Zootaxa 5023 (4): 509–536
https://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5023.4.3
http://zoobank.org/urn:lsid:zoobank.org:pub:DDFD67EF-FF9E-45FB-B486-3D068605944F

A descriptive and comparative neurocranium morphology of Anguilliformes fishes in Taiwan waters

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Abstract

Taiwan is one of the richest in the world in terms of eel fauna. In this study, we examined the osteological and morphological characteristics of eels under order Anguilliformes. Furthermore, we focused on the neurocranium of total of 30 Anguilliformes fishes under family Congridae (10), Muraenesocidae (1), Muraenidae (7), Nemichthyidae (1), Nettastomatidae (2), Ophichthidae (5), Synaphobranchidae (4), which are caught in Taiwanese waters. This paper shows the results of a comparative study on osteological characters of the neurocranium including the ratio of seven length characters using its NCL (neurocranium length), NCW (neurocranium width), OBL (orbit length), MFW (maximum frontal width), NCDB (neurocranium depth at basisphenoid), PEVW (premaxilla-ethmovomer width) and mPOBL (mid pre-orbital length), and 20 morphological diagnostic characters for 30 eel species. Results shows that species under family Nemichthyidae and Nettastomatidae have the highest values on the ratio of NCL/MFW, NCL/NCDB, and NCW/mPOBD. In morphological characters, it shows that species of the same family mostly share similar formation of the PEV plate and frontal structure. The usage of the length measurements and morphological diagnostic characters of neurocranium allowed for a more in depth understanding of how similar or different these eels can be. The neurocranial description and morphological characters may prove valuable for identification purposes and might be necessary tool for further studies on the status of order Anguilliformes.

Key words: Anguilliformes, eel, osteology, neurocranium, morphology

Introduction

Anguilliform fishes are generally elongated, which can reach 4 m (13 ft) in total length in the slender giant moray (McCosker,1998). They usually inhabit marine, brackish, and freshwater. Adults range in weight from 30 g to over 25 kg, they possess no pelvic fins, and many species also lack pectoral fins. Scales usually absent or, if present, cycloid and embedded, (Froese & Pauly, 2020). The Taiwan ichthyofauna, particularly the eel fauna (orders Anguilliformes and Saccopharyngiformes), is large and diverse (Ho *et al*., 2018). According to the latest annotated checklist of the eels of Taiwan, it is composed of 14 families and 232 species, and many additional species were reserved for further study. Several studies in classification and identification of eels were based on morphology and/or morphometric (Nelson, 1966; Böhlke, 1982; Robins, 1989), and genetic evidence (Vasconcelos, 2009; Tawa *et al*., 2012), which sometimes result in disagreement of DNA analysis and morphological comparisons in terms of phylogenetic relationships within the order (Wang *et al*., 2003).

Furthermore, there are studies focusing on functional morphology and discovered some interesting specializations, such as head-first burrowing in the Moringuidae (De Schepper *et al*., 2005, 2007), a unique system of prey transport using highly specialized pharyngeal jaws in the Muraenidae (Mehta & Wainwright, 2007), and the description of the most basal, extant clade (genus *Protanguilla*) and its morphology, strengthening comparisons of derived morphologies across Anguilliformes (Johnson *et al*., 2012). In family Muraenidae, there are dietary studies

Accepted by P. Konstantinidis: 23 Jul. 2021; published: 20 Aug. 2021