

Automated otolith image classification with multiple views: an evaluation on Sciaenidae

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Combined multiple 2D views (proximal, anterior and ventral aspects) of the sagittal otolith are proposed here as a method to capture shape information for fish classification. Classification performance of single view compared with combined 2D views show improved classification accuracy of the latter, for nine species of Sciaenidae. The effects of shape description methods (shape indices, Procrustes analysis and elliptical Fourier analysis) on classification performance were evaluated. Procrustes analysis and elliptical Fourier analysis perform better than shape indices when single view is considered, but all perform equally well with combined views. A generic content-based image retrieval (CBIR) system that ranks dissimilarity (Procrustes distance) of otolith images was built to search query images without the need for detailed information of side (left or right), aspect (proximal or distal) and direction (positive or negative) of the otolith. Methods for the development of this automated classification system are discussed.

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Key words: automated classification; geometric morphometrics; Malaysia; otoliths; shape analysis.

INTRODUCTION

Species in the family Sciaenidae, commonly called croakers or drums, are found in both marine and fresh waters of the tropical and temperate zones. Except for a few species in coral reefs, most are euryhaline inhabiting turbid coastal waters, bays, estuaries and rivers (Sasaki, 2001). Currently, the family includes 290 species in 66 genera worldwide (Eschmeyer *et al.*, 2010) and in Malaysia alone, 25 species in 12 genera were reported (Chong *et al.*, 2010). Positive identification of sciaenid specimens to genus and species requires the examination of swimbladders and sagittal otoliths. The swimbladder is perhaps the most useful for identification, being characterized as carrot or hammer-shaped and it may bear lateral branching appendages depending on genus and species (Sasaki, 1989). The form of the sulcus acusticus on the proximal surface of the otolith may be a distinguishing feature among species of fishes (Tuset *et al.*, 2008). It is generally less useful in the Sciaenidae, however, except for the genera *Argyrosomus* L. 1758, *Otolithes* Oken 1817 and *Pterotolithus* Fowler 1933 (Sasaki, 2001). The posterior crenulations or the marginal domes of the otoliths may be distinctive between

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