

THE FIRST RECORD OF THE EXTINCT CRAB *NECRONECTES* (DECAPODA: PORTUNIDAE) IN VENEZUELA

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ABSTRACT – The Urumaco Formation is well known for being fossiliferous, including both vertebrate and invertebrate assemblages. Despite extensive field work over the past years the decapod fauna from the Urumaco Formation still remains poorly known. In the present work we report for the first time the presence of the extinct portunid crab, *Necronectes proavitus* Rathbun from Venezuela, based on a well-preserved cast of the carapace recovered from the late Miocene Urumaco Formation. This record significantly contributes to a better understanding of both the biochronology and biogeography of *Necronectes* in the Caribbean region. *N. proavitus* is now known from the early to late Miocene of Puerto Rico, Trinidad, Panama, Venezuela and Brazil.

Key words: *Necronectes*, South America, late Miocene, Urumaco Formation, portunids.

INTRODUCTION

Necronectes is an extinct genus of the extant crab family Portunidae which is known from the Caribbean, North America, and Europe (Milne-Edwards, 1881; Rathbun, 1918, 1935; Tice, 1962; Collins & Donovan, 1995; Schweitzer *et al.*, 2002, 2006) with a biochron from the late Oligocene until the late Miocene. The genus *Necronectes* currently includes: *N. beaumonti* (Milne Edwards, 1864), initially referred to *Cancer*; *N. collinsi* (Schweitzer *et al.*, 2006); *N. drydeni* (Rathbun, 1935); *N. nodosa* (Schweitzer *et al.*, 2002); *N. (Gatunia) proavitus* (Rathbun, 1918); *N. schafferi* (Glaessner, 1928); *N. summus* (Collins & Donovan, 1995); *N. tajinensis* (Vega *et al.*, 1999); *N. (Portunites) vicksburgensis* (Stenzel, 1935), = *N. vaughani* Rathbun, 1935 (*vide* Rathbun, 1936); and *N. vidalianus* (Milne Edwards, 1881).

In the Caribbean, five fossil species of *Necronectes* are currently known. These are: *N. proavitus*, known from the San Sebastian Formation, “Basal Lares Limestone” (early Miocene) (Collins *et al.*, 2009), the Gatun Formation (middle Miocene) of Panamá (Rathbun, 1918) and the Brasso Formation (early to middle Miocene) of Trinidad (Collins *et al.*, 2009); *N. summus* from the Long Bay Member of the Antigua Formation (late Oligocene, Antigua) (Collins and Donovan, 1995); *N. tajinensis* from Tuxpan Formation (middle Miocene) of Mexico, and

Pirabas Formation (early Miocene) of Brazil (Vega *et al.*, 1999; Távora *et al.*, 2002), *N. collinsi* from the San Sebastian Formation (middle to late Oligocene) of Puerto Rico (Schweitzer *et al.*, 2006), and *N. nodosa* known from the Oligocene of Baja California, Mexico (Schweitzer *et al.*, 2002; Schweitzer & Iturralde-Vinent, 2005). Recently, Aguilera *et al.* (2010) reviewed the fossil record of the “Decapoda of Venezuela”, including fossils of brachyuran and anomuran decapods and reported poorly preserved unidentifiable chelipeds (possibly of *Necronectes*), from the early Miocene Castillo Formation.

The Urumaco Formation is one of the most important paleontological areas in Venezuela with a well-documented biodiversity of both vertebrate and invertebrate fossils (see Sánchez-Villagra *et al.*, 2010 for details). In the latter group, the most abundant are the mollusks but decapod crustaceans are common too (Quiroz & Jaramillo, 2010; Aguilera *et al.*, 2010). Several field trips to outcrops of the Urumaco Formation during the last few years resulted in the recognition of new fossil material similar to the genus *Necronectes*. Based on our study of these new specimens we present the first record of the genus *Necronectes* from the late Miocene Urumaco Formation, Northwestern Venezuela.

GEOLOGICAL SETTING

The Urumaco Formation consists of a complex intercalation of medium to fine grained sandstone, organic-rich mudstone, coal, shale, and thick-bedded coquinoidal limestone with abundant mollusk fragments (Quiroz & Jaramillo, 2010). The dominant paleoenvironment during the deposition of sediments forming the Urumaco Formation is still unclear. According to Díaz de Gamero & Linares (1989) and Hambalek *et al.* (1994), the sedimentation of the Urumaco Formation occurred in a complex of marginal and near-coastal environments, while Quiroz & Jaramillo (2010) suggest that deposition probably occurred in a prograding strandplain-deltaic complex. Based on a study of the foraminifera Díaz de Gamero & Linares (1989) proposed a late Miocene age for the formation. The vertebrate assemblage includes fish, reptiles, birds, and mammals (Sánchez-Villagra *et al.*, 2010) and based on the fossils of several terrestrial mammals recovered, Linares (2004) assigned the formation to the middle-late Miocene.

This formation can be informally divided into three members: lower, middle, and upper. The fossils here described were recovered from the lower member of the Urumaco Formation, at the “Cangrejote” locality, 29 km east of Capatarida Town, Buchivacoa municipality, Falcón State, Venezuela (Figure 1). The decapod here described was collected southwest of the locality where Rincón *et al.* (2015) found a new species of Mylodontoid sloth.

MATERIAL AND METHODS

The specimen here reported is curated in the paleoinvertebrate collection of the Paleontology Laboratory at Instituto Venezolano de Investigaciones Científicas (IVIC–P) in Caracas, Venezuela. All measurements are in millimeters and were taken with a precision caliper (Trupper, ± 0.1 mm, max. 150 mm).

The systematic classification used in this paper, essential terminology and nomenclature in descriptions, is mainly based on Schweitzer *et al.* (2002). In addition were used other complementary bibliography as Karazawa *et al.* (2008) and De Grave *et al.* (2009) as a support for systematic classification and genus phylogenetic relationships.

SYSTEMATIC PALEONTOLOGY

Order DECAPODA Latreille, 1802
Family PORTUNIDAE Rafinesque, 1815

Necronectes Milne Edwards, 1881

Type species. *Necronectes vidalianus* A. Milne Edwards, 1881, by original designation.

Necronectes proavitus Rathbun, 1918
(Figure 2)

Referred material. IVIC-P-2869; well-preserved cast of carapace, associated chelae and a mold of the right cheliped segments.

Locality and age. “Cangrejote” site ($11^{\circ}11'41.15''N$; $70^{\circ}21'37.32''W$), lower member of the Urumaco Formation (late Miocene), Buchivacoa Municipality, Falcón State, Venezuela.

Description. Carapace wider than long. Protogastric, mesogastric, and metagastric regions well developed; epibranchial, mesobranchial and metabranchial less differentiated, protogastric region prominent, depressing frontally. Frontal region fractured. Cardiac and intestinal region prominent, probably due to the taphonomy of the specimen and its preservation; the metabranchial region is depressed. Antero-lateral margin suboval with eight robust spines (including the outer orbital spine). Concave anterior margin and convex posterior margin, forward-directed and increasing in width from the outer orbital spine to the 7th. Lateral spine fragmented, bigger than the outer orbital spine but smaller than the 2nd. Tips acute and subacute, which may be due to taphonomy. Right anterolateral margin mostly fractured. Granule patches near the bases of the 3rd, and between the 4th and 5th (Figure 2) anterolateral spines, besides others present in the subhepatic region, indicate that the carapace was ornamented with granules. Posterolateral margin shorter than the anterolateral margin, almost straight, being slightly concave near the metabranchial region, towards the posterior margin. Front fragmented representing almost 43% of the total width, only presenting a supraorbital spine, wider than long. Narrow, shallow supraorbital fissure. Pterigostomal region with granules like the ones present in patches mentioned before. Thoracic sternites wider than long, distal region forward-directed, being longer than the proximal region. Thoracic sternites I to V, terminal abdominal somites and telson are not visible due to sediment. Apparently triangular abdomen, 2nd somite covering almost all the 8th thoracic sternite. Merus of the second pereopod long, slightly wider distally than proximally, with a longitudinal medial ridge, robust basicoxa. Large chelipeds, ischium discrete and close to the basis and coxa, oblong merus, being wider in the medium section of the segment and narrower distally and proximally. Massive, apparently inflated carpus. Asymmetric, strong chelae, with the right bigger and more massive than the left, longer than high both narrow distally and inflated

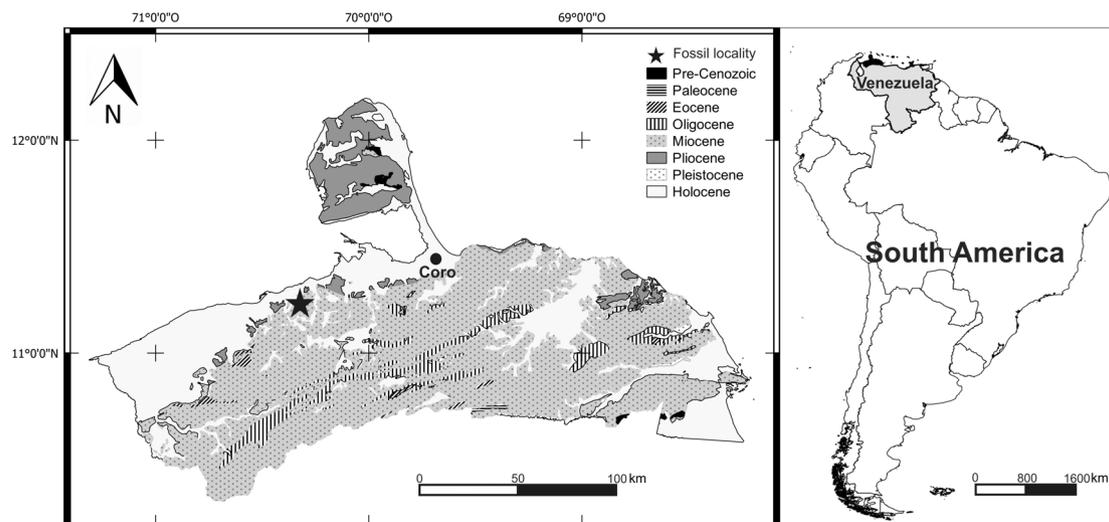


Figure 1. Maps of the location where the specimen here described was found. **A**, Simplify surface geology map of the Falcón State, Venezuela, showing the location of the “Cangrejote” locality (modified by Hackley *et al.*, 2004); **B**, map of South America showing Venezuela (light gray) and Falcón state (black).

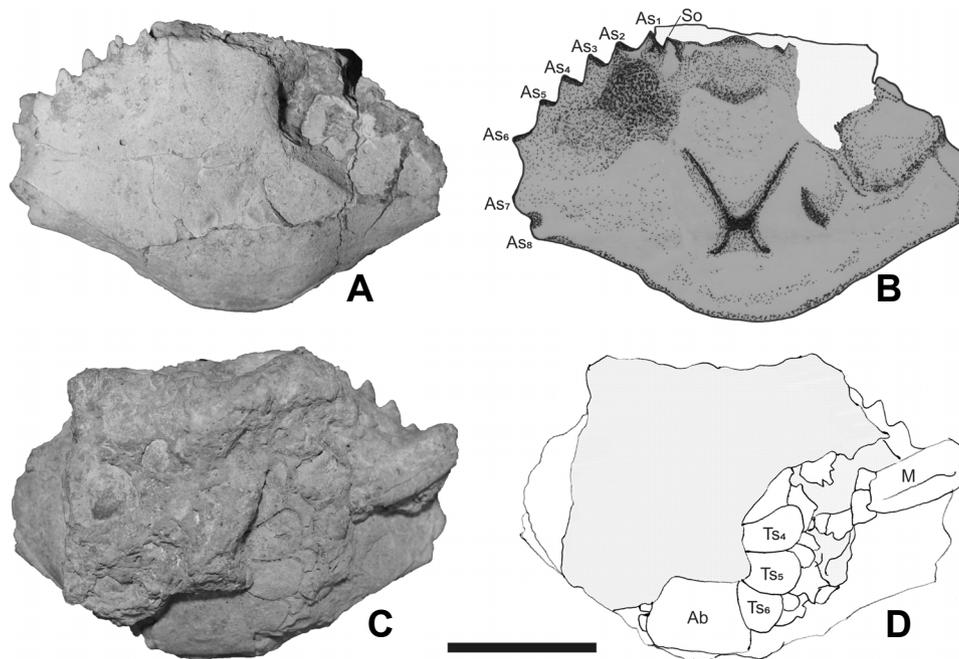


Figure 2. A-D, *Necronectes proavitus* from Urumaco Formation (IVIC-P-2869), in dorsal (A-B) and ventral (C-D) views. **Abbreviations:** **As₁**, outer orbital spine; **As₂₋₈**, 2th to 7th anterolateral spines; **M**, mero (second leg); **Ab**, abdomen; **Ts₄₋₆**, thoracic sternites. Scale bar = 50 mm.

proximally, with a longitudinal ridge in the upper part of the proximal section. The outer surface is slightly rounded. Fingers and articular condyle fragmented. Ornamentations absent.

Measurements. Carapace: width: 129.54 mm, length: 84 mm, front width: 55.38 mm; major chelae maximum height: 36.3 mm; major chelae length (manus): 44.5 mm; minor chelae maximum height: 28.4 mm; minor chelae length (manus): 41.3 mm.

DISCUSSION

The fossil examined fits the main characteristics of the genus *Necronectes* as defined by Milne-Edwards (1881) based on the following diagnostic characters: the number of anterolateral spines, size and development of the lateral spine – last anterolateral spine. Other morphological features mentioned by Schweitzer *et al.* (2002) include a transversal ridge weakly developed or absent, and the anterolateral margin tending to be longer than the posterolateral margin. The first three characters are the most distinctive for distinguishing *Necronectes* from other closely-related portunids (Schweitzer *et al.*, 2002). IVIC-P-2869 was compared with five of the species in the genus: *N. tajinensis*, *N. summus*, *N. nodosa*, *N. collinsi*, and *N. proavitus* known from the Caribbean.

IVIC-P-2869 resembles *Necronectes proavitus* (Rathbun, 1918) in the shape, disposition and sturdiness of the chelae, and differs from *N. nodosus*, which has long and slender chelae (Schweitzer *et al.*, 2002), however it differs from the ornamentation (fine granules) present in *N. proavitus*, although it might have been not preserved. Chelae in IVIC-P-2869 are similar to *N. tajinensis*, based on the asymmetry and sturdiness of the chelae (Vega *et al.*, 1999). The articular condyle could not be compared due the fragmentation of the distal portion of the chelae. No keels are present in the fossil, and the chelae shape is somewhat different in *N. summus*

with an increased height distally, but is similar in the rounded surface of the chelae (Collins & Donovan, 1995). The shape of the inferior-anterior part of the merus in *N. proavitus* is slightly rounded, as is the case in the specimen described here, and they both have a massive carpus. The oblong merus seems to be a common character to all of the species reported from the Caribbean, and have been described in *N. collinsi* and *N. proavitus*. The anterolateral spines differ in shape with those of *N. collinsi* (Schweitzer *et al.*, 2006), and has similarities to *N. proavitus*, however the increase in size of the spines is absent in the specimen, maybe due its preservation. The fossil from Urumaco differs from *N. nodosa* in the lateral orientation of the 6th and 7th spines (Schweitzer *et al.*, 2002), which are not present in IVIC-P-2869.

As previously mentioned, for Venezuela there is a single doubtful record of “*Necronectes* sp.” from the early Miocene Castillo Formation (Aguilera *et al.*, 2010). The authors recognized that the poor preservation of the fossil prevented an accurate identification (Aguilera *et al.*, 2010) and did not assign the specimen to *Necronectes*. Significantly, the presence of IVIC-P-2869 provides the first unequivocal record of *Necronectes* in Venezuela. In addition, its identification as *N. proavitus* improves our understanding of the biochronology and biogeography of this species in the Caribbean. This report adds the late Miocene of the Urumaco Formation to the previous records of the species in the area.

The brachyuran decapods live in coastal bottoms, reefs and some like the portunids are swimmers. *Necronectes collinsi* has pleopods and although these structures have not been described in other species of genus, this may be an artifact of preservation in which the pleopods were not preserved, so the character may be present in other species included in *Necronectes*. Another genus related with *Necronectes*, *Scylla* has this character (Karazawa *et al.*, 2008), suggesting that this hypothesis is fairly probable.

The presence of *Necronectes proavitus* in the Urumaco Formation, might imply that this species was distributed in the pelagic regions along the Caribbean coast, from Panamá to Trinidad, and before the final closure of the Panamanian isthmus about 3–4 Ma (Coates & Obando, 1996), its range may have extended along the coastline of Colombia.

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