TOWARDS A CONSTRUCTIONAL MORPHOLOGY OF CICHLID FISHES (TELEOSTEI, PERCIFORMES)

by

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SUMMARY

Based on ca 100 lacustrine cichlid species and following a holistic procedure of functional morphology, this paper analyses what constraints spatial relations of structures may set on the compatibility of functions. Among the many feeding behaviours of cichlids two groups are distinguished: (1) those in which powerful biting with the oral jaws are involved and (2) those in which the food is directly sucked into the buccal cavity without prior manipulation by the oral jaws. Related to the core functions “biting” and “sucking only” two types of oral jaw apparatuses (OJA) are distinguished and compared (i.e. comparison in a functional context). Taking the head as the available space (constructional component) it is subsequently investigated what spatial demands there are to accommodate these two types of OJA together with other apparatuses (comparisons in a constructional context), and how these spatial demands ‘affect’ the function of the other apparatuses, especially the expansion apparatus (EA) and outer head shape (OHS, part of the locomotory apparatus). It is demonstrated that the suction feeding and biting can be combined to a certain extent and at certain costs. Increase in streamline is inversely related to active head expansion, and in biters is also inversely related to the size of the maximally expanded buccal cavity. The possible implication for the tripartite compatibility of (1) the various types of locomotion, (2) suction feeding and (3) feeding involving oral manipulation of the food, are discussed.

For a number of other apparatuses (e.g. gill-apparatus and pharyngeal jaw apparatus) similar but less extensive analyses of spatial relations are made. Among these, examples are given of diversity in spatial relations: e.g. the relations between a particular outer head shape and differing head structures (see the section on ‘inner ear’).

The complex and indirect relations between the food-category eaten and the structure of the feeding apparatus are discussed.

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INTRODUCTION

Among vertebrates, the cichlid fishes of the Great Lakes of Africa present a unique reservoir of numerous morphologically similar organisms of unrivalled ecological diversity. Such a reservoir is ideal for comparative functional morphology. However, in comparison with the many studies on the systematics, phylogenetic relationships and ecology, relatively few publications deal with the functional morphology of these fishes. Liem (1974) at Harvard University was the first to explore this field and important papers on function and morphology of cichlids are still being published by him and his students (e.g. Liem & Kaufman, in press). So far Liem has focussed on the experimental analysis of the feeding repertoires, their evolutionary significance and their underlying morphology. The main interest of the cichlid research group at Leiden University concerns constructive and ecological morphology, i.e. the relation of integrated form-function complexes with ecology. It is a long way from anatomy to ecology, but by starting from both ends with well atuned programmes we are optimistic about the eventual multidisciplinary results. Among the studies in the ‘ecological track’ of our research (e.g. van Oijen et al., 1981; Witte, 1981, in press; van Oijen, 1982; Hoogerhoud et al., 1983), the work of Hoogerhoud (in prep.) on the intratrophic ecological and morphological differentiation of the molluscivores has come closest to morphology. In the ‘morphological track’ of our research (e.g. Barel et al., 1974; Anker, 1978; Hoogerhoud & Barel, 1978; Galis & Barel, 1980; Otten, 1983) the present paper is, as yet, the nearest step towards ecology. The paper deals mainly with the analysis of spatial relations between apparatuses performing different functions. Based on ca 100 cichlid species from various African lakes and following a holistic procedure of functional morphology, I have attempted to analyse whether spatial relations may set constraints on the