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Baseline

Asymmetry in the otolith length and width of three sparid fish species collected from Iraqi waters

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ABSTRACT

Bilateral asymmetry is presumed to reveal the developmental variability of the fish in polluted aquatic environments. In these habitats, high-level asymmetry develops, and these fish expend more energy to balance their growth than fish that are not under an impact. A total of 210 specimens of *Acanthopagrus bifasciatus*, *A. latus* and *Sparidentex hasta* were collected from the marine waters of Iraq in the northwest part of the Arabian Gulf. The asymmetry was calculated for the sagittal otolith characters of length and width. Otolith width has lower asymmetry than otolith length for the three sparid fish species investigated. An increase in the value of fluctuating asymmetry with fish length was observed. This could be a pertinent indicator of pollution in the habitat.

The discrepancy in development of a bilateral trait between the left and right sides of an organism is recognised as asymmetry (Van Vallen, 1962; Palmer and Strobeck, 1986; Leary and Allendrof, 1989). Fluctuating asymmetry which is a random deviation from perfect bilateral system reflects variable growth during development (Palmer, 1994; Fey and Hare, 2008) and is thought to reflect the genetic and environmental pressures experienced throughout development,

Asymmetry of otoliths has been suggested as a valuable index of body condition and health (Grønkjaer and Sand, 2003; Allenbach, 2011) during the early development and growth of fish (Gagliano and McCormick, 2004). Fluctuating asymmetry denotes a specific pattern of bilateral difference in a particular character showed by a sample of individuals, i.e. a frequency distribution of right minus left (R _ L) whose mean is zero and whose shape does not depart from normal (Somarakis et al., 1997b).

Fish otoliths are a very important structure in the fish body and perform vital functions such as recognition of sound and balance. Asymmetric otoliths may negatively affect the sensory accurateness of the inner ear (Lychakov and Rebane, 2005; Gagliano et al., 2008). Notwithstanding the prevalence of the use of fish otoliths for age and growth studies, few studies have examined fluctuating asymmetry in otoliths. Earlier studies have concentrated mostly on the larval stage (Panfili et al., 2005).

Some investigations have shown that increased fish otolith fluctuating asymmetry can happen due to stressful conditions caused by pollution (Franco et al., 2002), parasitism (Escós et al., 1995) and poor feeding conditions (Somarakis et al., 1997a, 1997b). However, other studies have not detected any strong relation between stress and fluctuating asymmetry in otolith (Folkvord, 2005; Panfili et al., 2005; Fey and Hare, 2008).

Assessment of the extent of fluctuating asymmetry has not been performed on the otolith widths or lengths of the three sparid fish species examined in the present study. Fish were collected from the marine waters of Iraq and the study is the first in its kind for the Arabian Gulf area in general and the Iraqi marine waters in particular.

A total of 210 specimens of the three members of the family Sparidae, *Acanthopagrus bifasciatus* (80), *A. latus* (80) and *Sparidentex hasta* (50) were collected from Khor Abdullah at the southern extent of the marine waters of Iraq using small trawler (21 m length x 3.5 m width), which was equipped with net of mesh size 2.5 cm. Khor Abdullah in southern part of the Iraqi marine waters is one of the main fishing grounds for the three sparid species in Iraq. Fish specimens were caught in the in the period January 2017 to March 2018 and at depth of 10–25 m. Sagittae from both sides of the fish head were removed from the sacculus part of the fish inner ear. Fish samples ranged from 204 to 330, 101–235 and 170–252 mm TL for *A. bifasciatus*, *A. latus* and *S.*

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