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Morphology of the Gas Bladder in Sea Catfishes (Siluriformes: Ariidae)

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Abstract

The morphology of the gas bladder and associated structures in sea catfishes (Siluriformes: Ariidae) is studied. The most simple gas bladder, exclusive to *Galeichthys* Valenciennes, is apple-shaped with weakly developed internal trabeculae, has smooth walls externally and a short Müllerian window associated with a broad, short Müllerian ramus that is firmly attached to Baudelot's ligament and supracleithrum. Most genera of Ariidae have a cordiform bladder with well-developed trabeculae, smooth walls externally, an elongate Müllerian window and an elongate Müllerian ramus with an acute tip that is free from the Baudelot's ligament and supracleithrum. *Sciades proops* (Valenciennes) and *S. parkeri* (Traill) have a similar gas bladder but with a well-developed secondary chamber. Other genera of Ariidae also have a cordiform bladder with well-developed trabeculae and elongate Müllerian window, but with lateral diverticula present as shallow rounded bulges or blister-like swellings along the peripheral margins of the bladder. The degree of development of lateral diverticula varies among and within species, with *Osteogeneiosus* Bleeker having the most highly-developed diverticula. *Bagre pinnimaculatus* (Steindachner) and *Bagre bagre* (Linnaeus) have unusual depressed gas bladders with complex network of internal trabeculae. The implications of gas bladder morphology for the taxonomy and phylogenetic relationships of the family are discussed.

Key words: systematics, phylogeny, taxonomy, anatomy

Introduction

Ariidae (sea catfishes) is the most widely distributed family of the order Siluriformes, and one of only two otophysan fish families that inhabit mostly marine and brackish waters. With approximately 150 species classified in 30 genera, ariids are common in tropical and temperate areas of the world, mainly in coastal waters on continental shelves, estuaries, and lower portions of coastal rivers; only a few species are entirely confined to either marine or freshwater (Marceniuk & Menezes, 2007). The group is important to tropical coastal fisheries for having numerous species with high economic value. Despite this importance, ariid classification has remained in disarray over the last century. Although the monophyly of the family is strongly supported by morphological and molecular evidence, recent classifications disagree over the circumscription and definition of various genera (Kailola, 2004; Marceniuk & Menezes, 2007; Betancur-R. *et al.*, 2007).

Ariids are known to produce sounds via the so-called elastic spring apparatus, a modification of the Weberian apparatus and associated structures in which the parapophysis of the fourth vertebra (also known as Müllerian ramus, or elastic spring) is flexible and not sutured to the supracleithrum and Baudelot's ligament as in most catfishes. The dorsoanterior face of the Müllerian ramus is firmly attached to the protractor muscle, which originates in a bony pocket formed by the ventral face of the posterior cranium (Tavolga, 1962). Contraction of the protractor muscle of the Müllerian ramus pulls the elastic spring forward, extending the gas bladder; its relaxation allows the tension in the spring to quickly restore the gas bladder to its normal position (Fine & Ladich, 2003). The elastic spring apparatus was first described by Müller (1842) for doradids, auchenipterids, mochokids and malapterurids, and subsequently for pangasiids (Bridge & Haddon, 1893) and

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