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A NEW APPRAISAL OF THE *SUSPENSORIUM* OF ALBULID FISHES [1]

(With 3 figures)

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ABSTRACT: The *suspensorium* of albulid fishes is reviewed. The metapterygoid-hyomandibular fenestra is covered by a membrane where part of the *levator arcus palatini* muscle attaches. Contrary to claims in the literature, this muscle does not pass through the fenestra nor does it insert in the medial surface of the palate. The function of this fenestra is probably to reduce the pressure on the *suspensorium* during feeding. Based on data presented herein and other unpublished observations on both fossil and extant albuloid fishes, it remains clear that a systematic review of this group is needed.

Key words: Albulidae, *suspensorium*, anatomy.

RESUMO: Uma nova avaliação do *suspensorium* de peixes albulídeos.

O *suspensorium* de peixes albulídeos é revisto. A fenestra metapterigóide-hiomandibular é coberta por uma membrana, onde parte do músculo *levator arcus palatini* é fixada. Ao contrário dos dados de literatura, não ocorre a passagem deste músculo através da fenestra, nem sua fixação sobre a face medial do palato. A função desta fenestra provavelmente está relacionada com a redução da pressão sobre o *suspensorium* durante a alimentação. Com base nas informações aqui obtidas e outras inéditas sobre albulóides fósseis e recentes, fica evidente a necessidade de uma revisão sistemática do grupo.

Palavras-chave: Albulidae, *suspensorium*, anatomia.

INTRODUCTION

The family Albulidae is a monophyletic assemblage within Elopomorpha known from Late Cretaceous to Recent. It comprises the genera *Albula*, †*Lebonichthys*, †*Deltaichthys*, and a new genus and species (GALLO & FIGUEIREDO, in press) from the Pernambuco-Paraíba Basin, Northeastern Brazil. The monophyly of this group is supported by the presence of a crushing dentition on the parasphenoid; edentulous basihyal and maxilla; posterior circumorbital bones large and covering the cheek plates; and lateral ethmoid sutured to wide parasphenoid (FIELITZ & BARDACK, 1992).

According to FOREY *et al.* (1996), albuloids, represented by *Albula* and *Pterothrissus*, form a clade supported by three synapomorphies: presence of subepiotic fossa; ectopterygoid bearing a dorsal process; and presence of a metapterygoid-hyomandibular fenestra allowing deep portions of the *levator arcus palatini* muscle to pass through and insert onto the medial surface of palate. Since we have questioned this latter feature, we examined some specimens of *Albula vulpes* (Linnaeus, 1758) and propose here a re-appraisal of the *suspensorium* and associated muscles of albulid fishes.

MATERIAL AND METHODS

The fossil material used in this study comprises †*Lebonichthys*, †*Deltaichthys*, and a new albulid from the Pernambuco-Paraíba Basin. Regarding the two former taxa, we have mainly used literature information (FOREY, 1973; FIELITZ & BARDACK, 1992). The new taxon belongs to the Paleovertebrate Collection of the Museu Nacional - Rio de Janeiro (MN 4571-V and MN 4572-V).

The extant specimens of Elopomorpha examined belong to the Anatomical and Ichthyological collections of Osteichthyes of the Departamento de Biologia Animal e Vegetal of Universidade do Estado do Rio de Janeiro (under the institutional abbreviations A.O.DBAV.UERJ and O.DBAV.UERJ, respectively). These include *Albula vulpes* (A.O.DBAV.UERJ 0016 and A.O.DBAV.UERJ 0043), and *Elops saurus* (Linnaeus, 1766) (A.O.DBAV.UERJ 0025). In order to examine the *suspensorium* musculature, we dissected some specimens of *A. vulpes* (O.DBAV.UERJ 1653) from Rio de Janeiro, Brazil; and *Pterothrissus gissu* (Hilgendorf, 1877) (O.DBAV.UERJ 1891 and O.DBAV.UERJ 1892) from Honshu, Japan. The dissection procedure follows WEITZMAN (1974) and the myologic nomenclature

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follows WINTERBOTTOM (1974) and GREENWOOD (1977). Osteological terms follow FOREY (1973), TAVERNE (1974), and ARRATIA (1997).

ANATOMICAL DESCRIPTION

In most of the albulids, the *suspensorium* is projected forwards and tightly joins the aliform lateral process of the parasphenoid. It includes a stout and almost vertically oriented hyomandibula (Fig.1, HM) which is tightly sutured to a large metapterygoid (Fig.1, MPT), except for a large fenestra between them (Fig.1, mpt-hm f.). A long and laminar sympletic (Fig.1, SYM) is lodged into a notch on the surface of the quadrate (Fig.1, QU). The ventral process of the quadrate (Fig.1, qu.pv.pr.) is straight and very elongate accompanying all the extension of the horizontal arm of the preopercle. The ectopterygoid (Fig.1, ECPT) is an arched and laminate bone with a prominent process on its posterodorsal corner (as pointed out by FOREY *et al.*, 1996), herein named ectopterygoid posterior process (Fig.1, ecpt.p.pr.). It is anteriorly limited by a spatulate palatine (Fig.1, PAL) and medially by a dentigerous endopterygoid (Fig.1, ENPT).

Considering the cheek muscles associated with the *suspensorium*, we took into account three components: *adductor mandibulae* complex, *dilatator operculi*, and *levator arcus palatini*.

The *adductor mandibulae* (Fig.2a, *AM*) complex originates from the anterior border of the preopercle and covers the hyomandibula, metapterygoid, sympletic, and quadrate. Its fibres overlap great part of the *levator arcus palatini* (Fig.2a, *LAP*), running forwards to insert onto an outer fossa in the anguloretroarticular. The tendon of the adductor mandibulae 1β (*sensu* GREENWOOD, 1977) (Fig.2a, tA1β) runs through the outer surface of the ectopterygoid and inserts onto the maxilla.

The *dilatator operculi* is hidden by the uppermost fibres of the *levator arcus palatini,* being separated from each other by a marked *fascia*. It originates from the floor of the deep *dilatator fossa* which is greatly filled by mucus. Its fibres run backwards to insert onto the anterodorsal corner of the opercle near the articular facet for the hyomandibula.

The fan-shaped *levator arcus palatini* (Fig.2b, *LAP*) is an undivisible muscle mass, which originates from the posterior border of the autosphenotic spine. Its fibres run obliquely backwards and downwards covering the outer surface of the hyomandibula. This muscle extends along the dorso-lateral lamina of metapterygoid reaching the suture with the endopterygoid, covering (but not passing through) the metapterygoid-hyomandibular fenestra. The endopterygoid has a deep fossa on the dorsal surface completely devoid of musculature.

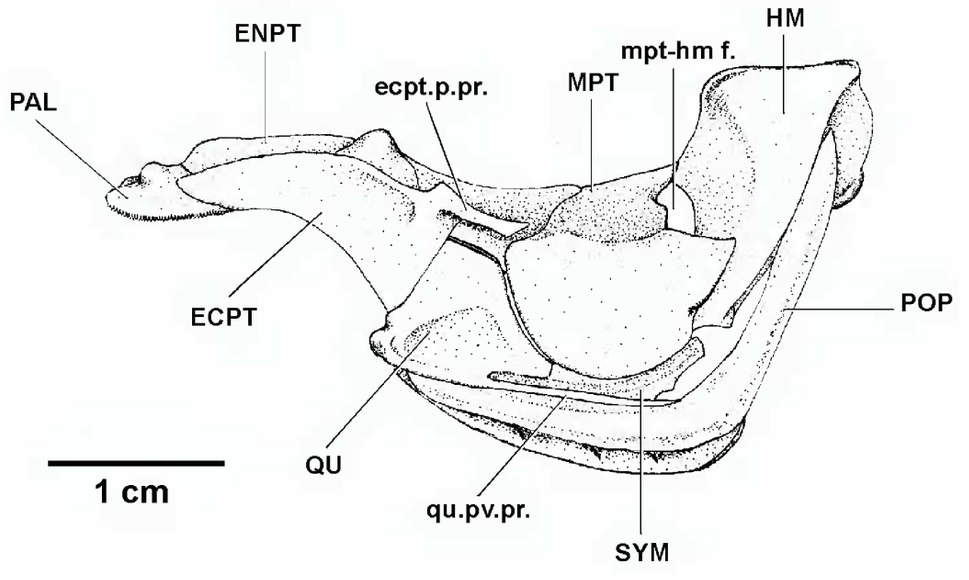

Fig.1- *Suspensorium* of *Albula vulpes* (Linnaeus, 1758) in left lateral view; (ECPT) ectopterygoid; (ecpt.p.pr.) ectopterygoid posterior process; (ENPT) endopterygoid; (HM) hyomandibula; (MPT) metapterygoid; (mpt-hm f.) metapterygoid-hyomandibular fenestra; (PAL) palatine; (POP) preopercle; (QU) quadrate; (qu.pv.pr.) quadrate posteroventral process; (SYM) sympletic.

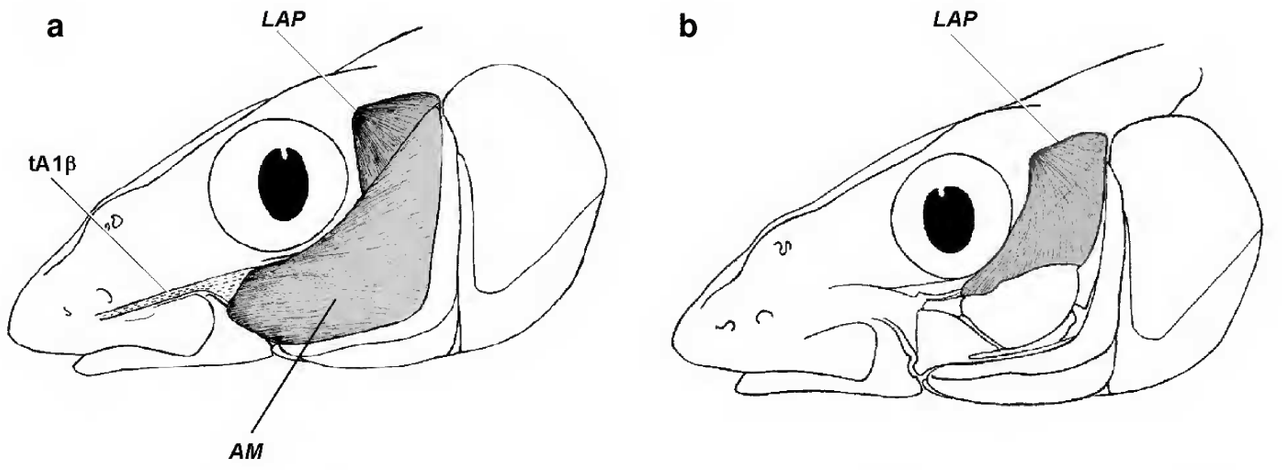

Fig.2- *Albula vulpes* (Linnaeus, 1758): (a) cheek muscles associated with the *suspensorium*; (b) *levator arcus palatine* on the *suspensorium*; (*AM*) *adductor mandibulae*; (*LAP*) *levator arcus palatini*; (tA1β) tendon of *adductor mandibulae* 1β.

DISCUSSION AND CONCLUSION

The relevance of myological features in the phylogeny of elopomorph fishes was pointed out by GREENWOOD (1977). Recently, data on muscles have been included in studies supporting the monophyly of some groups within Elopomorpha (FOREY *et al.*, 1996).

The meaning of the metapterygoid-hyomandibular fenestra in albuloids has been misunderstood by certain authors (*e.g.* FIELITZ & BARDACK, 1992; FOREY *et al.*, 1996). According to them, deep portions of the *levator arcus palatini* muscle pass through this fenestra and insert onto the medial surface of palate. We verified that in *Albula* and *Pterothrissus* there is a tenuous oval membrane (metapterygoid-hyomandibular membrane, Fig.3) covering the fenestra, but muscles or nerves definitively do not cross it.

This membrane permits the anchorage of the *levator arcus palatini* which contributes to the lateral expansion of the *suspensorium*. In this context, the metapterygoid-hyomandibular fenestra could reduce the pressure on the *suspensorium* during feeding on hard-bodied invertebrates. In fact, the majority of albulids possesses a durofagous feeding habit compatible with its crushing dentition.

This new look at the morphology of the *suspensorium* lead us to discard one of the three synapomorphies supporting the *Albula* plus *Pterothrissus* clade proposed by FOREY *et al.* (1996). A re-appraisal of albuloid relationships is therefore in need.

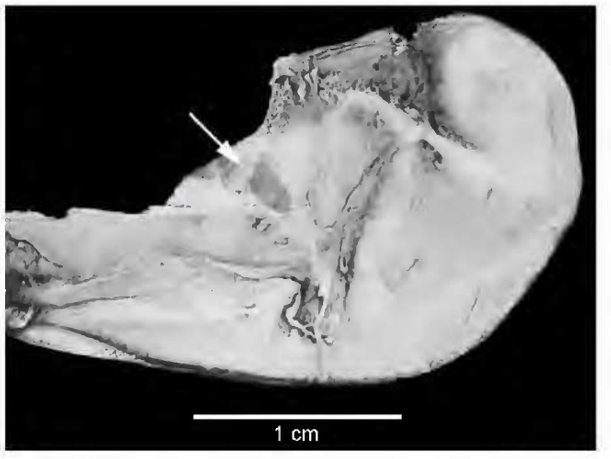

Fig.3- *Suspensorium* of *Albula vulpes* (Linnaeus, 1758), in internal view. Arrow indicates the metapterygoid-hyomandibular membrane.

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