

The Use of Otolith Morphometrics in Determining the Size and Species Identification of Eight Mullet (Mugiliformes: Mugilidae) from Malaysia

(Kegunaan Otolit Morfometrik untuk Menentukan Saiz dan Pengenalpastian Spesies bagi Lapan Belanak (Mugiliformes: Mugilidae) dari Malaysia)

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ABSTRACT

Sagittal otolith morphometric measurements from Malaysian Mugilidae species were selected to investigate their possible role in species identification, due to the Mugilidae species' morphological similarities, and age determination. Fish standard length (cm), otolith length (μm), width (μm) and mass (g) measurements were taken from eight species: Chelon macrolepis, C. melinopterus, C. subviridis, Ellochelon vaigiensis, Moolgarda cunnesius, M. seheli, Mugil cephalus and Valamugil engeli. Otolith aspect ratio, O_{AS} (otolith length divided by width), was calculated and compared between species. The four homogenous groups based on their O_{AS} were C. melinopterus (mean=1.65) and V. engeli (1.66) and M. cunnesius (1.89) and E. vaigiensis (1.89); M. seheli (2.08), C. macrolepis (2.14) and M. cephalus (2.17); and the latter two with C. subviridis (2.43). The relationships between fish standard length and otolith length/mass showed positive correlations for both, with otolith length providing the stronger correlation ($r_s = 0.897, P < 0.001$) than otolith mass ($r_s = 0.795, P < 0.001$). It is concluded that the more morphologically similar species have similar otolith aspect ratios, related to head shape; however, otolith shape is also affected by a variety of other environmental factors that have to be taken account of.

Keywords: Mugilidae; otolith; sagittal; taxonomy

ABSTRAK

Ukuran morfometri sagital otolit daripada spesies Mugilidae Malaysia telah dipilih untuk kajian kemungkinan peranannya dalam penentuan spesies yang disebabkan oleh persamaan morfologi spesies Mugilidae dan penentuan umur. Pengukuran piawaian panjang ikan (cm), panjang otolit (μm), lebar (μm) dan berat (g) telah diambil daripada lapan spesies: Chelon macrolepis, C. melinopterus, C. subviridis, Ellochelon vaigiensis, Moolgarda cunnesius, M. seheli, Mugil cephalus dan Valamugil engeli. Nisbah aspek otolit, O_{AS} (panjang otolit dibahagikan dengan lebar), dikira dan dibandingkan antara spesies. Empat kumpulan homogen berdasarkan O_{AS} mereka adalah C. melinopterus (min = 1.65) dan V. engeli (1.66) dan M. cunnesius (1.89) dan E. vaigiensis (1.89); M. seheli (2.08), C. macrolepis (2.14) dan M. cephalus (2.17); dan kedua-dua akhir dengan C. subviridis (2.43). Hubungan antara piawaian panjang ikan dan panjang otolit/berat menunjukkan korelasi positif bagi kedua-duanya, dengan panjang otolit memberikan hubungan yang lebih kukuh ($r_s = 0.897, P < 0.001$) berbanding berat otolit ($r_s = 0.795, P < 0.001$). Dirumuskan bahawa lebih morfologi spesies yang serupa mempunyai nisbah aspek otolit yang sama, yang berkaitan dengan bentuk kepala; namun, bentuk otolit juga dipengaruhi oleh pelbagai faktor persekitaran lain yang perlu diambil kira.

Kata kunci: Mugilidae; otolit; sagital; taksonomi

INTRODUCTION

Otoliths are calcareous structures (Popper & Lu 2000) found in the inner ear of fishes (Campana 2004). There are three pairs of otoliths; sagittae, asterisci and lapilli, found in three otolithic end organs; the saccule, lagena and utricle, respectively (Popper & Lu 2000). Their functions are involved in balance and hearing as mechanoreceptors (Popper et al. 2005).

Otoliths also have an important role in many different fields of scientific study such as: Age determination (Cailliet et al. 2001; Campana 2001; Wells et al. 2013); analysis of otolith chemical properties to distinguish

fish life histories (Tournois et al. 2013; Veinott et al. 2012); diet analysis for cetacean, birds, pinnipeds and piscivorous fish (Campana 2004; Radhakrishnan et al. 2010; Sweeney & Harvey 2011; Wenzel et al. 2013) and archaeological studies, to determine past fish community structure, sea temperatures and age distribution (Andrus et al. 2002; Lin et al. 2013; Reichenbacher et al. 2007).

Most importantly for the current study, otolith morphology is species specific, most notably in the sagittal otoliths (Popper et al. 2005). Morphology ranges from ellipsoidal to more complex shapes, with protrusions and invaginations (Campana 2004) and has been used in