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PRELIMINARY STUDY OF FLUCTUATING ASYMMETRY IN OTOLITHS OF PAGELLUS ERYTHRINUS LINNAEUS, 1758 (ACTINOPTERYGII, SPARIDAE, PERCIFORMES) IN THE LIGURIAN AND CENTRAL- NORTHERN TYRRENIAN SEA

STUDIO PRELIMINARE SULL'ASIMMETRIA DEGLI OTOLITI DI PAGELLUS ERYTHRINUS LINNAEUS, 1758 (ACTINOPTERYGII, SPARIDAE, PERCIFORMES) NEL MAR LIGURE E NEL MAR TIRRENO CENTRO SETTENTRIONALE

Abstract - Otolith Mass Asymmetry (OMA) represent a useful bioindicator to test different environmental impacts (e.g., pollution, parasitism) and/or genetic factors on fish populations. In this study, fluctuating asymmetry of the otoliths of *Pagellus erythrinus* was analyzed through otolith mass asymmetry. *P. erythrinus* otoliths come from the MEDITS survey (MEDiterranean International Trawl Survey) carry out in FAO Geographical Sub-Area 9 (GSA 9). For each individual, total length (TL, cm) was measured, and sex was determined macroscopically. Length (OL, mm) and weight (OW, g) were recorded for each otolith. ANOVA test was applied to determine differences between males and females; t-test was used to determine the presence of asymmetry and the relationships between OMA and the total length of the individual were studied. Asymmetry was not detected and no correlation between total length and OMA was observed.

Key-words: Otolith Mass Asymmetry, *Pagellus erythrinus*, Fluctuating Asymmetry

Introduction – Otoliths are calcified structures located in the inner ear of all teleosts (Mahè *et al.*, 2021) and represent a permanent record of life history in fishes (D'Iglio *et al.*, 2021) as otolith material is unlikely to be resorbed or altered, remaining unaffected by the short-term changes in fish condition (Mahè *et al.*, 2021). Otolith's shape is species-specific and it is influenced by abiotic (temperature, salinity, depth, types of substrates), biotic (food or spatial-temporal differences) (Mérigot *et al.*, 2007) and genetic factors (Lishchenko and Jones, 2021).

In the organisms with bilater symmetry, fluctuating asymmetry is the result of random deviations from perfect bilateral symmetry and it is usually associated with stress and environmental heterogeneity (Mahè *et al.*, 2021).

Measurement of the fluctuating asymmetry in the otoliths represent a tool for fisheries biologist to evaluate the effects of environmental stressors influence on fish population; therefore, the coefficient of otolith mass asymmetry has been explored in several studies as a bioindicator, by evaluating relationship between fish wellness status and asymmetry (Jawad *et al.*, 2023).

The common pandora *Pagellus erythrinus* (Linnaeus, 1758) is a species widespread throughout the Mediterranean sea. It is a demersal species that inhabits both the hard mixed bottoms, made of rocks, pebbles and debris and the muddy-sandy bottoms of the continental shelf (Sartor *et al.*, 2017).

The aim of present work is a preliminary study of otolith asymmetry of *Pagellus erythrinus* in the Ligurian and Northern-central Tyrrhenian Sea.

Materials and methods - A total of 520 individuals of *Pagellus erythrinus* were collected from International Bottom Trawl Survey in the Mediterranean Sea (MEDITS) carried out in the FAO Geographical Sub-Area 9 (Ligurian Sea and the north-central

Tyrrhenian Sea) during November 2020 (Tab. 1, Fig. 1). For each fish, total length (TL, cm) were recorded and the sex was assigned macroscopically.

Sagittal otoliths were extracted with forceps through cranium sagittal cut, cleaned with hydrogen peroxide 5%, rinse with distilled water and dried for processing.

Otoliths (Tab. 2) were weigh with precision balance (sensibility 0.001 g) and the otolith mass asymmetry (OMA) was calculated from:

$$OMA = \frac{(mr - ml)}{\bar{m}}$$

Where mr and ml are the otolith masses of the right and left paired otoliths and \bar{m} is the mean mass of the right and left paired otoliths. The OMA value ranging between -2 and +2, and OMA= 0 represents the absence of mass asymmetry ($mr = ml$), whereas OMA= -2 or OMA= 2 represent the maximal asymmetry (absence of one otolith) (Mejri *et al.*, 2015). The relationships between OMA and the total length of the individual were analyzed in order to identify differences in sexes (ANCOVA). The presence of asymmetry (OMA \neq 0) was tested using Student's t-test and correlation between TL and OMA was analyzed.

Tab. 1 – Sample composition with number of specimens (N), mean TL with standard deviation (SD), size range (in cm) for females (F) and males (M).

Composizione dei campioni con numero di individui (N), TL media con deviazione standard (SD), range di taglie (in cm) per femmine (F) e maschi (M).

Sex	N	TL (cm)		
		Range	Mean	SD
M	254	5.5 – 26.5	15.9	5.4
F	266	4.5 – 23.0	14.8	4.6



Fig. 1 – Study area GSA 9 (in red).
Area di studio GSA9 (in rosso).

Tab. 2 – Summary of otolith analyzed with number (N), mean otolith weight (OW) with standard deviation (SD) and weight range (in g).

Sintesi delle informazioni per gli otoliti analizzati con numero di individui (N), peso medio (OW) con deviazione standard (SD) e range in termini di peso (in g).

Otolith Side	N	OW (g)		
		Range	Mean	DS
L	520	0.003 – 0.231	0.064	0.047
R	520	0.003 – 0.235	0.062	0.046

Results – No significant difference between males and female was found (ANCOVA, $p > 0.05$). The lowest and highest values of asymmetry noticed were $-0,085$ and $0,089$; the mean value of OMA $-1.202E-05 \pm 0.023$ and the mean value of $|OMA|$ is 0.018 ± 0.015 . The results showed absence of otolith mass asymmetry ($p > 0.05$). According to the regression analysis, there were no correlation between fish length and OMA ($p > 0.05$) and otolith mass difference ($mr - ml$) ($p > 0.05$) (Fig. 2).

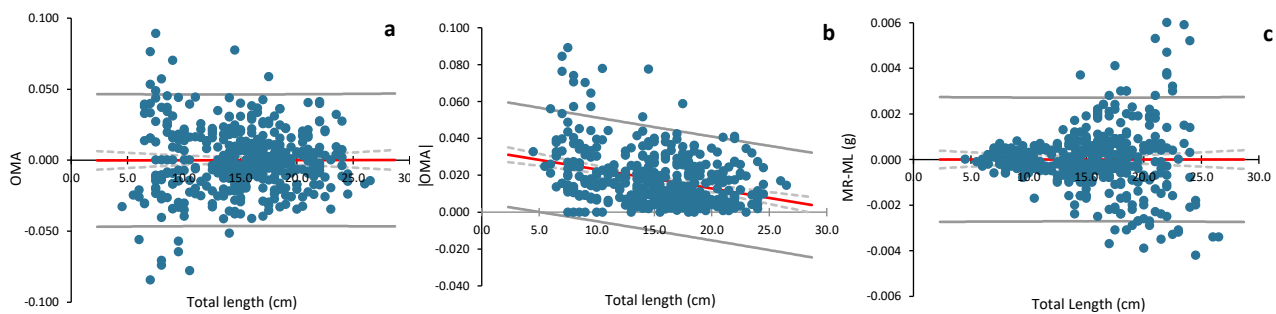


Fig. 2 – (a) Relationship between otolith mass asymmetry and total length of individuals of *P. erythrinus*; (b) Relationship between absolute value of otolith mass asymmetry and total length of individuals of *P. erythrinus*; (c) Relationship of otolith mass difference ($mr - ml$) and fish length.

(a) Relazione tra asimmetria di massa degli otoliti e lunghezza totale degli individui di *P. erythrinus*; (b) Relazione tra il valore assoluto dell'asimmetria di massa degli otoliti e la lunghezza totale degli individui di *P. erythrinus*; (c) Relazione tra la differenza di massa otolitica ($mr - ml$) e la lunghezza dell'individuo.

Conclusions – Variations in otolith mass asymmetry can negatively affect activities necessary for the life of the fishes, especially in terms of hearing and balance (Yedier *et al.*, 2018). According to the current study, *P. erythrinus* in GSA 9 do not show asymmetry, suggesting a uniform growth of both otoliths.

Nowadays, environmental stressors are increasing due to climate change for this reason it is necessary to apply simple methods to measure and examine the magnitude of these effects (Yedier *et al.*, 2018). The evaluation of fluctuating asymmetry in otolith has become a methodology frequently used as it represents an effective low-cost approach that provides effective information and efficient results on the fish population.

The otolith mass asymmetry was explored in many studies all over the world, and in the last years also in some areas of Mediterranean Sea. Moreover, for *P. erythrinus*, studies on sagittal otoliths and its morphology are very limited (D'Iglio *et al.*, 2021); this preliminary study provide a starting point for future otolith mass asymmetry studies in western Mediterranean area and it will aid towards future stock assessment investigations and management of fishery and management of *P. erythrinus* resources in the Ligurian and Northern-central Tyrrhenian Sea.

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