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Հայաստանի Գիտությունների Ազգային Ակադեմիա	Emma	Հայաստանի Կենսաբանական Հանդես
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# FLUCTUATING ASYMMETRY IN THE OTOLITH DIMENSIONS OF LUTJANUS BENGALENSIS (LUTJANIDAE) COLLECTED FROM MUSCAT COAST ON THE SEA OF OMAN

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The otolith length and width of adult teleost Lutjanus bengalensis were used to calculate the fluctuating asymmetry in these two characters. 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 Lutjanus bengalensis. On the other hand, the lowest level of asymmetry in the two otolith characters is at the fish length ranging between 19.0-19.9 mm and the highest at the fish length ranging between 23.0-23.9 mm. The possible cause of the asymmetry in this species has been discussed in relation to different pollutants and their presence in the area. A trend of increase in the asymmetry values with the fish length was noticed for the otolith length and width.

## Bilateral asymmetry - otolith - Lutjanidae - ecological indicator -Lutjanus bengalensis

Lutjanus bengalensis hասուն ձկան օթոլիտի մոտ երկարությունն ու լայնքը օգտագործվել են հաշվարկելու այդ երկու պարամետրերի Ֆլուկտուացող ասիմետրիան։ Արդյունքները ցույց են տալիս, որ օթոլիտ լայնքի ասիմետրիայի մակարդակն ամենամեծն եր Lutjanus bengalensis ձկան օթոլիտից ստացված ասիմետրիայի երկու արժեքների միջև։ Մյուս կողմից, երկու օթոլիտ պարամետրերի ասիմետրիայի ամենացածը մակարդակը գտնվում է ձկան երկարության՝ 19.0-19.9 մմ սահմաններում, իսկ ամենաբարձրը՝ երկարության 23.0-23.9 մմ սահմաններում։ Այդ տեսակների մոտ ասիմետրիայի հնարավոր պատճառը քննարկվում է հաշվի առնելով տարբեր ախտոտվածություններն ու դրանց առկայությունը միջավայրում։ Ձկան երկարության հետ ասիմետրիայի արժեքների ավելացման միտումը նկատվում է օթոլիտի երկարության և լայնքի համար։

#### Երկկողմանի ասիմետրիա – օթոլիտ – Lutjanidae – Էկոլոգիական ցուցիչ – Lutjanus bengalensis

Длина и ширина отолита взрослой рыбы Lutjanus bengalensis применялись для расчета флуктуирующей асимметрии этих двух параметров. Результаты показали, что уровень асимметрии ширины отолита самый высокий среди двух значений ассиметрии отолита, полученного у рыбы Lutjanus bengalensis. С другой стороны, самых низкий уровень ассиметрии двух параметров отолита находится в пределах длины рыбы 19.0-19.9 мм, а самых высокий – в пределах длины рыбы 23.0-23.9 мм. Возможная причина асимметрии у этих видов обсуждается в связи с разными загрязнениями и их наличием в среде. Для длины и ширины отолита взрослой рыбы наблюдается тенденция увеличения значений ассиметрии.

Двустороняя асимметрия – отолит – Lutjanidae – экологический показатель – Lutjanus bengalensis

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Fluctuating asymmetry is the differential development of a bilateral character between the sides of an organism [41, 32, 25]. Fluctuation asymmetry can reflect developmental instability [31, 16], which is the inability of an organism to compensate for disturbances during development [43], and can be affected by stress related to environmental or genetic conditions. Thus, the situation of fish larvae facing unfavourable conditions can be indicated by the study of the high fluctuating asymmetry of several morphological characters. Hence, the bilateral asymmetry measure could show the severe effect 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 proposed, including the number of gill rakers, pectoral fin rays, fish body proportions, eye spot area, or otolith size and shape [5, 3, 15, 36,37, 21, 22, 23, 30, 19].

[17 and 18] have reviewed and determined the effect otoliths asymmetry in fish behaviour. This could affect survival of larvae in terms of misleading them in finding proper settlement grounds.

As fluctuating asymmetry studies were never performed on the otolith dimensions of the species in question in Omani waters or on that of the same species from other localities in Omani waters the present work represents the first study on fish otolith asymmetry of the Sea of Oman.

The present work studied fluctuating asymmetry in the otolith length and width of the teleost fish Lutjanus bengalensis collected from the Sea of Oman near Muscat City.

The present study aims to provide information related to the detection of suitable settlement habitats by the larvae of *Lutjanus bengalensis*.

*Materials and methods.* Description of sampling area. Sultanate of Oman is a fortunate country as it lies on the coasts of three seas, the Arabian Gulf, the Sea of Oman and The Arabian Sea. This country has an extensive coastline of 3,165 km, which includes the Gulf of Oman in the North and the Arabian Sea in the South. Muscat is located in northeast Oman, at 24°00'N 57°00'E 24°N 57°E with the Sea of Oman forms the northern and western periphery of the city.

The climate generally is very hot, with temperatures reaching 54 °C (129.2 °F) in the hot season, from May to September with very little rainfall. Annual rainfall averages in Muscat City is 100 mm, falling mostly in January.

The water along to coast of Muscat runs deep, forming two natural harbors, in Muttrah and Muscat. The Western Al-Hajar Mountains run through the northern coastline of the city.

The marine area in the vicinity of Muscat City is characterized with inshore islands, rocky stacks and mangrove forest. In addition, the coasts can be of several types, alluvial plains, delta, raised gravel terraces, coastal cliffs, sandy and Sabkha [38]. The ecological factors such as water temperature, salinity and PH value showed variation in water column. [38] reported 23.39° - 23.90  $^{\circ}$ C, 20.0 – 23.72  $^{\circ}$ C, 36.8 – 38.5PPt and 7.7 – 8.9 for surface water temperature, temperature in the water column, salinity and PH value respectively. Recently, [6] gave slightly different values for the above mentioned ecological factors (23.13 - 26.69 °C, 18.04 - 32.74 °C, 35.32 - 41.46 PPt and 7.03 8.98 respectively). It is evident that the main meteorological force, the monsoons affecting the physical-biological in the coastal ecosystem of the Sea of Oman [7]. Monsoons manifest themselves as strong, seasonally reversing winds [42]. There are two types of monsoons, the north east monsoon (NEM) and the south west monsoon (SWM). The NEM shows its effect from November-February, during which sea surface winds over the Sea of Oman are mainly Northeastterly [35]. The SWM takes place from June-mid-September when sea surface winds over the region are predominantly from the southwest [11] and stronger than during the NEM [12]. Coastal upwelling persists during SWM along the coast of Oman impacting mainly the southern part of the coast "Dhofar region" [34]. The effects of upwelling can be detected to about 750 km offshore of Oman and can also be observed in the Sea of Oman when injection of cool water occurs and as a consequence temperatures profiles is effected dramatically during summer. Inflow of the water from the Arabian Gulf and high air temperature has a strong impact on the intrusion of upwelled water into the Sea of Oman. Such effect leads to strong vertical stratification in the coastal water masses.

**Sample collection**\_Fish specimens of *Lutjanus bengalensis* (230) were collected using trawler net from only one location on 15<sup>th</sup> March 2010 from the coastal waters of Muscat City, Sea

of Oman. Sagittae from both sides of the fish head were dissected out from the sacculus part of the fish inner ear. Otolith length and width were measured to nearest millimetre under dissecting microscope. Asymmetry in the otolith length and width is aimed to be study in the fish species in question. In the present study fluctuating asymmetry was not correlated with sex because asymmetries develop in the early life stages, when larvae sex cannot be recognized. The asymmetries cannot be eliminated by further growth as they are persistent and thus become a stressor for an individual throughout its life.

**Statistical analysis.** The statistical analysis was based on the squared coefficient of asymmetry variation (CV2<sup>a</sup>) for the two otolith dimensions according to [40]:

$$CV_{a}^{2} = (S_{r-1}X 100/X_{r+1})^{2}$$

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.

The vicinity of Muscat City was chosen as it represents one of the main fishing grounds for the species in question and asymmetry study for *L. bengalensis* is important to the effect of this phenolmenon on the settlement of the larvae of this species in this important fishing ground.

**Results and Discussion.** Tab. 1 shows the results of asymmetry data analysis of the otolith length and width of *Lutjanus bengalensis* collected from the coastal water around Muscat City, Sea of Oman. In the results, the level of asymmetry of the otolith width was the highest among the two asymmetry values obtained for the otolith of *Lutjanus bengalensis* ranging in length between 19.0-19.9 mm and 23.0-23.9 mm respectively. A tendency of increasing asymmetries in otolith width and length with fish body length can be noticed (tab. 2).

**Table 1.** Squared coefficient of asymmetry (CV  $_{a}^{2}$ ) value and character means (X<sub>r+1</sub>) of *Lutjanus bengalensis* 

Character	CV <sup>2</sup> <sub>a</sub>	Ν	Character mean	% of individuals with asymmetry
Otolith length	5.06	230	9.08	95.7
Otolith width	10.29	230	5.38	100

The percentage of the individuals showing asymmetry in the otolith width character was the highest among the percentages obtained for the two otolith characters (tab.1).

Asymmetry in morphological characters of vast number of animal taxa is usually negatively correlated with the animal fitness (e.g. [27, 28,9]. On the other hand, studies on the possible effect of asymmetry on dispersal and recruitment of individuals are lacking [29, 10].

 Table 2. Squared coefficient of asymmetry and character means by size class of Lutjanus bengalensis.

Character	$CV^2_a$	N	Character mean $X_{r+l}$	% of individuals with asymmetry
Otolith length				
19.0-19.9	23.5	10	9.1	100
20.0-20.9	24.6	30	8.86	100
21.0-21.9	25.6	120	8.95	91.67
22.0-22.9	25.9	60	9.37	100
23.0-23.9	27.8	10	9.13	100
Total		230		
Otolith width				
19.0-19.9	1.37	10	5.30	100
20.0-20.9	1.46	30	5.28	100
21.0-21.9	10.47	120	5.34	100
22.0-22.9	11.59	60	5.52	100
23.0-23.9	12.99	10	5.46	100
Total		230		

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The obvious effect of bilateral asymmetry in fish otolith mass is the abnormal swimming activity [20] and interference with correct sound localization resulting in inability of individuals to integrate with the habitat they are living in [26].

The capability of the young individuals of *Lutjanus bengalensis* to find and settle down in a suitable environment can be hindered by the variations in the dimensions of the otolith [17, 18]. Thus, the settlement of the larvae of the species studied in the present work might be affected due to the asymmetry observed in its morphological characters.

Due to the lack of data regarding natural asymmetry in Oman it is impossible to evaluate the level of asymmetry of the two morphological characters of the otolith of L. *bengalensis* and to determine if they are higher or lower than the average.

It is impossible to have a precise indication on the significance of the correlation between asymmetry in the morphology of the fish species in question and different environmental pollutions along a pollution gradient, or from fish taken from polluted and non polluted sites due to unavailable of such data.

However, based on previous studies in this field, it is possible to correlate between environmental stress due to pollution and asymmetry in the morphology of this species. Such environmental factors are present in the Sea of Oman waters in general and the Omani coasts of the Sea of Oman in particular [13, 14, 2, 39, 1, 24].

Several natural events can be listed under the environmental causes, and nutritional deficiencies can be caused by many factors such as various pathogens and various population phenomena [8], and it is highly possible that these factors may be in action in Oman Sea as they seem to be common in the aquatic environment [1, 2, 13, 14].

Fish length and asymmetry in morphological characters have shown to be correlated as indicated by several authors where there was a trend of increase in the asymmetry value with the increase in fish length [5, 3, 4, 21]. The results also show a trend of increase of otolith length and width asymmetry value with fish length.

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