

## PRELIMINARY STUDY ON ASYMMETRY IN MORPHOLOGICAL CHARACTERS OF *PENTAPRION LONGIMANUS* (OSTEICHTHYES: GERRIDAE) FROM THE SEA OF OMAN

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### ABSTRACT

*The fluctuating asymmetry in *Pentaprion longimanus*, was estimated by determining the number of rays in pectoral fins and measurement of four body morphometric characters, i.e. preorbital length, postorbital length, orbital diameter and head length on both sides of the body in 91 individuals from the population of *P. longimanus*, collected from the waters off Muscat City, The Sea of Oman. Units of asymmetry were determined as the absolute value of difference between counts on both sides of body. Results indicate that pre and postorbital length and the number of pectoral fin rays demonstrate a higher level of asymmetry than the rest of the characters studied. In the pre and postorbital lengths we also noticed the trend of increase in the asymmetry values with the fish length. The possible cause of the asymmetry in this species was discussed in relation to different pollutants and their presence in the area. The usefulness of the information in future taxonomic studies on *P. longimanus* was also addressed.*

**Keywords:** fluctuating asymmetry (FA), Sea of Oman, Sultanate of Oman, *Pentaprion longimanus*, indicator

## STUDIO PRELIMINARE SULL'ASIMMETRIA DEI CARATTERI MORFOLOGICI DI *PENTAPRION LONGIMANUS* (OSTEICHTHYES: GERRIDAE) DEL MARE DELL'OMAN

### SINTESI

*L'Asimmetria Fluttuante di *Pentaprion longimanus* è stata valutata grazie alla determinazione del numero dei raggi delle pinne pettorali e alla misurazione di quattro caratteri corporei morfometrici: lunghezza preorbitale, lunghezza postorbitale, diametro orbitale e lunghezza del capo da entrambi i lati del corpo, in 91 individui provenienti da una popolazione di *P. longimanus* catturata nelle acque al largo della città di Mascate, nel mare dell'Oman. Le unità di asimmetria sono state determinate come valore assoluto della differenza fra i conteggi effettuati su entrambi i lati del corpo. I risultati indicano che le lunghezze pre- e postorbitali e il numero dei raggi delle pinne pettorali dimostrano un livello di asimmetria maggiore rispetto agli altri caratteri studiati. Riguardo alle lunghezze pre e postorbitali è stato inoltre notato un aumento nei valori dell'asimmetria all'aumentare della lunghezza corporea. Gli autori discutono la possibile causa di asimmetria in questa specie in relazione ai diversi inquinanti e alla loro presenza nell'area. L'articolo evidenzia pure l'utilità di tale informazione per studi tassonomici futuri su *P. longimanus*.*

**Parole chiave:** asimmetria fluttuante (FA), mare dell'Oman, Sultanato dell'Oman, *Pentaprion longimanus*, indicatore

## INTRODUCTION

The longfin mojarra, *Pentaprion longimanus* (Cantor, 1849) is a tropical demersal species distributed in the Indo-West Pacific, mainly in the Sea of Oman, western and southern coasts of India and off Sri Lanka to Indonesia. It is also reported from the Philippines, the Ryukyu Islands and southern to northern parts of Australia (Froese & Pauly, 2010). This species inhabits coastal waters and forms large schools. It feeds on small benthic animals. In Oman, the longfin mojarra is considered commercially important as its landing reached 10 000 tons in 2010 (Fish Statistics, 2010). It represents an important part of the everyday Omani diet and is also used as dry fish commodity (Al-Abdessalaam, 1995).

There are numerous studies investigating the impact of miscellaneous environmental stressors on developmental stability and the variety of organisms studied is wide (Eriksen *et al.*, 2008). However, the only published study on the fluctuating asymmetry in Omani fish species is that of Jawad *et al.* (2010), therefore, the present study is considered a quantitative and qualitative addition to the previous studies on Omani fish fauna.

The objectives of the present preliminary study were to determine the extent and direction of the asymmetry in some morphological characters of *Pentaprion longimanus* and the possible usefulness of the information in future taxonomic studies of *P. longimanus*.

## MATERIALS AND METHODS

Sultanate of Oman lies on the coasts of two seas, the Sea of Oman and the Arabian Sea. The country has an extensive coastline of 3,165 km, on the Sea of Oman



**Fig. 1:** Map showing the collection site of the specimens of *Pentaprion longimanus*.

**Sl. 1:** Zemljevid, ki prikazuje lokacijo ulova primerkov vrste *Pentaprion longimanus*.

in the north and the Arabian Sea in the south. Muscat is located in NE Oman, at 24°00' N and 57°00' E with the Sea of Oman at the northern and western periphery of the city.

A total of 91 specimens of *Pentaprion longimanus* were collected from the Muscat coastal area, the Oman Sea (Fig. 1). Five bilateral characters used to compare asymmetry were recorded as follows: (1) length of the pre-orbital distance (mm): measured from mouth to the anterior edge of the orbit; (2) length of the post-orbital distance (mm): measured from the posterior edge of the eye to the posterior edge of the operculum; (3) orbital diameter (mm): measured from the anterior to the posterior edges of the eye; (4) head length (mm): measured from mouth to the posterior edge of operculum; (5) number of pectoral fin rays: count of the total number of pectoral fin rays, including the most upper ray. Most characters were counted and measured under a binocular dissecting microscope. For specimens too large to fit under a microscope, a magnifying glass was used.

The statistical analysis included calculating the square coefficient of asymmetry variation ( $CV_a^2$ ) for metric and meristic characters according to Valentine *et al.* (1973):

$$CV_a^2 = (S_{r-l} \times 100 / X_{r+l})^2$$

where  $S_{r-l}$  is the standard deviation of the signed difference and  $X_{r+l}$  is the mean of the character, calculated by adding the absolute scores for both sides and dividing by the sample size. To eliminate scaling problems associated with growth in metric characters, each measurement was divided by suitable general size measurements, e.g. head length was used as the standardizing measurement. Each of the metric characters was treated in this manner before obtaining the signed differences.

## RESULTS

The results of asymmetry data analysis of the previously listed characters of *Pentaprion longimanus* collected from the Muscat coastal area, the middle part of the Oman Sea, are shown in Table 1. The highest values were recorded for the pre and postorbital length and the number of pectoral fin rays, and the lowest value for the head length.

The percentage of individuals showing asymmetry in the postorbital length character was the highest among the percentages recorded for the five characters (85.71% of the total fish studied) and the lowest percentage was for individuals with asymmetry in preorbital length (65.93% of the total fish studied). Individuals of *P. longimanus* were grouped into length classes (Tab. 2). An increasing trend in the asymmetry value with fish length was noticed for preorbital and postorbital lengths ( $P < 0.05$ ).

The results have shown that all the characters studied are dextral, with the right side showing higher value

**Tab. 1: Square coefficient of asymmetry variation ( $CV_a^2$ ) values and character means ( $X_{r+i}$ ) of *P. longimanus*.****Tab. 1: Vrednosti kvadratnega koeficienta asimetrije ( $CV_a^2$ ) in povprečne vrednosti morfoloških znakov ( $X_{r+i}$ ) vrste *P. longimanus*.**

Character	$CV_a^2$	N	Character mean	% of individuals with asymmetry
Preorbital length	328.29	91	8.91	65.93
Postorbital length	418.73	91	9.52	85.81
Eye diameter	92.90	91	9.66	73.63
Number of pectoral fin rays	478.98	91	9.61	78.02
Head length	50.50	91	22.76	75.82

**Tab. 2: Square coefficient of asymmetry variation and character means ( $X_{r+i}$ ) by size class of *P. longimanus*.****Tab. 2: Kvadratni koeficient asimetrije in povprečne mere telesnih morfoloških znakov ( $X_{r+i}$ ) za posamezne velikostne razrede vrste *P. longimanus*.**

Size class	n	$CV_a^2$	character mean $X_{r+i}$	% of individuals with asymmetry
Preorbital length				
10.1-11.0	3	81.29	6.92	66.67
11.1-12.0	23	92.48	8.08	78.26
12.1-13.0	31	98.13	8.88	67.74
13.1-14.0	30	101.87	9.57	63.33
14.1-15.0	4	105.45	10.50	0
Total	91			
Postorbital length				
10.1-11.0	3	43.83	6.17	66.67
11.1-12.0	23	75.15	8.67	82.61
12.1-13.0	31	83.03	9.73	90.23
13.1-14.0	30	94.72	10.06	80.00
14.1-15.0	4	99.23	11.23	100
Total	91			
Eye diameter				
10.1-11.0	3	243.87	6.92	100.00
11.1-12.0	23	147.43	9.48	78.26
12.1-13.0	31	63.61	9.68	70.97
13.1-14.0	30	84.81	9.95	76.67
14.1-15.0	4	17.42	10.38	25.00
Total	91			
Head length				
10.1-11.0	3	44.64	21.17	33.33
11.1-12.0	23	54.25	25.52	78.26
12.1-13.0	31	78.32	27.82	83.87
13.1-14.0	30	24.78	29.46	70.00
14.1-15.0	4	5.20	32.44	75.00
Total	91			
Number of pectoral fin rays				
10.1-11.0	3	338.61	11.17	100
11.1-12.0	23	351.08	9.39	73.91
12.1-13.0	31	469.10	9.32	77.42
13.1-14.0	30	602.44	9.82	80.00
14.1-15.0	4	203.22	10.38	75.00
Total	91			

over the left side. The only exception is the pectoral fin ray count, which appears to be sinistral since counts on the left side are larger than those on the right side. For the pectoral fin ray count, bilateral asymmetry occurred in 78.02% of the total of 91 *P. longimanus* examined. The percentage of the left handed individuals is 46.2%. As to the preorbital, postorbital lengths, orbital diameter and head length, the bilateral asymmetry exhibited was 65.9%, 85.81%, 73.6% and 75.8% respectively. The percentages of the right handed specimens are, 38.5%, 49.5%, 35.7% and 38.9% respectively.

## DISCUSSION

*Pentaprion longimanus* is an active fish, subjected to greater energy demands. The energy is needed both for its developmental needs and environmental stress. Some energy is allocated for maintaining homeostasis (Mitton, 1994). If the available energy is not sufficient to buffer the stress effects, homeostasis may be impaired, resulting in abnormal development (Mitton, 1994; Somarakis *et al.*, 1997). Consequently, higher levels of asymmetry can be recorded in *P. longimanus*.

There is some variation in the asymmetry values among the five morphological characters studied in *P. longimanus*. Characters like pre and postorbital length and pectoral fin ray count showed higher asymmetry values than those of the other characters studied. High asymmetry values for these three characters have also been recorded in several freshwater and marine fish species (Al-Hassan *et al.*, 1990; Al-Hassan & Hassan, 1994; Jawad, 2001, 2003; Jawad *et al.*, 2010). Such agreements in results of asymmetry might indicate the vulnerability of these three characters to immediate changes in the environment. On the other hand, the low asymmetry values displayed in the two characters, head length and orbital diameter might be explained on the basis that these characters are designated with high functional importance and are highly canalized during ontogeny thus giving low level of fluctuating asymmetry, FA (Palmer & Strobeck, 1986; Moller & Pomiankowski, 1993).

The effect of asymmetry on the size of the fins, the body proportions of the fish and rendering the fish either left handed or right handed is evident from the results of some studies (Moodie & Reimchen, 1976; Reimchen, 1983; Cameron, 1995; Zygari *et al.*, 1999; Künzler & Bakker, 2000; Gonçalves *et al.*, 2002; Bergstrom & Reim-

chen, 2003). It is quite possible for such asymmetry to hinder the basic functions of those body parts.

In taxonomic and racial studies involving pectoral fin ray count and the pre and postorbital lengths, interchanging counts and differences in dimensions from left and right sides of *P. longimanus* introduce an additional source of variation to taxonomists who rely on these characters when separating specimens of this species or its populations. Bilateral asymmetry has proven problematic for fish taxonomists (Parenti, 1986) and taxonomists of animal groups other than fish such as owl (Norberg, 1977).

Pollution of sea water and sediments by hydrocarbons, heavy metals, pesticides and organic matter are considered the main cause of environmental stress (Bengtson & Hindberg, 1985). This state of pollution is not unusual for the coastal environment of the Oman Sea where different pollutants were reported to affect its waters in the last twenty years (De Mora *et al.*, 2004, 2005; Al-Darwish *et al.*, 2005; Tolosa *et al.*, 2005; Abdel Gawad *et al.*, 2008; Khan, 2008).

Several authors have shown a relationship between the coefficient of asymmetry and fish length (Al-Hassan *et al.*, 1990; Al-Hassan & Hassan, 1994; Al-Hassan & Shwafi, 1997; Jawad, 2001; Jawad *et al.*, 2010) where there was a trend of increase in the asymmetry value with the increase in fish length. This trend is probably the result of incomplete development; character means are always lowest in smaller size classes (Valentine *et al.*, 1973). The same results were obtained by Valentine *et al.* (1973) in selected fish species collected from California, U.S.A. and Jawad *et al.* (2010) in the carangid fish species, *Decapterus russelli* collected from the northern coastal region of the Oman Sea, Oman. The researchers suggested two possible hypotheses that may account for such a trend; namely, the ontogenetic changes (an increase in asymmetry with size - age) and the possible historical process (a secular increase in asymmetry).

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## PREDHODNA ŠTUDIJA ASIMETRIJE MORFOLOŠKIH ZNAKOV PRI VRSTI *PENTAPRION LONGIMANUS* (OSTEICHTHYES: GERRIDAE) IZ OMANSKEGA ZALIVA

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### POVZETEK

Članek obravnava spremenljivost asimetrije pri vrsti *Pentaprion longimanus*, ocenjeno na podlagi števila plavutnic v trebušnih plavutih in meritev štirih telesnih morfoloških znakov, tj. preorbitalne razdalje, postorbitalne razdalje, premera očesa in dolžine glave na obeh straneh telesa 91 primerkov iz populacije *P. longimanus*, ujetih pri mestu Muscat v Omanskem zalivu. Kot mero za asimetrijo smo uporabili absolutno razliko v meritvah telesnih morfoloških znakov na vsaki strani telesa. Rezultati kažejo, da je pri preorbitalni in postorbitalni razdalji in številu plavutnic v trebušnih plavutih asimetrija večja kot pri drugih obravnavanih telesnih znakih. Pri preorbitalni in postorbitalni razdalji je bil opažen tudi trend večanja vrednosti asimetrije z večanjem dolžine ribe. Kot možen vzrok asimetrije pri tej vrsti bi lahko navedli različna onesnaževala in njihovo prisotnost na obravnavanem območju, Upoštevana je bila tudi možnost uporabe teh ugotovitev v prihodnjih taksonomskih študijah vrste *P. longimanus*.

**Ključne besede:** spremenljiva asimetrija (FA), Omanski zaliv, Sultanat Oman, *Pentaprion longimanus*, indikator

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