A NOVEL BITING MECHANISM IN DAMSELFISHES (POMACENTRIDAE): THE PUSHING UP OF THE LOWER PHARYNGEAL JAW BY THE PECTORAL GIRDLE

by

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ABSTRACT

This study presents a novel mechanism for biting with the pharyngeal jaws in the labroid family Pomacentridae (damselfishes). Results of experiments in which 9 branchial and hyoid muscles were electrically stimulated are presented. Upon contraction of the m. protractor pectoralis the pectoral girdle is protracted and makes contact with the lower pharyngeal jaw resulting in the elevation of the lower pharyngeal jaw. The force of the m. protractor pectoralis contributes to the biting force of the m. levator externus 4 and m. levator posterior during biting and in this way increases the total biting force that can be exerted on prey.

KEY WORDS: Pomacentridae, Cichlidae, Labroidei, pharyngeal jaw apparatus, pectoral girdle, biting.

INTRODUCTION

The pharyngeal jaw apparatus of labroid fishes is of strong evolutionary significance: 7 out of the 8 characters that distinguish this suborder from other perciforms are found in the pharyngeal jaw apparatus (STIASSNY & JENSEN, 1987). Furthermore, the functioning of the pharyngeal jaw apparatus is supposed to have played an important role in the speciation and diversification of cichlids and other labroids (LIEM, 1973; LIEM & SANDERSON, 1986; GALIS & DRUCKER, 1996). The pharyngeal biting in labroids is characterized by a powerful upward movement of the lower pharyngeal jaw against the prey and the upper pharyngeal jaw. The upper pharyngeal jaw is pressed against the neurocranium so that the neurocranial reaction force contributes to the biting force (fig. 1; GALIS, 1993; GALIS & DRUCKER, 1996). At the place of contact there are large articulation facets, both on the neurocranium and on the upper pharyngeal jaw (a diarthrosis). These
articulation facets are derived characters of the labroids (KAUFMAN & LIEM, 1982; STIASSNY & JENSEN, 1987). Generalized perciforms have a different biting mechanism in which not only the lower pharyngeal jaws are pulled up, but the upper pharyngeal jaws are pressed down at the same time upon contraction of the same levator muscles (coupled biting mechanism, GALIS & DRUCKER, 1995).

Pomacentrids alone lack the key innovation which characterizes the other labroid families (Cichlidae, Labridae and Embiotocidae): the shift of insertion of the m. levator externus 4 from the epibranial 4 to the lower pharyngeal jaw (figs 1, 2; KAUFMAN & LIEM, 1982; STIASSNY & JENSEN, 1987). The importance of this shift lies in the increased mobility of the lower pharyngeal jaw (LIEM, 1973; GALIS & DRUCKER, 1996). The m. levator posterior, which in some labroids has also shifted from the epi-branial 4 to the lower pharyngeal jaw, is in pomacentrids in the primitive position inserting on the epibranial 4 (figs 1, 2). These levatores can only indirectly lift the lower pharyngeal jaw via the connection between