable significance as this is the first time that a member of this lineage has been reported for northern South America (**Degrange *et al.***, 2024). The fossil specimen, designated MT 0200, was discovered in the Diomatal locality (Huila) by César Perdomo of the Museo Paleontológico La Tormenta and subsequently studied by a group of researchers from various institutions in Argentina, Colombia, the United States, and Perú. The discovered remains comprise the distal end of a left tibiotarsus and were recovered from the Chunchullo beds unit of the La Victoria geological formation (**Figure 1**). The anatomical element was then subjected to comparison and analysis with other species of Phorusrarchidae, including *Phorusrhacos longissimus*, *Devincenzia pozzi*, *Patagornis marshi*, *Llallawavis scagliai*, and *Mesembriornis milneedwardsi*. The analyses enabled the identification of the specimen within the subfamily Phorusrhacinae, which includes some of the larger species. In particular, the Colombian terror bird is identified as the largest specimen to date, with an estimated mass of 156 kg, a value that is considerably higher than previous estimates for other large forms, such as *Kelenken* or *Titanis* (**Degrange *et al.***, 2024) (**Figure 2**).

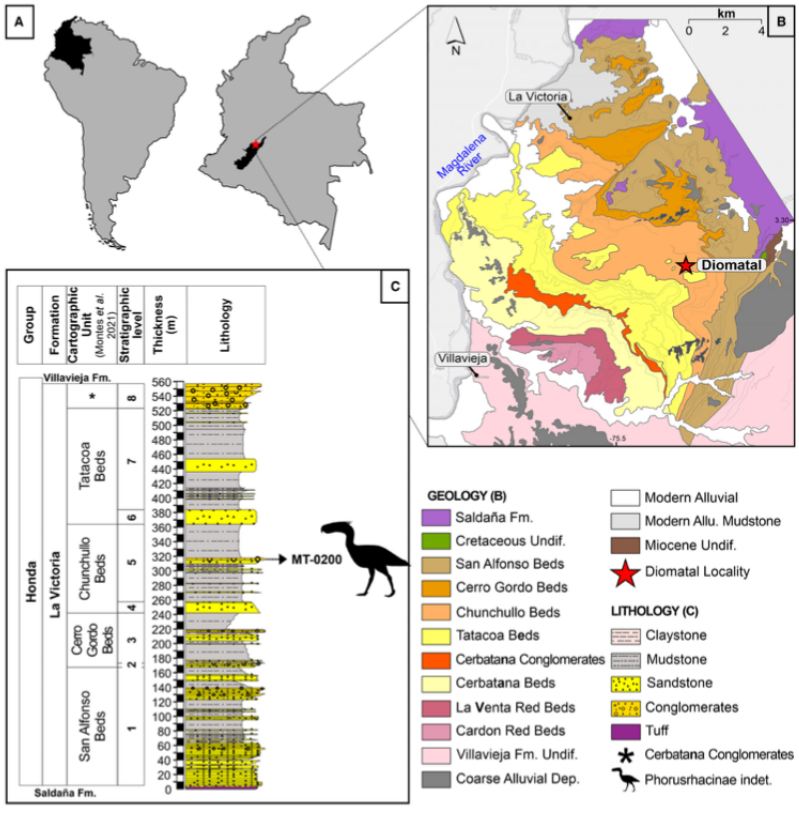

Figure 1. Geological context and stratigraphic occurrence of MT-0200 ('Phorusrhacinae' indet.) **A.** Maps of South America and Colombia indicating the Tatacoa Desert at Huila department. **B.** Geological map of the Honda Group highlighting the Diomatal locality. **C.** Stratigraphic column illustrating the provenance of MT-0200. The cartographic unit marked with an asterisk (*) denotes the Cerbatana Conglomerates (**Degrange *et al.***, 2024).

Figure 2. Proposed paleontological scientific illustration of specimen MT0200 in its paleoenvironmental context (Illustrator: Andrés Bernal)

The pervasive occurrence of terror birds in southern South America, in contrast to their absence in the tropical region of the continent, has prompted speculation regarding the potential dispersal routes of these birds and the process of their colonization of North America. In light of this evidence, the recent discovery of specimen MT-0200 has implications for the paleobiogeographic context, suggesting that the terror birds may have fully expanded throughout South America during the middle Miocene. This epoch was pivotal in the emergence, expansion, and configuration of diverse open and semi-open environments that could have facilitated the dispersal of these organisms (**Doláková *et al.*,** 2021). Similarly, the hypothesis suggests that the Phorusrhacinae lineage may have migrated from present-day Colombia to North America via the Panama land bridge, which would have provided a potential pathway for the subsequent origin of the *Titanis* genus during the Pliocene.

The discovery of MT-0200 has significant implications for the paleoecology of the La Venta ecosystem during the middle Miocene. Thus far, the evidence suggests that the trophic structure would have been dominated by caimans of various sizes and predatory niches, such as those developed by Sebecid species (e.g. *Langstonia*) or giant caimans such as the large *Purussaurus* (**Wilson & Parker**, 2023). However, the new terror bird may indicate an important role as an apex predator in open and semi-open terrestrial environments in proximity to water bodies where it could encounter medium and large prey. In conclusion, the new terror bird record not only contributes to the knowledge of the Miocene avifauna of La Venta but also provides evidence of the enormous paleontological potential and the possibility of future discoveries in the Tatacoa Desert region.

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