

Revisiting the actinopterygian preoperculum

Kathryn E. MICKLE

Abstract

The preoperculum has been a closely studied character among actinopterygians. Previous studies have identified the preopercular conditions of palaeoniscoids as primitive, subholosteans as intermediate, and holosteans as advanced. Changes in the preoperculum across actinopterygians are thought to have functional implications regarding the jaw suspensorium and feeding mechanisms. Here, a wider study of the preoperculum in Paleozoic, Mesozoic, and Recent fishes reveals that the conventional wisdom that there is a gradual and progressive change from the palaeoniscoid condition to a more advanced condition in holostean and teleost fishes is an oversimplification. For instance, there are numerous palaeoniscoid fishes with vertical preopercula and specialized feeding regimes. When the preopercular conditions of Paleozoic and Mesozoic fishes are examined within a phylogenetic context, the original hypothesis is also not supported. A hindrance to this study is the fact that phylogenetic hypotheses for a wide variety of fishes are lacking. This character study highlights the need for strong phylogenetic hypotheses of relationships for a broad sampling of Paleozoic and Mesozoic actinopterygians, as well as the need for more in depth studies into specific morphological characters and interpretations regarding their homology.

Introduction

The preoperculum has been considered a particularly important bone in the evolution of actinopterygians. Different configurations of preopercular bones have been proposed for the pre-phylogenetic grade levels of Paleozoic palaeoniscoids, more advanced ‘subholosteans’, and holosteans (BROUGH 1939, SCHAEFFER 1956, SCHAEFFER & ROSEN 1961, GARDINER 1967). These differences have been attributed to changes in the jaw suspensorium and in turn, feeding mechanisms (SCHAEFFER 1956, SCHAEFFER & ROSEN 1961, GARDINER 1967). Traditionally, palaeoniscoids have been described as having the most “primitive” preopercular condition with a tight association between the preopercular bone, maxilla, and palate; a characteristic generally used to define these actinopterygians (BROUGH 1939, SCHAEFFER 1956, SCHAEFFER & ROSEN 1961, GARDINER 1967). It is hypothesized that this tight association is gradually lost, allowing for a change in the feeding mechanism.

Goals

A primary problem with this hypothesis is that it never has been investigated in a systematic or phylogenetic fashion. Past publications dealing with the importance of the preopercular bone provide few examples of the preopercular condition of Paleozoic, Mesozoic, and Recent actinopterygians. These publications do not take into account or investigate the great diversity the preoperculum shows in these fishes, nor do they investigate this diversity within a phylogenetic framework. Here, a literature review of the hypotheses regarding the importance of the actinopterygian preoperculum is presented. This paper also seeks to test the strength of these hypotheses via a broader examination of the preopercular condition of actinopterygians from the Devonian to the Recent, and to include newly described forms in this analysis. Though some readers may feel that the results of the previous preopercular studies are outdated and incorrect, no official refutation of these papers has been published. These previous hypotheses are addressed here for the first time. Lastly, a major goal of this paper is to point out that morphological characters must be examined within a phylogenetic context.

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