ON THE RECORD OF VERTEBRAL DEFORMITIES IN *Mastacembelus mastacembelus* COLLECTED FROM THE LOWER REACHES OF EUPHRATES RIVER, IRAQ

Laith **JAWAD**[1]**;** Falah **MUTLAK**[2] ; Abbas **AL-FAISAL**[2]

Abstract

Severe deformity such as coalescence of vertebrae, compact vertebrae, loss of vertebral parts, and different levels of deformed vertebral centra and minor deformities such as undulation of the haemal spines of the vertebrae are reported in six specimens of *Mastacembelus mastacembelus* (Family: Mastacembelidae) collected from the lower reaches of Euphrates River, at Nasiria marsh area, Iraq. Several abdominal and caudal vertebrae are involved in this anomaly. Possible causes such as genetic and epigenetic factors may be implicated in this anomaly.

Keywords: abnormalities, column, coalescence, marshes

RELATO DE DEFORMIDADES VERTEBRAIS DE *Mastacembelus mastacembelus* COLETADOS NO RIO EUPHRATES, IRAQUE

Resumo

Deformidade grave, como a coalescência de vértebras, vértebras compactadas, perda de partes vertebrais e diferentes níveis de deformidades vertebrais e deformidades menores, tais como ondulação dos espinhos hemal das vértebras são relatados em seis espécimes de *Mastacembelus mastacembelus* (Família: Mastacembelidae) coletados no curso inferior do rio Eufrates, na área Nazriya pântano, Iraque. Várias vértebras abdominal e caudal estão envolvidas nesta anomalia. As possíveis causas, como fatores genéticos e epigenéticos podem estar implicadas nesta anomalia**.**

Palavras-chave: anormalidades, coluna, coalescência, pântano

Nota Científica: Recebido em 20/08/2015 – Aprovado em 21/01/2016

[1] *Manukau, Auckland, New Zealand*
[2] *Marine Science Centre, University of Basrah, Basrah, Iraq*
**Correspondence author:* laith_jawad@hotmail.com

INTRODUCTION

Skeletal anomalies are usually considered one of the main difficulties that face fish during development, as they affect their morphology, growth and survival (BOGUTSKAYA *et al.*, 2011). Such abnormalities are rare in the wild (GAVAIA *et al.*, 2009), but some of them are so severe that they disturb the fitness of the fishes. Still others may be slight and not considered serious to their survival (ERSHOV, 2008).

The spiny eel, *Mastacembelus mastacembelus* is a principle freshwater species in the Tigris-Euphrates Rivers basin and belongs to the family Mastacembelidae, whose members are distributed from Africa eastward to Korea and Malaysia (COAD, 2010). This family comprises 5 genera and around 73 species (COAD, 2010; Froese and Pauly, 2014).This species lives in both lentic and lotic environments and can withstand desiccation by burrowing in the mud and having nocturnal habits (COAD, 1996).

MATERIAL AND METHODS

The severe vertebral deformity observed in the present species was revealed while T. Roberts of Mahidol University, Thailand was studying the diagnostic characters of a number of specimens of this species collected by gill net from the marsh area southeast of Nasiria City, 120 km northwest of Basrah city (Figure 1). The six abnormal specimens together with another 60 normal specimens of the same species were collected on 20th September 2013 and deposited in the fish collection of the Thailand Natural history Museum in Rangsi, Thailand, Catalogue numbers THNHM-F 001902, 3: 327,369, and 390 mm TL (specimens originally identified as *M. mastacembelus*), and THNHM-F 001903, 3: 370, 410, and 489 mm (specimens originally identified as possibly a different species on basis of coloration). Radiograph images obtained for the six abnormal and one normal specimen were used to determine the extent of the deformities. The length of the vertebral column from the anterior margin of the first vertebra to the posterior margin of the last vertebra was measured for the deformed and normal fish specimens and divided by fish total length to produce a ratio that is used to compare abnormal with normal fish. The lengths of the centra of the deformed vertebrae were measured from the x-ray and compared with those of the normal specimen. The vertebral column of the deformed fish was compared with that of the normal fish to determine the extent of the deformity.

RESULTS

All the specimens with vertebral anomalies look normal externally, as shown in Figure 1. The vertebral number of the studied specimens is between 86-87. The examination of the x-rays of the six abnormal specimens has revealed two cases of anomalies, severe and minor. In the former case, there are coalescent and compact vertebrae, vertebrae that lost their centra, and different levels of deformed vertebral centra. The latter case consists of slight deformation of the centra and non-alignment and deformation of the haemal spines

The compacted vertebrae are found in several regions of the vertebral column of the six specimens of *M. Mastacembelus* (Figures 2 and 3; Table 1). On the vertebral column of the six abnormal specimens, there are 6 vertebrae in three locations for specimen A, 23 vertebrae in 5 places for specimen B, 6 vertebrae in one position in specimen C, 8 vertebrae in 2 positions in specimen D (Figure 2, A-D), 2 vertebrae in one spot in specimen E, and 7 vertebrae in 3 locations in specimen F (Figure 3, E-F). The vertebral column of specimen B is the most affected column among the anomalous specimens studied.

The compacted vertebrae observed in the six deformed specimens shown to have the length of their centra are affected and look different from those of the normal specimen. The length of the vertebral centrum ranges between 5.6-8.1 mm and 3.4-4.6 mm for the normal and compacted vertebrae respectively.

The range of the between the vertebral column to the fish total length is 0.62-0.80 and 0.67-0.84 for the normal and deformed fish specimens respectively.

Although the case of coalescent vertebrae is severe, it is only found in two specimens of the six abnormal specimens studied (abdominal region of specimen A and caudal region of specimen C). For specimen A, vertebrae number 19 and 20 seem to be fused together. The anterior and the posterior parts of the centrum of the 9th and 20th vertebrae are lost respectively. In specimen C, the coalescence of vertebrae is more serious as 4 vertebrae are involved (vertebra no. 55-58), where vertebrae numbers 55 and 58 have lost the anterior and posterior parts of their centrum respectively, while vertebrae no. 56 and 57 have lost the centrum completely and only the neural and haemal spines are left joined in the four vertebrae coalescent complex.

The minor anomaly is found in specimens, A, B, and E. The centra of the vertebrae 18, 67, 69, 74-76, and 79-80 are slightly deformed. In specimen B, the haemal spines of vertebrae 55 and 57 are slightly deformed and shown to be in non-alignment in comparison with the haemal spines of the normal neighbouring vertebrae. In specimen E, the centra of vertebrae 48 and 51 exhibit deformity, as the posterior and the anterior edges are curved respectively, leaving a small gap between the two vertebrae. Such abnormality is found in the caudal region of the vertebral column of specimen E.

DISCUSSION

From the description of the vertebral anomalies mentioned above, it is clear that specimen A has the largest share of abnormalities among the six specimens examined, as all the types of deformities described in this study are revealed in this specimen.

The abnormality observed in the present specimen seems having not much effect on the length of the vertebral column of the specimen. The range of the ratio of the vertebral column length to the fish length of the deformed specimen is 0.67-0.84 while in case of the normal the range is 0.62-0.8. On other hand the ratio between the lengths of the centra of the deformed caudal vertebrae with the length of the vertebral column have shown a considerable difference (5.6-8.1) from the values obtained from the normal specimen (3.4-4.6). Such practice of using dimensions of the vertebrae is used by CHANG *et al.*, (2010) on thornfish, *Terapon jarbu* and by LOUIZ *et al.*, (2007) on some members of the family Gobiidae to evaluate the severity of the abnormality case.

Today, a considerable amount of information exists on wild fish anomalies (DIVANACH *et al.*, 1996; JAWAD *et al.*, 2013, 2014) which illustrate the causes of different deformities. These include the genetic (ISHIKAWA, 1990) and epigenetic factors as a possible source of such aberrations (FJELLDAL, 2009) as well as environmental factors such as temperature, light, salinity, pH, low oxygen concentrations, inadequate hydrodynamic conditions and parasites (CHATAIN, 1994; GAVAIA, 2009).

In the present deformed specimens, the anomalies represent compacted, coalescent and deformed vertebrae. Such deformity is characterised in having changes in the extracellular matrix (ECM) components and mineralization of intervertebral regions and arch centra (YTTEBORG *et al.*, 2010; WITTEN *et al.*, 2006). It might be possible that these abnormal fish specimens have faced harsh environmental factors that cause such vertebral deformity and the changes at the cellular level in the body of the vertebrae. Both water and sediments of the Marshes in Iraq have been shown to have high levels of heavy metal (AL-IMARAH *et al.*, 2000). Such levels are also present in the tissue of several fish species including *Carasobarbus luteus* and *Tenualosa ilisha* living in the marsh's water as Al-IMARAH *et al.*, (2006) has reported. High pollutant levels are also recorded in both environment and fish tissue in areas around the location where the specimens of *M. mastacembelus* were collected (AL-IMARAH *et al.*, 2008). Variation in temperature of the marsh's water is very large, ranging from 8-37°C (DOUABUL *et al.*, 2012). Such a large variation in water temperature will definitely have a direct effect on the development of the vertebral column of the fish larvae.

CONCLUSION

Specimens of *Mastacembelus mastacembelus* caught from the Euphrates River, Iraq have shown severe deformity such as coalescence of vertebrae, compact vertebrae, loss of vertebral parts, and different levels of deformed vertebral centra and minor deformities such as undulation of the haemal spines of the vertebrae. The deformities are covered both abdominal and caudal vertebrae. Possible causes such as genetic and epigenetic factors may be implicated in this anomaly.

Figure 1. *Mastacembelus mastacembelus*, normal, 410 mm TL, THNHM-F 001903, mars area southeast of Nasiria City, southern Iraq

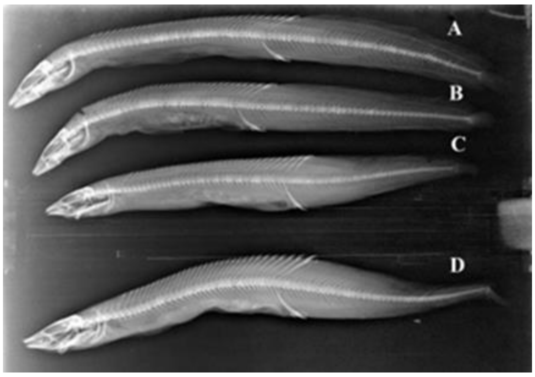

Figure 2. *Mastacembelus mastacembelus*, abnormal, a-c, 327-390 mm TL, THNHM-F 001902; d, 327 mm TL, THNHM-F 001903 marsh area southeast of Nasiria City, southern Iraq.

ACKNOWLEDGEMENTS

Our sincere thanks are due to Tyson Roberts, Mahidol University, Salaya, Thailand for the confirmation of the identity of the species and for the two x-ray films and to David Smith, Smithsonian Institution for reading the manuscript and for his valuable advice and suggestions.

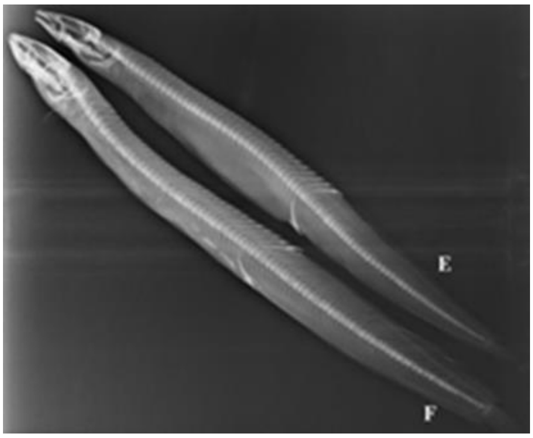

Figure 3. *Mastacembelus mastacembelus*, abnormal, e-f, 410, 489 mm TL, THNHM-F 001903, marsh area southeast of Nasiria City, southern Iraq.

REFERENCES

AL-IMARAH, F.J.M.; GHADDBAN, R.A.; AL-SHAWY, S.F. 2000 Levels of trace metals in water of southern part of Iraq. *Mar. Mesop.*, *15*: 365-372.

AL-IMARAH, F.J.M.; HANTOUSH, A.A.; NASIR, A.M.; AL-YASERI, S.T.L. 2006 Seasonal variations of the total petroleum hydrocarbons in water and sediments of southern Iraqi marshland after rehabilitation 2003. *Marsh Bull.*, *1*: 1-8.

AL-IMARAH, F.J.M.; MAHMOOD, A.A.; MITHAQE, S.; HUMAIDI, M.S. 2008 Levels of trace metals in Shatt Al-Arab River branches during spring and summer seasons. *Mar.Mesop.*, *23*: 9-17.

BOGUTSKAYA, N.G.; ZUYKOV, M.A.; NASEKA, A.M.; ANDERSON, E.B. 2011 Normal axial skeleton structure in common roach *Rutilus rutilus* (Actinopterygii: Cyprinidae) and malformations due to radiation contamination in the area of the Mayak (Chelyabinsk Province, Russia) nuclear plant. *J. Fish Biol.*, *79*: 991-1016.

CHANG, C.W.; WANG, Y.Z.; TZENG, W.N. 2010 Morphological study on vertebral deformity of the thorn fish *Terapon jarbu*in the thermal effluent outlet of nuclear power plant in Taiwan. *J.fish.Soc.Taiwan*, *37*: 1-11.

CHATAIN, B. 1994 Abnormal swimbladder development and lordosis in sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus auratus*). *Aquaculture*, *119*: 371–379.

COAD, B.W. 1996 Zoogeography of the fishes of the Tigris-Euphrates basin. *Zool. Middle East*, *13*: 51-70.

COAD, B.W. 2010 *Freshwater fishes of Iraq*. -Pensoft Series Faunistica No. 93, 274 pp. Published by Pensoft Publishers, Moscow.

DIVANANCH,P.; BOGLIONE, C.; MENU, B.; KOUMOUDOUROS, G.; KNETOURI, M.; CATAUDELLA, S. 1996 Abnormalities in finfish mariculture: an overview of the problem, causes and solutions. In: Chantain B., Saroglia M., Sweetman J., Lavens P. (eds.), *Seabass and seabream culture: Problem and prospects*. International Workshop. Verona, Italy. October 16-18, 1996. - European Aquacultural Society, Oostende, Belgium.

DOUABUL, A.A.Z.; AL-MUDHAFER, N.A.; ALHELO, A.A.; AL-SAAD, H.T.; AL-MAAROFI, S.S. 2012 Restoration versus re-flooding: Mesopotamia marshlands. *Hydrol. Cur. Res. 3*: 140-143.

ERSHOV, P.N. 2008 The vertebral abnormalities in eelpout *Zoarces viviparous* (Linnaeus, 1758) (Pisces, Zoarcidae). *Proc. Zool. Inst.*, *RAS 312*: 74–82.

FJELLDAL, P.G.; GLOVER, K.A.; SKAALA, O.; IMSLAND, A.; HANSEN, T.J. 2009 Vertebral body mineralization and deformities in cultured Atlantic salmon (*Salmo salar* L.): Effects of genetics and off-season smolt production. *Aquaculture*, *296*: 36-44.

FROESE, R.; PAULY, D. (Editors) 2014 *Fish Base*. World Wide Web electronic publication. www.fishbase.org, version (08/2014).

GAVAIA, P.J.; DOMINIQUES, S.; ENGROLA, S.; DRAKE, P.; SARASQUETE, C.; DINIS, M.T.; CANCELA, M.L. 2009 Comparing skeletal development of wild and hatchery-reared Senegalese sole (*Solease negalensis*, Kaup 1858): evaluation in larval and postlarval stages. *Aquaculture Research*, *40*: 1585-1593.

ISHIKAWA, Y. 1990 Development of caudal structures of a morphogenetic mutant (Da) in the teleost fish medaka (*Oryzias latipes*).*J. Morphol.*, *205*: 219–232.

JAWAD, L.; SADIGZADEH, Z.; SALARPOURI, A.; AGHOUZBENI, S. 2013 Anal fin deformity in the longfin trevally, *Carangoides armatus*. *Korean J. Ichthyol.*, *25*: 169-172.

JAWAD, L.A.; KOUSHA, A.; SAMBRAUS, F.; FJELLDAL, P.G. 2014 On the record of pug-headedness in cultured Atlantic salmon, *Salmo salar* Linnaeus, 1758 (Salmoniformes, Salmonidae) from Norway. *J. Appl. Ichthyol.*, *30*: 537-539.

LOUIZ, I.; MENIF, D.; BEN-ATTIA, M.; BEM-HASSINE, O.K. 2007 Incidencedês déformations squelettiques chez troisespèces de Gobiidae de lalagune de Bizerte (Tunisie).*Cybium*, *31*: 199-206.

WITTEN, P.E.; OBACH, A.; HUYSSEUNE, A.; BAEVERFJORD, G. 2006 Vertebrae fusion in Atlantic salmon (*Salmo salar*): development, aggravation and pathways of containment. *Aquaculture*, *258*: 164–172.

YTTEBORG, E.; TORGERSEN, J.; BAEVERFJORD, G.; TAKLE, H. 2010 Morphological and molecular characterization of developing vertebral fusions using a teleost model. *BMC Physiol.*, *10*: 1-15.