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# FLUCTUATING ASYMMETRY IN THE OTOLITH WIDTH AND LENGTH OF ADULT TELEOST (*Beryx splendens* LOWE, 1834) (FAMILY: BERCIDAE) COLLECTED FROM THE ARABIAN SEA COASTS OF SULTANATE OF OMAN

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## *Summary*

Fluctuating asymmetry was described for the otolith width and length of adult teleost *Beryx splendens*. The results showed that the level of asymmetry of the otolith width was the highest among the two asymmetry values obtained for the otolith of *B. splendens*. For the otolith width character, the results showed that the level of asymmetry at its highest value in fish ranging in length between 191–200 mm and in its lowest value in fish ranging in length between 121–180 mm. For the otolith length, the highest value of asymmetry is noticed in fish ranging in length between 231–244 mm and the lowest value in fish within the length of 121–190 mm. The possible cause of the asymmetry in this species has been discussed in relation to different pollutants and their presence in the area. No trend of increase in the asymmetry values with the fish length was noticed for the otolith width, but there is a weak trend of increase with the fish length in case of otolith length character.

**Key words:** asymmetry, otolith width, otolith length, *Beryx splendens*, Arabian Sea, Oman

## *INTRODUCTION*

The differential development of a bilateral character between the sides of an organism is known as asymmetry (Van Valeen, 1962; Palmer and Strobeck, 1986; Leary and Allendrof, 1989). Fluctuation asymmetry which is a random deviation from perfect bilateral system can reflect develop-

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mental instability (Palmer, 1994; Fey and Hare, 2008). The inability of an organism to compensate for disturbances during development is known as developmental instability (Zakharov, 1992), and can be affected by stress related to environmental or genetic conditions. Taking into consideration environmental stress causes developmental instabilities; high fluctuating asymmetry could indicate the lower condition of larvae that were experiencing unfavourable environments. Thus, the method could show the specific environmental effects on the condition of the organism.

The relationship between fish condition and fluctuating asymmetry has been studied for adult fishes, and a number of measurements have been analysed, including the number of gill rakers, pectoral fin rays, fish body proportions, eye spot area, or otolith size and shape (Al — Hassan et al., 1990; Al — Hassan and Hassan ,1994; Escós et al., 1995; Somarakis et al., 1997a,b; Jawad, 2001, 2003, 2004; Øxnevad et al., 2002; Gçonalves et al., 2002).

Fluctuating asymmetry studies were never performed on the otolith width or length of the species in question, that of the same species from other localities in Omani waters or even that from previous years. Therefore, the present study is considered the first in its kind for Omani waters. The present work studied fluctuating asymmetry in the otolith width and length of the teleost fish Beryx splendens collected from Arabian Sea coasts of Oman.

## *MATERIAL AND METHODS*

Fish specimens of *Beryx splendens* Lowe, 1834 were collected from the Arabian Sea coasts of Oman. Otolith width and length were used to study the asymmetry level in the fish species in question.

The statistical analysis included calculating the squared coefficient of asymmetry variation ($CV^2_a$) for otolith width and length according to Valentine et al.(1973).

$$CV^2_a = (S_{r-l} \text{ X } 100/X_{r+l})^2$$

Where $S_{r-l}$ is the standard deviation of signed differences and $X_{r+l}$ is the mean of the character, which is calculated by adding the absolute scores for both sides and dividing by the sample size.

## *RESULTS*

The results of asymmetry data analysis of the otolith width and length of *B. splendens* collected from the Arabian Sea coasts of Oman are shown in Table 1. The results showed that the level of asymmetry of the otolith width was the highest among the two asymmetry values obtained for the otolith of *B.*

*splendens*. For the otolith width character, the results showed that the level of asymmetry at its highest value in fish ranging in length between 191–200 mm and in its lowest value in fish ranging in length between 121–180 mm. For the otolith length character, the highest value of asymmetry is noticed in fish ranging in length between 231–244 mm and the lowest value in fish within the length of 121–190 mm.

The percentage of the individuals showing asymmetry in the otolith length character was the highest among the percentages (65.63% of the total fish studied). Individuals of *B. splendens* were grouped into length classes (Table 2). No trend of increase in the asymmetry values was noticed in the width of the otolith while there is a weak trend of increase in the asymmetry values in the otolith length character.

*Table 1. Squared coefficient of asymmetry ($CV^2_a$) values and character means ($X_{r+l}$) of* Beryx splendens
*Tablica 1. Kvadrat koeficijenta vrijednosti asimetrije ($CV^2_a$) i srednja vrijednost parametra ($X_{r+l}$)* Beryx splendens

| Character — Značajka | $CV^2_a$ | N | Character mean — srednja vrij. | % of individuals with asymmetry — % jedinki s asimetrijom |
|---|---|---|---|---|
| Otolith length — dužina (mm) | 72.30 | 224 | 12.47 | 65.63 |
| Otolith width — širina (mm) | 81.09 | 224 | 9.64 | 40.63 |

*Table 2. Squared coefficient of asymmetry and character means by size class of* Beryx splendens
*Tablica 2. Kvadrat koeficijenta asimetrije i srednje vrijednosti veličina* Beryx splendens

| Character — Značajka | $CV^2_a$ | N | character mean — sred. vrij. $X_{r+l}$ | % of individuals with asymmetry — % jedinki s asimetrijom |
|---|---|---|---|---|
| Otolith length — dužina otolita (mm) | | | | |
| 121–130 | 0.00 | 11 | 9.00 | 0.00 |
| 161–170 | 0.00 | 11 | 12.00 | 0.00 |
| 171–180 | 0.00 | 11 | 11.50 | 100.00 |
| 181–190 | 16.99 | 29 | 12.06 | 55.56 |

| | | | | |
|---|---|---|---|---|
| 191–200 | 17.36 | 58 | 12.00 | 100.00 |
| 201–210 | 14.79 | 58 | 13.00 | 100.00 |
| 211–220 | 40.29 | 21 | 12.93 | 57.14 |
| 221–230 | 3.56 | 12 | 13.25 | 50.00 |
| 231–240 | 56.51 | 13 | 13.67 | 100.00 |
| Otolith width — širina otolita (mm) | | | | |
| 121–130 | 0 | 11 | 10.5 | 100.00 |
| 161–170 | 0 | 11 | 11 | 0.00 |
| 171–180 | 0 | 11 | 11 | 0.00 |
| 181–190 | 58.52 | 29 | 9.44 | 66.66 |
| 191–200 | 138.77 | 58 | 8.75 | 50.00 |
| 201–210 | 18.55 | 58 | 9.63 | 25.00 |
| 211–220 | 28.57 | 21 | 10 | 0.00 |
| 221–230 | 164.36 | 12 | 9.75 | 50.00 |
| 231–240 | 6.37 | 13 | 9.33 | 66.66 |

## *DISCUSSION*

There is some variation in the asymmetry values among the two morphological characters of the otolith of *B. splendens*. In the present time it is impossible to evaluate the level of asymmetry of those characters and to determine if they are higher or lower than the average due to the lack of data regarding natural asymmetry in this part of the world. However, character like otolith length showed higher asymmetry value than those of the otolith character. The high asymmetry value of the otolith length might indicate the vulnerability of this character to the immediate changes in the environment. It is not possible at this stage to confirm such effect as the correlation between different environmental pollution and the morphology of the fish species in question is not available. However, based on previous studies in this field, it is possible to conclude that there is a direct correlation between environmental stress due to pollution and asymmetry in this species. Such environmental factors are present in the waters of the Arabian Sea coasts of Oman. On the other hand, the low asymmetry value displayed by the otolith width character might be explained on the basis that this character is less vulnerable to environmental stresses.

The origin and cause of asymmetry in fishes can depend on several factors, one of which is genetic factors that might be responsible for the asymmetry in these two characters, but these can not be discussed at this stage due to the lack of genetic data on the ichthyofauna of Oman. The other possible factor is the environmental stress which leads to an increased level of asymmetry, but might occur at low levels before causing wide spread death (Bengtsson and Hindberg, 1985).

Pollution of sea water and sediments by hydrocarbons, heavy metals, pesticides and organic matter are considered the main cause of environmental stress. This state of pollution is not unusual for the Arabian Sea coasts of Oman environment where different pollutants were reported to affect its water for at leas in the last twenty years (Ramamurthy, 1991; Badawy and Al — Harthy, 1991; Sen Gupta et al., 1993).

The environmental causes might be natural events, and several factors are known to produce nutritional deficiencies such as various pathogens and various population phenomena (Bengtsson and Hindberg, 1985), and it is highly possible that these factors may be in action in the Arabian Sea waters of Oman as they seem to be common in the aquatic environment.

Several authors have shown a relationship between the coefficient of asymmetry and fish length (Al — Hassan et al., 1990; Al — Hassan and Hassan, 1994; Al — Hassan and Shwafi, 1997; Jawad, 2001) where there was a trend of increase in the asymmetry value with the increase in fish length. The otolith morphological characters studied were identical and gave zero value for the asymmetry coefficient in several length groups studied. This is because there is only one fish specimen in these groups. The results also show a weak trend of increase of otolith length asymmetry value with fish length. For otolith width characters there was no such trend.

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***Sažetak***

## ASIMETRIJA ŠIRINE I DUŽINE OTOLITA ODRASLIH TELEOSTIDA (*Beryx splendens* LOWE, 1834) (PORODICA: BERCIDAE) ULOVLJENIH UZ OBALU ARAPSKOG MORA U OMANU

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U radu je prikazana promjena asimetrije širine i dužine otolita odraslih primjeraka *Beryx splendens*. Dobiveni rezultati pokazuju da su vrijednosti asimetrije širine bile više u riba koje su bile duge između 191 i 200 mm, a kod riba dužine između 121 i 180 mm vrijednosti su bile niže. Vrijednosti dužina otolita bile su više u riba dugih između 231 i 244 mm, a u riba dužine između 121 i 190 mm vrijednosti bile su niže. Mogući uzrok spomenute asimetrije razmatran je u odnosu na različite onečišćivače i njihovu prisutnost u tom području. Nije primijećeno povećanje vrijednosti asimerije širine otolita s obzirom na dužinu riba, ali je zapaženo slabo povećanje vrijednosti dužine otolita u odnosu na veličinu riba.

Ključne riječi: asimetrija, širina otolita, dužine otolita, *Beryx splendens*, Arapsko more, Oman

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