

On the piscivorous behaviour of the Early Cretaceous amiiform neopterygian fish *Calamopleurus cylindricus* from the Santana Formation, northeast Brazil*

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Abstract

A specimen of the Early Cretaceous amiiform fish *Calamopleurus cylindricus* with stomach content is described from the Santana Formation, Brazil. The prey concerns a smaller conspecific individual. Until now, prey items documented for *Calamopleurus* almost exclusively involved the aspidorhynchid *Vinctifer*. On the basis of the present record it is suggested that the prey preference of *Calamopleurus* was less pronounced than previously assumed.

Keywords: Lower Cretaceous, prey items, fish eating

Introduction

The Lower Cretaceous Santana Formation in the Araripe Basin (northeast Brazil) ranks amongst the world's most famous vertebrate-bearing deposits (Martill, 1993; Kellner & De Almeida Campos, 1999). This unit, situated between the states of Ceará, Pernambuco and Piauí, has been subdivided into the Crato, Ipubi and Romualdo members, from bottom to top. Geological, stratigraphical and palaeoecological aspects of the Santana Formation have been described in detail on several occasions (e.g., Maisey, 1991, 1994; Martill, 1993). The sediments reflect deposition in an estuarine environment (Forey, 1977).

The best-known vertebrate fossils from the Santana Formation are various kinds of actinopterygian fish; however, less common taxa have also been recovered, including coelacanths and pterosaurs (see Maisey, 1986; Frey & Martill, 1994). Of the common fish the amiiform neopterygian *Calamopleurus cylindricus* Agassiz, 1841 is most widely known. However, to date, only four examples of this species' piscivorous behaviour are on record; these concern the aspidorhynchid *Vinctifer* sp. as a prey item. In addition, there is a single record of the ichthyodectiform *Cladocyclus* (Maisey, 1994, table 2; Boucot & Poinar, 2010, p. 114, table 18). This has led authors to conclude that

Vinctifer may have been the preferred diet of *Calamopleurus* (Maisey, 1994, p. 9, fig. 14; see also Maisey, 1996, inclusive of a life-like reconstruction by David W. Miller). Here, a new record is presented with a smaller conspecific as stomach content.

To denote the repositories of material referred to in the text, the following abbreviations are used: ND – Museum Natura Docet Wonderryck Twente, Denekamp, the Netherlands; Z – former Natural History Museum Ecodrome, Zwolle, the Netherlands.

Systematic palaeontology

Class Osteichthyes Huxley, 1880 (sensu Friedman & Brazeau, 2010)

Subclass Actinopterygii Cope, 1887

Infraclass Neopterygii Regan, 1923

Order Amiiformes Hay, 1929

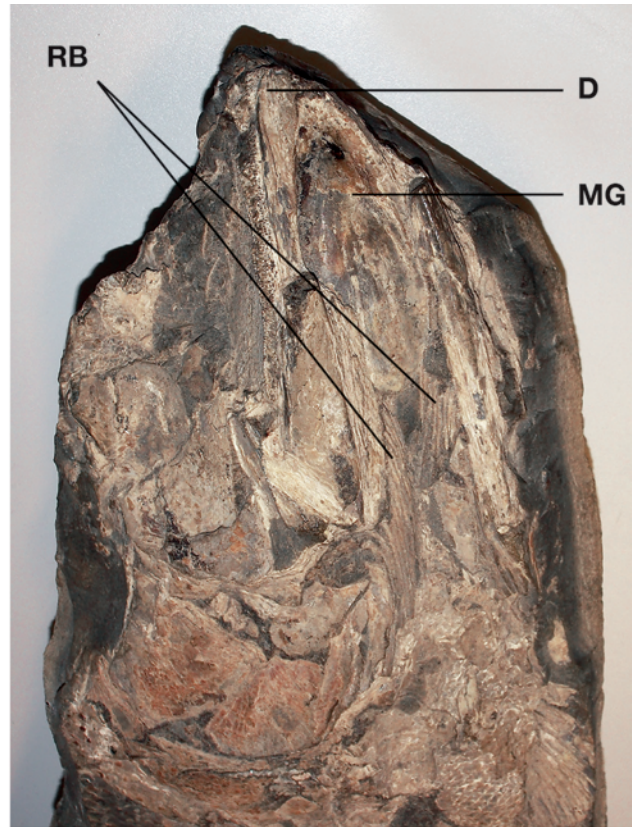
Family Amiidae Bonaparte, 1838

Genus Calamopleurus Agassiz, 1841

Calamopleurus cylindricus Agassiz, 1841

Figs 1, 2.

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B

Fig. 1. *Calamopleurus cylindricus* Agassiz, 1841, ND 2013.01. A. specimen with swallowed conspecific individual, Crato region, Ceará (Brazil), Romualdo Member. Arrow indicates prey item. Total length, as preserved, is 705 mm; B. detail of the skull. D – dentary; MG – median gular plate; RB – radii branchiostegi.

- 1991 *Enneles audax*; Frickhinger, p. 433.
 1993 *Enneles audax*; Martill, p. 86, pl. 19.
 1994 *Calamopleurus*; Maisey, p. 9, fig. 6.

Material

A single, poorly preserved specimen with a smaller-sized conspecific individual as stomach content, ND 2013.01 (ex Z. 36813) (Fig. 1), from the Crato region (State of Ceará), Romualdo Member, Albian (Maisey, 1994). The fossil has recently been donated by the former Ecodrome Zwolle to the Museum Natura Docet Wonderryck Twente at Denekamp.

Description

ND 2013.01 (Fig. 1A) is one half of a nodule, the whereabouts of its counterpart are unknown. As preserved, the fossil measures 705 mm in length, its right lateral side being exposed. The dermatocranial elements (e.g., postorbitals, preopercular, opercular and subopercular) are partially lost; however, they have left behind distinct marks. The mandible and *radii branchiostegi* are visible in ventrolateral view, which explains why dentary teeth cannot be observed. Bordered by the dentaries, the

diagnostic median gular plate is present (Fig. 1B). The fins are not preserved, with the exception of fragments of the left pectoral and pelvic, which are visible in ventral view. Part of the vertebral column can be seen as well. The poor state of preservation of this specimen may have been caused by the splitting of the original nodule. In a small area of the abdomen, tissue and scales have broken off, revealing the stomach content.

The prey's position reveals that the smaller specimen of *Calamopleurus* was swallowed head first. That the prey item is conspecific with the predator is demonstrated by the heavy proportions of the angular-dentary unit, in comparison to the skull and the median gular plate, which is present here as well (Fig. 2; compare Maisey, 1994, fig. 6).

Discussion and conclusions

ND 2013.01 is the first record of *C. cylindricus* with a smaller-sized conspecific individual as prey item. This shows that *Calamopleurus* did not exclusively feed on *Vinctifer*. This raises the question why *C. cylindricus* would express cannibalistic behaviour to a certain extent? Juanes (2003) studied such



Fig. 2. *Calamopleurus cylindricus* Agassiz, 1841, ND 2013.01. Detail of the skull of the swallowed prey (see Fig. 1); O – orbit, M – median gular plate; D – dentary.

behaviour, in particular the allometry of cannibalism in extant gadid neopterygians. That author observed a trend for 'selectivity for larger cannibal prey, which may be driven by higher rates of size-dependent capture success with familiar prey. For all (studied) species, mean trophic breadth of diets including cannibalised prey were larger than those not including cannibal prey, suggesting that relatively large prey sizes may always be available for cannibals' (Juanes, 2003, pp. 594, 600). It is plausible that this also holds true for extinct taxa such as *C. cylindricus*.

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