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A Wild Specimen of Indian Carp, *Cirrhinus mrigala* (Ham.) 1822 with Multiple Vertebral Deformities.

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Abstract: An abnormal specimen of *Cirrhinus mrigala,* with multiple vertebral deformities has been described. The causes of vertebral deformities in teleosts are discussed.

Key words: Scoliosis · Lordosis · Kyphosis · Ankylosis · *Cirrhinus mrigala*

INTRODUCTION

Vertebral deformities, like scoliosis (abnormal lateral curvature), lordosis (excessive inward curvature), kyphosis (excessive outward curvature) and ankylosis (abnormal stiffening and immobility of joint due to fusion of bones), though rare, but have been recorded for many species of teleosts [1 - 4]. These have been attributed to teratogenic effects of environmental contamination, scarcity of nutrient(s), oxygen deficiency, sudden change in temperature, water current, mutation, inbreeding, parasitic infestations and mechanical trauma etc.

Though the inland fishing industry in India is mainly based on carps, records of deformed carps are scantier and limited to sporadically caught specimens only [5]. A hump backed *Catla catla* (Hamilton) has been described [6, 7] and a report of four specimens of *Labeo rohita* (Hamilton) with vertebral deformity is also available [8]. An abnormal specimen of *Labeo boga* with bent posterior vertebral column resulting in deformed urostyle and a change in caudal fin structure has been reported [9].

The present communication describes an abnormal wild specimen of Indian carp *C. mrigala* with multiple vertebral deformities like scoliosis, lordosis, kyphosis and ankylosis all occurring simultaneously. A scanning of the available literature reveals that there is no similar report of multiple vertebral abnormalities.

MATERIAL AND METHODS

An adult specimen of *C. mrigala*, showing signs of multiple spinal abnormalities, was netted in a mixed catch of carps - *Labeo rohita*, *Catla catla*, *Cirrhinus mrigala* and *Labeo calbasu*, from Chutia pond, Ranchi (23° 20×' N lat. and 85° 30×' E long.), Jharkhand, India on 30th October, 2009. No other fish, in the catch of 129 fish, was having any skeletal abnormality. The abnormal specimen was identified by counting the fin rays, lateral line scales and other morphometric features. The fish was photographed and X-ray photographs were taken of its lateral as well as dorso-ventral view. It was then subjected to internal examinations.

RESULTS

C. mrigala, a slow growing species, is one of the major carps of India cultivated widely in composite fish culture. The anomalous specimen caught was an adult female having total length 23.5 cm., standard length 19 cm. and head 5 cm. It weighed 625 gs. All the paired and unpaired fins were normal. The fin formula was D- 4/12; A- 3/ 5; P- 17; V- 1/ 8 and scale formula was L.l. 43; L. tr. 6 / 7. There was no sign of any lesion or ulceration on the skin of fish. The scales were irregular at the sites of curvatures. The fish was identified as *C. mrigala,* approximately one year old.

Spinal deformities were apparent on the fish body immediately after capture, with curved spine and flexures in a 2.5 cm. area in between ventral and anal fin (Figs. 1, 2). Typically a *C. mrigala* has 20 trunk vertebrae and 13 caudal vertebrae. The X-ray photograph of the specimen showed all the13 caudal vertebrae were anomalous and involved in scoliosis and kyphosis (Fig. 3). The last 4 precaudal trunk vertebrae formed a ventro-lateral (towards left side) bending (lordosis) of 120° ventral and 40° lateral. Caudal vertebrae number 9- 14 were fused (anchylosed) and formed a complete Ω like loop, which was dorso- lateral (to right side) (Fig. 4).

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Fig. 1: Left lateral view of the anomalous *C. mrigala*

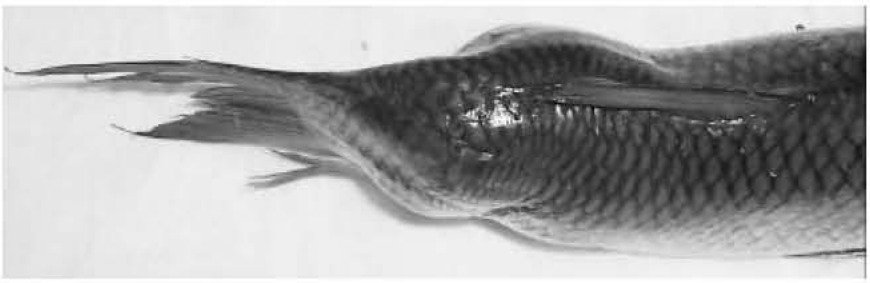

Fig. 2: Dorsal view of the deformed caudal region of the anomalous *C. mrigala*

Fig. 3: Left lateral X- ray photograph of the anomalous *C. mrigala* showing lordosis in the precaudal vertebrae, kyphosis and ankylosis and a normal air bladder

Fig. 4: Dorso-ventral X-ray photograph of the anomalous *C. mrigala* showing scoliosis and kyphosis of the caudal vertebrae forming a Ω like loop to the left

The degree of flexure was assessed by measuring the angles between the lines passing through the vertebral column on both the sides of the curvatures [10]. The terminal three caudal vertebrae were normal and supported a normal caudal fin (Fig. 3).

All the internal organs were normal as liver, kidney and gonads did not show any anomaly. No parasite or cyst was encountered either in the viscera, abdominal cavity, or muscle. The air bladder was normally developed.

DISCUSSION

Ever since the classical review of Gemmill [11] the occurrence of vertebral abnormality in natural population of teleosts belonging to various taxonomic groups have been reported from different parts of the world. Excellent monographs on anomalies in fishes are available [1 - 4]. Vertebral abnormalities have been found in various kinds of fish stock and wild populations [12]. However, most of the available reports deal with the abnormal fish caught during normal fishing operations. Vertebral anomalies have been reported from different parts of the globe: in a batch of bream *Abramis brama* (L) from Holland [13]; in *Barbus sharpeyi*, *Barbus luteus*, *Barbus xanthopterus*, *Aphanius dispar* and *Pampus argenteus* form Iraq and U.A.E. [14]; in mullets from New Zealand *Mugil cephalus* [10] and Turkey *Liza abu* [15]; in gobies, *Gobius niger* [16] from Sado estuary, Portugal and *Zosterisesser ophiocephalus* [17] from Karina Sea; in cyprinid fish, *Garra variabilis* Heckel and *Capoeta damascina* Val. from Killis (Turkey) [18] and teleosts belonging to different taxonomic groups from Japanese waters [19- 22].

Incidences of vertebral deformities are more frequent in smaller fish as compared to older one which may be attributed to high mortality of deformed fish at early stages. The deformed fish do not live to grow old, however, the present fish survived to the adult stage.Vertebral deformities may affect the biology of the fish indirectly through inhibiting its free movements [10]. *Cyprinus carpio* with spinal deformity either swim upside down or sideward and its growth is slow compared to a normal fish [23]. Similar behaviour has been observed in a pike, *Esox lucius* L. with abnormal spinal cord [24]. Average length and weight of abnormal fish have been found to be substantially lower than that of normal fish, probably due to their inability to feed normally [23].

Gemmill [11], as early as 1912, while dealing with fish teratology observed that the 'twisted bodies' and the allied deformations "no doubt they are mainly congenital and it is probable that their production depends on some very early developmental aberrations capable of being induced by the action of external factors". Several workers have identified various factors for the different types of abnormalities. Pollutants have been considered to be responsible for deformation of different parts of the body of fish [25]. Various cause(s) have been attributed to skeletal deformity ranging from teratogenic effects of environmental and inbreeding, to genetic factors of mutation [26], parasitic infestations and mechanical trauma contamination, oxygen deficiency, water current, sudden change in temperature, heredity [15]. Skeletal disorders, often a complex mixture of vertebral and spinal malformations, in larval and juvenile fish have been linked to a poorly understood relationship between nutrition, environment and genetic factors [27].

Curvature of spine in pike-perch (*Lucioperca sandra* L.), has been linked to waste water from households [28]. Role of key nutrients in the pathogenesis of skeletal deformities with an emphasis on minerals (calcium, phosphorus and trace elements), vitamins (A, D, C, E and K), lipid and nutrient interaction has also been proposed [27]. Experimental avitaminosis C causes retarded growth and high mortality associated with vertebrae deformation, lordosis, scoliosis and haematopathological changes in *C. mrigala* [29]. Vitamin C deficiency in the diet was also found responsible for the spinal cord deformity in *Cyprinus carpio* [23]. In the present case, out of more than one hundred normal specimens of different carps from the same habitat, only one specimen of *C. mrigala* has been found to be anomalous hence, the above theory of nutrient deficiency does not seem to be plausible.

Abnormal shape of vertebrae is some times caused by severe curvature of the vertebral column resulting from poor balance of lateral muscles [22]. In newly hatched larvae of *Clarius*, exposed to toxic levels of malathion, deformed notochord results from uncontrolled contraction of body musculature that causes vertebral deformity [30]. The author, in the present case, is of the view that poor lateral muscles moving the 4 precaudal trunk vertebrae might have caused these to bend towards left when the muscles immediately posterior to these developed to compensate this bending and have resulted in a loop formation on the right side of the caudal vertebrae. Deformities due to vertebral anomaly in *Labeo rohita*, an

Indian carp, have been attributed to mechanical injury at an early stage caused by some violence followed by irregular calcification [8]. However, in the present study no sign of a mechanical trauma is apparent, neither any of the fin is anomalous as such chances of injury at an early age can be ruled out.

Thermal pollution or raised water temperature is considered to be one of the causes of the vertebral abnormalities [14, 31, 32] as sudden change in water temperature may lead to abnormal muscle growth and spinal anomaly. The water in the pond, from where the present specimen was netted out, does not show much variation in the temperature throughout the year hence it is unlikely that in the present case the vertebral anomaly has been induced by a drastic change in temperature during its larval life or thereafter. Dissolved oxygen content of the water during spawning seasons and developmental stages may be responsible for production of vertebral abnormality [14, 33, 34]. Absence and inability to inflate the swimbladder during post larval growth has been associated with spinal curvature in sea bream and sea bass [26, 35] and mugil, *Liza abu* [15]. In the specimen presently studied a normal air bladder suggested that the fish had not undergone any oxygen stress.

The vertebral shortening and anchylosis, characteristic of a race of carp (*Cyprinus carpio*)- the Aischgrund carp, is hereditary [36], whereas the vertebral anchylosis in medaka is known to be both hereditary and non heritable [37]. A few studies have been designed to observe the role of heredity and strain differences on the skeletal abnormality in cultured population of freshwater teleosts: *Oryzias latipes* [37], *Poecilia reticulate* [12], *Cyprinus carpio* L. [23], *Solea senegalensis* [38]. Vertebral abnormalities are known to occur in *C. mrigala* and *Hypothalmichthys molitrix* due to inbreeding depression [Panday and Awasthi cited in [5]. The lordotic anomalies that have been analyzed indicate that lordosis is not a simple recessive character [37]. These type of anamoly has been reported in the guppy *Lebistes reticulatus* [39, 40], in sword tail *Xiphophorus helleri* [41], in medaka *Oryzias latipes* [37] and lordoscoliosis in the striped panchax *Aplocheilus* (*Panchax*) *lineatus* [42]. Since the present fish was not genetically analysed, it could not be ascertained whether the anomalies were hereditary or nonheritable.

The aetiology of the vertebral abnormality in the presently studied fish could not be ascertained, hence, the authors believe that the anomaly can be linked with some unusual situation that the animal might have encountered as an egg or during its early development, or the abnormality might have been caused by polluted environment as the pond where the present fish was found has been used for drainage of domestic sewage since last few decades.

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