

Morphology and Function of Pectoral Fin Muscles in Lizardfishes (Actinopterygii: Aulopiformes: Synodontidae), with Comments on an Additional Muscle of the Fin

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The morphology of the pectoral fin muscles of lizardfishes (Synodontidae) is described. Members of this family commonly have six pectoral fin muscles: the abductor superficialis, abductor profundus, arrector ventralis, adductor superficialis, adductor profundus, and arrector dorsalis. An additional muscle, the arrector medialis (named in this study), was discovered on the mesial side of the pectoral fin in all nine examined species of *Synodus* and *Trachinocephalus*, but is absent in all four examined species of *Harpadon* and *Saurida*. It inserts on an anterior process of the base of the mesial half of the uppermost ray and appears to have a function similar to that of the arrector ventralis in supporting the protraction of the uppermost ray and the abduction of the pectoral fin. This muscle supports the division of the synodontids into two groups (present in *Synodus* and *Trachinocephalus* vs absent in *Harpadon* and *Saurida*). The function of the arrector medialis is morphologically discussed.

Key Words: lizardfishes, Synodontidae, pectoral fin, muscles, arrector medialis.

Introduction

The family Synodontidae, a member of the order Aulopiformes, comprises four genera and about 57 species (Nelson 2006). Species are commonly found on coral, rock, and sand bottoms in shallow coastal waters of temperate and tropical regions in the Atlantic, Indian, and Pacific Oceans (Russell 1999; Nelson 2006). The purposes of this study are to describe the pectoral fin muscles of the Synodontidae, to discuss their functions, and to review available comparative data. Although anatomical studies of the Aulopiformes, especially the family Synodontidae, have been conducted by several authors (Rosen 1973; Sulak 1977; Baldwin and Johnson 1996; Sato and Nakabo 2002), they have mostly focused on osteology and few authors have studied the myology of the order. Rosen (1973) examined the interrelationships among higher euteleostean fishes focusing on characters of the pharynx, jaw, and caudal regions. With regard to aulopiform myology, he described the pharyngobranchial and cheek muscles and made some use of these characters in inferring relationships among euteleostean orders. Sato and Nakabo (2002) examined the pectoral fin muscles of many aulopiforms, including the four synodontid genera, and used two transformation series including characters associated with the adductor profundus, an element of the pectoral fin muscles, to infer phylogenetic relationships within this order. Until recently, the myology of the family

Synodontidae has not otherwise been studied in detail. In this study, the pectoral fin muscles of representatives of this family were re-examined, and a unique muscular bundle was found that has never before been reported in fishes.

Materials and Methods

Preserved specimens were stained with alcian blue and alizarin red-S before dissection. Dissections and observations were undertaken with a Leica stereomicroscope fitted with a camera lucida attachment to facilitate illustrations. Osteological and myological terminology follows Sato and Nakabo (2002) and Winterbottom (1974) respectively. Specimen sizes are reported as standard length (SL). Institutional abbreviations follow Eschmeyer (1998), except for the Hokkaido University Museum, Hakodate (HUMZ).

Material examined. Synodontidae: *Harpadon nehereus* (Hamilton, 1822), HUMZ 201983, 162 mm SL; *Harpadon squamosus* (Alcock, 1891), MCZ 149098, 103 mm SL; *Saurida nebulosa* Valenciennes, 1850, HUMZ 124908, 107 mm SL; *Saurida tumbil* (Bloch, 1795), USNM 404394, 181 mm SL; *Synodus evermanni* Jordan and Bollman, 1890, AMNH 234786, 106 mm SL; *Synodus foetens* (Linnaeus, 1766), AMNH 80195, 131 mm SL; *Synodus hoshinonis* Tanaka, 1917, HUMZ 114357, 198 mm SL; *Synodus lucioiceps* (Ayres, 1855), HUMZ 113029, 162 mm SL; *Synodus sageneus* Waite, 1905, AMS I.22831-040, 141 mm SL; *Synodus saurus*