

FIRST RECORD OF *CALAMOPLEURUS* (ACTINOPTERYGII: HALECOMORPHI: AMIIDAE) FROM THE CRATO FORMATION (LOWER CRETACEOUS) OF NORTH-EAST BRAZIL

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Abstract : A partial skeleton represents the first occurrence of the amiid (Actinopterygii: Halecomorphi: Amiidae) *Calamopleurus* from the Nova Olinda Member of the Crato Formation (Aptian) of north east Brazil. The new specimen is further evidence that the Crato Formation ichthyofauna is similar to that of the slightly younger Romualdo Member of the Santana Formation of the same sedimentary basin. The extended temporal range, ?Aptian to ?Cenomanian, for this genus rules out its usefulness as a biostratigraphic indicator for the Araripe Basin.

Key words: Amiidae, *Calamopleurus*, Early Cretaceous, Brazil

Première mention de *Calamopleurus* (Actinopterygii: Halecomorphi: Amiidae) dans la Formation Crato (Crétacé inférieur), nord est du Brésil

Résumé : la première mention dans le Membre Nova Olinda de la Formation Crato (Aptien ; nord-est du Brésil) de l'amiidé (Actinopterygii: Halecomorphi: Amiidae) *Calamopleurus* est basée sur la découverte d'un squelette partiel. Le nouveau spécimen est un élément supplémentaire indiquant que l'ichthyofaune de la Formation Crato est similaire à celle du Membre Romualdo de la Formation Santana, située dans le même bassin sédimentaire. L'extension temporelle de ce genre (?Aptien à ?Cénomanien) ne permet pas de le considérer comme un indicateur biostratigraphique pour le bassin de l'Araripe.

Mots clés : Amiidae, *Calamopleurus*, Crétacé inférieur, Brésil

INTRODUCTION

Fossil fishes are very common in the Nova Olinda Member of the Crato Formation where the ichthyofauna is dominated (>95%) by the gonorhynchiform *Dastilbe crandalli* Jordan, 1910 (Davis & Martill, 1999). Other fish species include the ichthyodectid *Cladocycclus* sp. Maisey (1996) which occurs rarely and single occurrences only of the semionotid cf. *Araripelepidotes* (Brito *et al.*, 1998) and the coelacanth *Axelrodichthys* sp. (Brito & Martill, 1999). These rarer taxa are well known and relatively common in the slightly younger Romualdo Member of the Santana Formation in the same basin. Fishes are also known from the Ipubi Formation near

Araripina and at Mina Pedra Branca, near Nova Olinda where cf. *Dastilbe* sp. and *Vinctifer* sp. have been collected from laminated black shales beneath massive evaporite deposits. However, although *Dastilbe crandalli* is exceptionally abundant in the Crato Formation, it has not been certainly reported from the Romualdo Member of the Santana Formation, and as a result the two fish faunas have been considered distinct (Maisey, 1991; Martill, 1993; Davis & Martill, 1999). Here we report on the occurrence of an incomplete specimen of an amiid resembling *Calamopleurus* from the Crato Formation: a taxon that is common in the Romualdo Member of the Santana Formation.

LOCALITY AND STRATIGRAPHY

The new specimen was obtained from a quarry worker who reported that it was collected from the laminated limestones worked in the region of Nova Olinda and Santana do Cariri, southern Ceará, Brazil (fig 1). More precise locality details were unavailable. The matrix is entirely consistent with a derivation from this region, where numerous quarries are worked for building, paving and ornamental stone (Martill, 1993).

The limestones worked in this region were termed the Nova Olinda Member by Martill (1993), and they form a distinctive lithological unit of between ~1 and 11.5 metres lying at the base of the Crato Formation. These limestones are generally considered to be of Aptian age on palynological grounds (Pons *et al.*, 1990) and lie within a sequence of sandstones, clays, shales and siltstones of the Araripe Group (Fig 2). They have been considered to represent freshwater lacustrine environments by Maisey (1996) whereas Martill (1993) and Davis & Martill (1999) suggest a stratified hypersaline/anoxic lagoonal system for their accumulation.

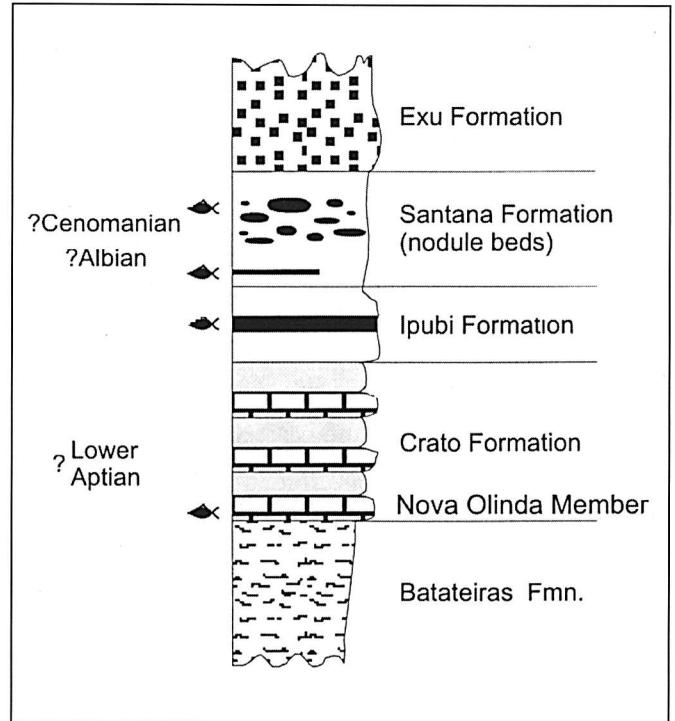


Figure 2. Simplified stratigraphic column for the Araripe Group of the Araripe Basin. The new specimens of *cf. Calamopleurus* are from the Nova Olinda Member of the Crato Formation. Fish symbols indicate horizons known to yield fishes.

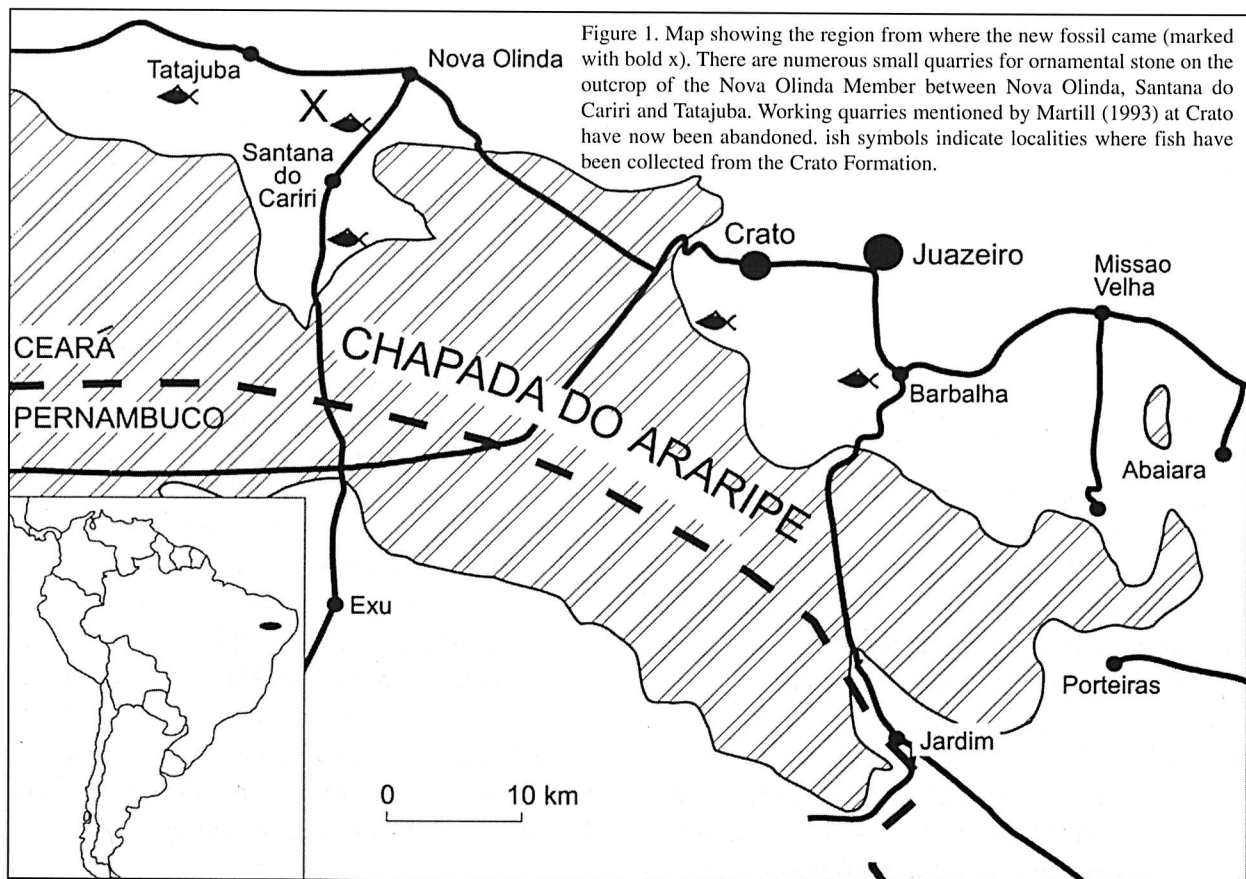


Figure 1. Map showing the region from where the new fossil came (marked with bold x). There are numerous small quarries for ornamental stone on the outcrop of the Nova Olinda Member between Nova Olinda, Santana do Cariri and Tatajuba. Working quarries mentioned by Martill (1993) at Crato have now been abandoned. Fish symbols indicate localities where fish have been collected from the Crato Formation.

SYSTEMATIC PALAEOONTOLOGY

- Subclass ACTINOPTERYGII Cope,
1887 (*sensu* Rosen *et al.*, 1981)
Series NEOPTERYGII Regan, 1923
(*sensu* Rosen *et al.*, 1981)
Division HALECOSTOMI Regan, 1923
(*sensu* Patterson, 1973)
Subdivision HALECOMORPHI Cope, 1872
(*sensu* Patterson, 1973)
Order AMIIFORMES Hay 1929
(*sensu* Grande & Bemis, 1998)
Family AMMIIDAE Bonaparte, 1838
Subfamily VIDALAMIINAE Grande & Bemis,
1998
Tribe CALAMOPLEURINI Grande & Bemis, 1998
Genus cf. *Calamopleurus* Agassiz, 1841

THE NEW SPECIMEN

The new specimen is accessioned in the collection of the Museo do Santana do Cariri, specimen numbers MPSC (Fig. 3). The fish skeleton lies on its left side (as viewed) on a slab of cream coloured, laminated limestone measuring 380 mm x 120 mm. The slab is fractured with the fracture extending through the fossil. Although the skeleton is incomplete, the bones are well preserved. The bones of the trunk are only slightly crushed, although there is much flattening of the skeleton such that the specimen is somewhat 2D.

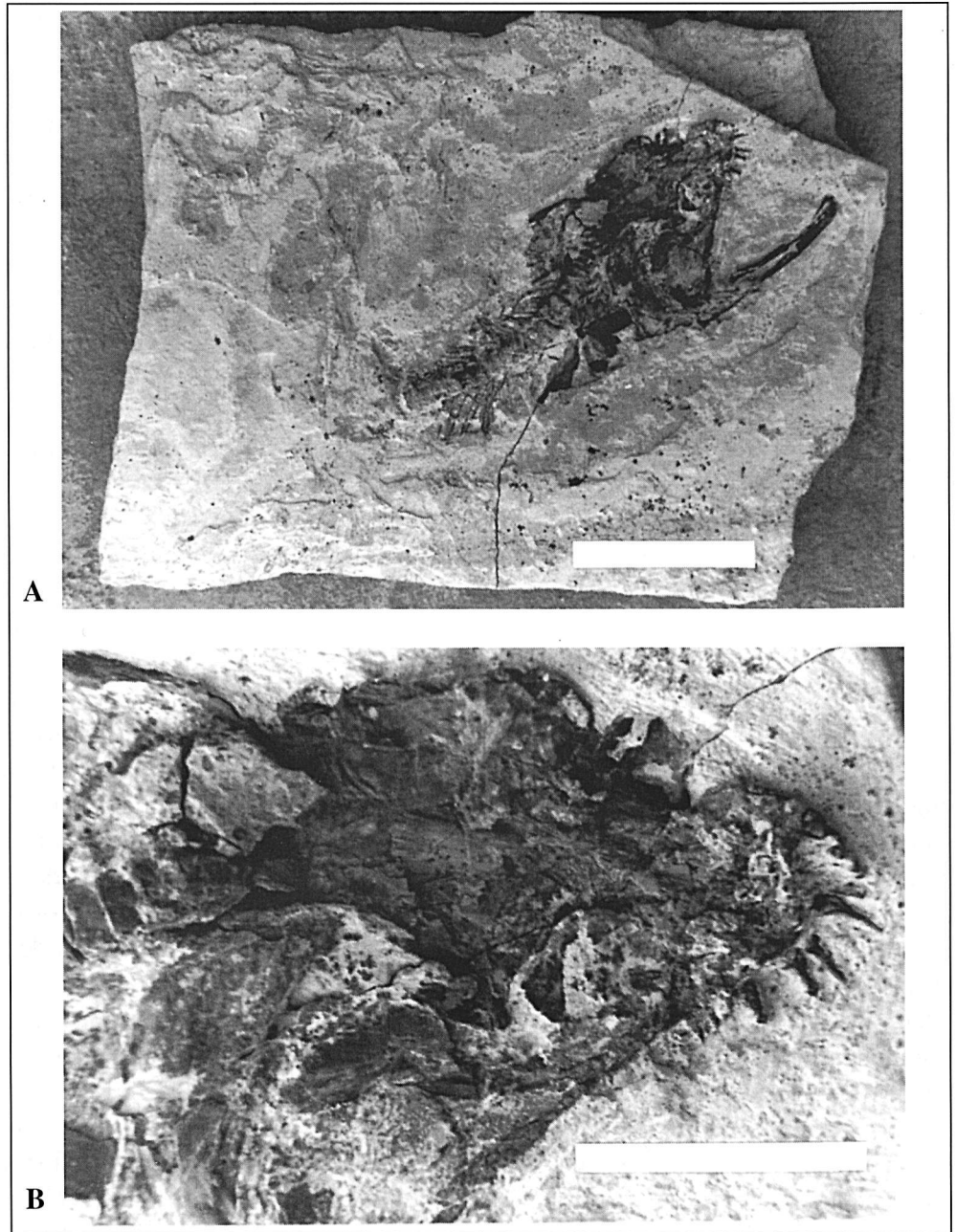
The skeleton comprises the skull roof, left lower jaw, and anterior twenty-two vertebrae and ribs of the trunk (Fig. 3). The roof of the skull and braincase is seen from internally. Teeth are present in the left dentary but are largely obscured by matrix. Teeth are also present on the left premaxilla (5 large teeth), the left maxilla (5 small teeth seen) and the vomer (a few small teeth). The left preopercle and parts of the left opercle and subopercle are present. The anterior-most part of the vertebral column comprising twenty-two vertebrae with several neural arches and pleural ribs present is preserved still attached to the skull. There is no trace of the pectoral girdle or fins and there are no scales preserved.

The systematic classification follows Grande & Bemis, 1998. The new specimen is an amiiform and

is assigned to the tribe Calamopleurini on account of the coronoid bones possessing only a single row of teeth. In addition the arrangement of the teeth on the vomers (e.g. an anterior row of five teeth, followed by a row of three teeth) matches that described by Grande & Bemis (1998) for Calamopleurini.

Further identification is difficult as the new specimen does not display features that allow us to distinguish between the three species included in *Calamopleurus*. Two species of *Calamopleurus* have been reported from the Early Cretaceous of Brazil. *C. cylindricus* from the Romualdo Member of the Santana Formation was described in detail by Santos (1960), Taverne (1974), Wenz (1977) and more recently by Grande & Bemis (1998), while its nomenclatural history was reviewed by Maisey (1991). *C. cylindricus* (commonly found in the literature as *Enneles audax*) is known from many hundreds of complete or near complete specimens (see Grande & Bemis 1998 for an extensive list of figured and examined material). A second Brazilian species, *C. mawsoni* (Woodward, 1902) from the Ilhas Formation (Early Cretaceous, Bahian local stage) of Bahia is known from only a single specimen lacking a skull (see Grande & Bemis 1998 for a complete review of this taxon) and cannot be compared with the new specimen described herein. A caudal skeleton attributed to *Calamopleurus* sp. was described from the Aptian-Albian marine beds of Equatorial Guinea (Taverne, 1997). A third species, *Calamopleurus africanus* Forey & Grande (1998) has been described from north west Africa. This species is certainly distinct from *C. cylindricus*, but a synonymy with *C. mawsoni* cannot be ruled out. Assignment of the specimen described here to a species is rendered slightly difficult because of its incomplete nature as well as the incomplete nature of the holotype of *C. mawsoni*. *C. cylindricus* can readily be distinguished from *C. africanus* on account of its broader, smooth gular; that of *C. africanus* is narrow and possesses an anterior carina (Forey & Grande, 1998).

Figure 3.
 Partial skeleton of cf.
Calamopleurus sp. from the
 Nova Olinda Member
 of the Crato Formation,
 comprising an incomplete skull
 and anterior portion
 of the vertebral column.
 Specimen UERJ PMB VP-88.
 A. Entire specimen,
 scale bar = 80 mm.
 B. Detail of skull,
 scale bar = 40 mm.



DISCUSSION

The occurrence of cf. *Calamopleurus* in the Nova Olinda Member of the Crato Formation is further evidence for the similarity of its ichthyofauna with that of the Romualdo Member of the Santana Formation (Martill 1988, Maisey 1991). Abundance data (only one specimen of *Calamopleurus* reported from the Crato Formation compared with hundreds from the Romualdo Member of the Santana Formation) suggests that *Calamopleurus* was rare in the Crato lagoon.

Taphonomic considerations (the specimen is incomplete) suggest that it may not have inhabited the lagoon and is an allochthonous occurrence. The taphonomic condition hints at some post-mortem drifting and decay. Thus the specimen of *Calamopleurus* in the Nova Olinda Member may represent an exotic transported from marine (*Calamopleurus* in the Romualdo Member is thought to be marine or brackish (Maisey, 1991)) or more freshwater environments (most post-Mesozoic amiids are freshwater or from freshwater deposits (Grande & Bemis, 1998)) adjacent to the Crato lagoonal system.

Notwithstanding the similarities between the ichthyofaunas of the Crato and Santana Formations (see Table 1), there remain notable differences. All fish genera other than *Dastilbe* are exceedingly rare in the Crato Formation, while many species that are abundant in the Santana Formation remain to be reported from the Crato Formation; e.g. *Vinctifer*, *Rhacolepis*, *Notelops*, *Brannerion*, *Neoprocinetes*, *Tharrias*. Although these differences may in part be attributed to age, it can be presumed that some disparity is due to palaeoecological rather than preservational factors, as a wide range of vertebrate fossils occur in an excellent state of preservation in the Nova Olinda Member. Such palaeoenvironmental factors are likely to be related to salinity and/or oxygen content. We suggest that the very high abundance of the single taxon *Dastilbe crandalli* in the Crato lagoon is evidence for elevated salinities rather than low salinities (see discussion in Davis & Martill, 1999). If this scenario is correct, then the Crato lagoon was probably a highly restricted system connected to a normal marine basin from which occasionally entered marine fishes. Much work remains to be done on the ichthyofaunas of the Crato and Santana formation fishes to resolve some of the palaeoecological conundrums of this fascinating fossil lagerstätte.

ACKNOWLEDGEMENTS

Special thanks to Dr André Herzog (URCA, Crato) and Dr Artur Andrade (D.N.P.M. Crato) for their assistance in the field. Thanks to Mr Robert Loveridge (Portsmouth) for photography and Drs Lance Grande (Chicago), Lionel Cavin (Esperaza) and Mike Barker (Portsmouth) for critical reading of the manuscript. Also thanks to the 1999 Portsmouth Brazil expedition team.

GENUS	CRATO FORM'N Nova Olinda Mbr	IPUBI FORM'N	SANTANA FORM'N Romualdo Member
<i>Iansan</i>			*
<i>Tribodus</i>			*
<i>Araripelepidotes</i>			*
<i>Neoprocinetes</i>			*
<i>Iamanja</i>			*
<i>Obaichthys</i>			*
<i>Calamopleurus</i>	*		*
<i>Oshunia</i>			*
<i>Vinctifer</i>		*	*
<i>Cladocyclus</i>	*		*
<i>Araripichthys</i>			*
<i>Brannerion</i>			*
<i>Paraelops</i>			*
<i>Rhacolepis</i>			*
<i>Notelops</i>			*
<i>Tharrias</i>			*
<i>Dastilbe</i>	*	?*	
<i>Santanaclupea</i>			*
<i>Mawsonia</i>			*
<i>Axelrodichthys</i>	*		*
<i>Gen Nov.</i>	*		

Table 1. Genera of fish from the Araripe Basin, north-east Brazil. Data for Santana Formation from Maisey (1991) and Martill (1993); data for Crato Formation from Brito *et al.* (1998) and this paper; data for Ipubi Formation from recent fieldwork by Martill.

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