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Feeding in Mesozoic fishes: a functional perspective

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Abstract

The potential feeding abilities of Mesozoic fishes are investigated using analyses of functional morphospace. The closing lever ratio of the lower jaw and the relative jaw length are used to compare potential feeding modes among Mesozoic and Cenozoic fish faunas. Preliminary analyses support earlier suggestions that there was an increase in durophagy in actinopterygian fishes in the Norian. Furthermore, the data highlight the prevalence of low force-transmission feeding modes in Jurassic teleosts and the role that this feeding mode may have played in the radiation of this group. Analyses of functional morphospace provide an objective basis for evaluating the potential feeding abilities of both extant and extinct fishes. It provides a novel tool for investigating the abilities of fishes that is largely independent of taxon or age.

Introduction

One of the greatest challenges in the study of fossil fishes is to understand their ecology. By placing a fish in an ecological context it provides us with a clearer understanding of the role that the fish may have played in palaeocommunities, the possible significance of morphological structures in the life of the fish and the biological basis for the differences we see among species. Traditionally, and almost intuitively, fishes are placed in an ecological context by direct comparisons with living forms. A close resemblance to living forms is taken as a reflection of a similar ecology (i.e. taxonomic uniformitarianism, DODD & STANTON 1990).

This approach is, in some ways, the palaeoecological equivalent of a phenetic classification – ecological similarity is assumed based on an overall, primarily morphological, similarity between taxa. As with phenetic classifications, the resultant patterns are often supported by more appropriate analyses. In ecological terms, however, it is the function not the morphology that is most important. This is the crux of the matter. To what extent can the function of a particular structure be inferred from morphology? This issue is critically appraised by LAUDER (1995), who identified the limitations of inferring function from form, and highlighted the difficulty of applying functional interpretations to fossil fishes. Even in the best systems, when the function of structures can be directly measured in the laboratory, the links are often tenuous. In only one of the three examples selected by LAUDER, was morphology and function clearly linked in a predictable manner. In this case, it was found that one could predict, at a general level, the diet and trophic ecology of fishes based on measurements of the pharyngeal jaw.

In all deliberations, LAUDER (1995) identified the nervous system as a relatively unpredictable component in the linkage between structure and function. This is particularly evident when behaviour is included and function is considered in an ecological context. Nevertheless, neontological studies have made considerable progress in recent years, and have increased our understanding of the links between morphology, function, performance and ecology in a wide range of organisms, including fishes. To date, most of this work has been based on feeding and locomotion but other systems have been examined in some detail (e.g., vision). The general approach is classified as ecological morphology (e.g., WAINWRIGHT & REILLY 1994) or ecomorphology (e.g., WAINWRIGHT & BELLWOOD 2002). The aim is to directly quantify the links between morphology, function (physiology, biomechanics), performance (potential resource use; the fundamental niche) and ecology (actual resource use; the realized niche). Morphology and function are usually examined in the laboratory, while performance and ecology are typically examined in

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