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Short Communication

ASYMMETRY IN SOME MORPHOLOGICAL CHARACTERS OF FOUR SPARID FISHES FROM BENGHAZI, LIBYA

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Abstract

Asymmetry analyses were conducted on some bilateral characters of four members of the family Sparidae, *Boops boops* (Linnaeus 1758), *Diplodus anularis* (Linnaeus 1758), *Diplodus vulgaris* (E. Geoffroy Saint-Hilaire 1817) and *Lithognathus mormyrus* (Linnaeus 1758) which were collected from coastal waters near Benghazi City, Libya. The results indicated that the highest asymmetry level is in the post-orbital length character. Eye lens diameter and eye lens weight exhibited the lowest asymmetry values.

INTRODUCTION

Members of the family Sparidae are among the most important commercial fishes in the Mediterranean Sea and in Libya in particular. Several species have been observed in the Mediterranean Sea and along the Libyan coast (Whitehead *et al.* 1986, Al-Hassan and El-Silini 1999).

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 Allendorf 1989). Fluctuating asymmetry results when a trait present on both sides of the body does not undergo identical development. It is also known that fluctuating asymmetry represents a measure of developmental sensitivity to environmental stress (Moller and Pomiankowski 1993). Asymmetry usually increases under environmental stresses due to the failure of the homeostatic regulatory mechanism. These developmental effects might occur before the concentration of toxicants in the water or food reaches levels high enough to produce morbidity (Bengtsson and Hindberg 1985).The present work studied fluctuating asymmetry in selected morphological characters of four sparid fish species collected from waters near Benghazi City, Libya.

MATERIALS AND METHODS

Fish specimens were collected from the coastal water around Benghazi City, Libya. Four sparid species were used in the present study - *Boops boops, Diplodus anularis, D. vulgaris* and *Lithognathus mormyrus*. Five bilateral characters were used to compare the asymmetry levels in the fish species *B. boops* and *D. Anularis* (pectoral fin ray, pre- and post-orbital length, eye lens diameter, weight). Only three characters, pre- and post-orbital length and eye lens diameter, were studied in *D. vulgaris* and *L. mormyrus*. These characters are the most vulnerable to any changes in the environment (Bengtson *et al.* 1985), and they are easy to evaluate.

The statistical analysis included calculating the squared coefficient of asymmetry variation (CV^2_a) for meristic and morphometric characters according to Valentine and Soule (1973):

$$CV^2_a = (S_{r-1} \text{ X } 100/X_{r+1})^2$$

Where S_{r-1} is the standard deviation of signed differences, and X_{r+1} is the mean of the character, which is calculated by adding the absolute scores for both sides and dividing by the sample size. To obviate scaling problems associated with growth in morphometric characters, each measurement was divided by suitable general size measurements, *e.g*. head length was used as the standardizing measurement. Each of the morphometric characters was treated as such before obtaining the signed differences. No previous studies on record have focused on the natural level of asymmetry in the species in question, that of the same species from other localities or even that from previous years. Therefore, the present study should be considered as preliminary work in this field for Libyan waters.

Table 1

Squared coefficient of asymmetry (CV^2_a) values and the character mean (X_{r+1}) of the four sparid species from Benghazi waters, Libya.

Character	CV^2_a	N	Character Mean
Boops boops			
Pre-orbital length	3.03729	380	6.5850
Post-orbital length	92.0396	380	9.3850
Pectoral fin-ray count	36.6679	380	15.5200
Eye lens diameter	23.9823	380	2.6000
Eye lens weight	22.0396	380	0.0120
Diplodus annularis			
Pre-orbital length	35.4974	108	11.4200
Post-orbital length	63.7986	108	10.3200
Pectoral fin-ray count	10.4315	108	13.3600
Eye lens diameter	18.6000	108	2.9000
Eye lens weight	4.6154	108	0.0730
Lithognathus mormyrus			
Pre-orbital length	28.1366	76	22.7340
Post-orbital length	97.0014	76	16.3500
Eye lens diameter	35.3033	76	3.1540
Diplodus vulgaris			
Pre-orbital length	26.3136	82	13.7650
Post-orbital length	77.7131	82	12.5370
Eye lens diameter	9.5277	82	3.8500

RESULTS AND DISCUSSION

The results of asymmetry data analysis are presented in Table 1. There is some variation in the asymmetry values of these characters among the four teleostean fishes. It is presently impossible to evaluate the level of asymmetry of each character and to determine if it is higher or lower than the average due to the lack of data regarding natural asymmetry in this part of the world. However, it is possible to compare characters, and the results indicate that some characters have higher values in comparison with others. For instance, the asymmetry value for pre-orbital length was higher than that of the other characters in all the fishes studied except for *B. boops*, where eye lens diameter and weight were higher.

Since direct, correlated studies between different environmental pollutants and fish morphology are not available, it is impossible to draw final conclusions regarding the cause of asymmetry in the fish species in question. 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 these fishes. Such environmental factors are present in Libyan waters.

The origin and cause of asymmetry in fishes can depend on several factors, one of which is environmental stress which leads to an increased level of asymmetry. Such developmental deformities might occur at a level which is just below that which causes wide-spread morbidity (Bengtsson and Hindberg 1985).

The high asymmetry values obtained for pre-orbital length and the variation in those of other characters in the fish species in question may be due to environmental stresses caused by the pollution of the coastal waters with different types of sediments and organisms.

In general, the Mediterranean coast exhibits variable degrees of pollution with different types of pollutants. Hydrocarbons, heavy metals, pesticides and organic matter are the main pollutants in the area (Bernard and Renzoni 1977, Saad and Fahmy 1985, Saad and Kandeel 1988, Domovic 1992, Meadows 1992, Sellali *et al.* 1992).

The pollution along the Libyan coast does not differ from that of other parts of the Mediterranean coast. Hydrocarbons were recorded in Libyan waters and sediments along its coast (Magazzu and Angott 1981,Tumi *et al.* 1992). Heavy metals were recorded in fishes (Giama, *et al*, unpublished data, Bentalb, unpublished data) and in the sediments (Hamouda and Wilson 1992). Organic and inorganic mercury were also recorded in the area (Barghigiani and Pelleggrini 1992), and finally, human wastes of different kinds were among the pollutants found in Libyan coastal waters (Biano *et al.* 1992).

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 play in the coastal waters of Benghazi City. They seem to be common in the aquatic environment.

Other characters showed a low asymmetry value, *i.e.* eye lens weight in *D.anularis,* eye lens diameter in *D. vulgaris* and pre-orbital length in *B. boops*. Moderate values were noted in the eye lens diameter of *D. annularis*. It is possible to conclude that both eye lens weight and diameter are less vulnerable to harsh environmental factors. This may be the case when the developmental period of the eye lens does not coincide with adverse environmental events. Other factors, including genetic ones, might be responsible for asymmetry in these characters, but these cannot be discussed at this stage due to the lack of genetic data on the ichthyofauna of Libya.

REFERENCES

Biano, R., Silvesttri, R., Serena, F., Voliani, A. and Volpi, C, 1992, *Anthropical wastes surveyed on sea bottom*, Bull. Mar. boil. Res. Cent., 9(B): 137-149.

Barghighiani, C. and Pelleggrini, D. 1992, *A case of mercury concentration in fish and human*, Bull. Biol. Res. Cent., 9(B): 5-10.

Bengtsson, B.E. and Hindberg, M. 1985. *Fish deformities and pollution in some Swedish waters*, Ambio, 14(1): 32-35.

Bernard, M. and Renzoni, A. 1977, *Mercury concentration in the Mediterranean marine organisms and their environment: natural anthropogenic origin*, Thalasia Juqosl., 13:265-300.

Domonvic, D. 1992, *The source of marine oil pollution in the Mediterranean*, Bull. Mar. boil. Res. Cent., 9(B): 179-204.

Hamouda, M.S. and Wilson, J.G. 1992, *Levels of heavy metals and total Hydrocarbon along the Libyan coastline*, Bull. Mar. Biol. Res. Cent., 9(B): 31-43.

Leary, A. and Allendorf, f.W. 1989, *Fluctuating asymmetry as an indicator of stress: Implications for conservation biology*, Trends in Evol., 4: 214-217.

Magazzu, G. and Angot, M. 1981, *Dissolved and dispersed petroleum hydrocarbon in Libya coastal waters*. Bull. Mar. res. Cent., 1: 1-45.

Meadows, P.S. 1992, *Pollution, conservation and the Mediterranean ecosystem: A perspective view*, Bull. Mar.boil.Res.Cent., 9(B): 269-289.

Moller, A.P. and Pomiankowski, A. 1993, *Punctuated equilibria or gradual evolution; fluctuating asymmetry and variation in the rate of evolution*, J.Theo. Biol., 161:359-367.

Palmer, A.R. and Strobeck, C. 1986, *Fluctuating asymmetry: measurements, analysis and pattern*, Am. Rev.Ecol.syst., 17: 391-421.

Saad, M.A.H. ana Fahmy, M.A. 1985, *Occurrence of some heavy metals in surficial sediments from the Damietta estuary of the Nile*, J. Etud. Poll.CIESM, 7:405-407.

Saad, M.A.H. and Kandeel, m.M. 1988, *Distribution of copper, iron and manganese in the coastal Red Sea waters in front of Al-Ghardaqa*. Proc. Indian Natl.Sci.Acad. 54A(4): 642-652.

Sellali, B., Kemoum, a. and Tounsi, R. 1992, *Dissolved-dispersed hydrocarbons in the bay of Alger: preliminary results*, Bull.Mar.Biol. Res.Cent., 9(B): 163-170.

Tumi, S.O., Kumar, N.S. and El-Hinshery, A.K. 1992, *Assessment of dissolved and dispersed petroleum hydrocarbons in Libyan sea waters*, Bull. Mar.boil.res.Cent., 9(B): 153-162.

Valentine, D.W. and Soule, M.E. 1973, *Effect of p,p-DDT on developmental stability of pectoral fin ray in the grunion, Leuresthestennius*, Nat. Mar. fish. Ser. Fish. Bull, 71: 921-925.

Van Valeen, L. 1962, *A study of fluctuating asymmetry*, Evol., 16: 125-142.

Whitehead, P.J.P., Bauchot, M.L., Hureau, J.C., Nielson, J. and Tortonese, E. 1986, *Fishes of the North-eastern Atlantic and the Mediterranean*, Vol.1-3, UNESCO.