Research Article

Vertebral Deformities in Two Major Carp Species, *Catla catla* and *Labeo rohita* from Rice Canal Larkana, Sindh, Pakistan

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Abstract | During the field visit for the analysis of fish diversity of Rice canal, district Larkana, Sindh, two deformed carp specimens *Catla catla* and *Labeo rohita*)were encountered from the catch of fisherman. Vertebral column deformities were analyzed through X-rays and radiographs of both the species. The radiograph of the *Catla catla* showed lordotic curvature from the 20th up to 35th vertebra. While the radiograph of *Labeo rohita* shows whole body vertebral column scoliosis starting from 11th abdominal vertebrae to 35th. The present investigation of deformities in two different species suggests that deformities are widespread in the study area due to number of reasons like water quality, scarcity, food deficiency, predation and indiscriminate fishing pressure in the canals.

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Introduction

Major carps, *Catla catla* (Thaila) and *Labeo rohita* (Rohu) are one of the important food fish of Pakistan and are rich in approximately for each and every one variety of freshwater circumstances (Chandio *et al.*, 2020). Skeletal deformities are prevalent issues in aquaculture, affecting fish health, survival and economic returns (Narejo *et al.*, 2007). Several skeletal distortions like vertebral fusion, bending in jaw, lordosis process like curvature in ventral vertebral parts and abnormalities in operculum parts. Likewise, sporadic complex of the spinal deformities having of a consecutive doubling of scoliosis, the kyphosis and lordosis (SKL) as well departs from the head up to the tail fins as reported by several researchers (Narejo *et al.*, 2007 in *Cirrhinus mrigala,* and Parveen *et al.*, 2021 in *Channa striata*). The present study was carried out to record and describe the occurrence of lordosis (ventral curvature of spine) in *C. catla* and scoliosis (lateral curvature of spine) in *L. rohita*. Knowledge of these

malformations is important to improve aquaculture methods. Skeletal curvature (deformities) are mainly caused to injuries during the early days of inadequate water quality, food scarcity and indiscriminate fishing pressure in the area (Jafri *et al*., 1998). Furthermore, this study compares aberrant fish with normal fish and implies abnormality is not related to the growth of dissimilar bodily metrics and quality of fish.

Materials and Methods

Larkana city is located in upper Sindh at a distance of about 85 km southwest of Sukkur. It includes an area of 7423sq km. and lies at 33˚00′ N, 65˚16′ E longitude. With the completion of the Sukkur Barrage in 1931 towards the west of Larkana was Dadu Canal and in the east Rice Canal. It is the non-perennial, while the others are perennial canals and run through the district for 76 km, Dadu canals for 80 km, Warah for 84 km and the Khirthar canal for 60 km (Khoso *et al*., 2021). During the period of research activity on August 20, 2024 in Rice Canal Larkana. The specimens of deformed *C. catla and L. rohita* were encountered from the catch of fisherfolks with malformations in the vertebral column. The fish were caught by fishermen through gill net. These specimens were stored in ice box and transported to laboratory for separate analysis. Fish specimens were measured in cm and in body weight in g as well.

The X-ray radiographs were examined in laboratory facility and the location of deformities was recorded. The similar body length and weight of normal fish of both the species (*C. catla* and *L. rohita*) was also procured from the catch of fishermen of the Rice canal. Total length (cm) of both the normal and abnormal fish were recorded by using a measuring tape and weight in g through electronic balance. The specimen of *C. catla* measured 44.0 cm in length and weighed 1500g, while *L. rohita* measured 35.0 cm in length and weighed 778g. Data was statistically analyzed by using student t-test for comparison of means (P<0.05).

Results and Discussion

The examined fish specimen were identified (Figure 1) as malformed due to abnormal body shapes deviating from the normal phenotype. Specifically two types of vertebral column deformities were observed (Figure 1; P<0.05) shows the deformity at caudal region in *C. catla* while (Figure 2; P<0.05) in *L. rohita* shows the skeletal deformity from 11th to 35th vertebrae. Comparison of several morphometric features of both aberrant and normal fish showed no difference in measurements. It demonstrated that abnormality is not associated with the growth of body parameters and the quality of abnormal fish in comparison with normal ones (Table 1 and Table 2; P<0.05).



Figure 1: *Horizontal view of radiograph of C. catla from Rice canal district Larkana, Sindh, Pakistan.*

Table 1: *Comparison of morphometric parameters between normal and abnormal individuals of C. catla collected from Rice Canal, Larkana, Sindh, Pakistan. Different superscripts are significantly (P<0.05) different. (n= 186).*

Body parameters	Normal catla catla	Abnormal catla catla
Total body weight (g)	1516±11.41[a]	1500±8.93[a]
Total body length (cm)	44±6.13[a]	44±5.37[a]
Fork length (cm)	40±3.21[a]	39.8±3.62[a]
Standard length (cm)	36.5±7.30[a]	35.1±5.82[a]
Head length (cm)	10±8.34[a]	11±1.22[a]
Eye diameter (cm)	0.9±0.05[a]	1±0.73[a]
Body girth (cm)	31±2.52[a]	34.3±2.56[a]
Pectoral fin length(cm)	9±0.81[a]	9.1±1.28[a]
No. of pectoral fin rays	17.0±0.93[a]	17±1.63[a]
Pelvic fin length (cm)	7.9±0.73[a]	8±1.11[a]
No. of pelvic fin rays	10±0.88[a]	9.6±1.34[a]
Dorsal fin length (cm)	10.7±0.68[a]	11±1.48[a]
No. of dorsal fin rays	19±1.00[a]	18±1.58[a]
Anal fin length (cm)	7.5±0.65[a]	8±1.49[a]
No. of anal fin rays	8±0.93[a]	8±0.99[a]
Tail fin length (cm)	6.7±0.59[a]	7±1.33[a]
No. of tail fin rays	11±1.10[a]	11±2.03[a]
Lateral line(cm)	22.5±1.74[a]	23±1.88[a]



Figure 2: *Horizontal view of radiograph of L. rohita from Rice canal, District Larkana, Sindh, Pakistan*

Table 2: *Comparative analysis of body parameters in normal vs. abnormal L. rohita collected from rice canal, district larkana, sindh, pakistan. dissimilar superscripts are significantly different (P<0.05). (n= 186).*

Body parameters	Normal labeo rohita	Abnormal labeo rohita
Total body weight (g)	844±3.61 [a]	845±2.87 [a]
Total body length (cm)	42±2.74 [a]	41±3.11 [a]
Fork length (cm)	36.1±0.95 [a]	35.4±2.78 [a]
Standard length (cm)	34±0.96 [a]	33±3.52 [a]
Head length (cm)	7.5±1.01 [a]	8±1.22 [a]
Eye diameter (cm)	0.7±0.04 [a]	1±0.08 [a]
Body girth (cm)	24±2.34 [a]	25±2.44 [a]
Pectoral fin length(cm)	2±0.68 [a]	3±0.83 [a]
No. of pectoral fin rays	17±2.65 [a]	16±1.43 [a]
Pelvic fin length (cm)	5±0.69 [a]	5.5±1.22 [a]
No. of pelvic fin rays	9±1.12 [a]	9±1.42 [a]
Dorsal fin length (cm)	7.5±1.31 [a]	6.5±1.22 [a]
No. of dorsal fin rays	13±2.01 [a]	14±1.67 [a]
Anal fin length (cm)	2.5±0.99 [a]	3±1.83 [a]
No. of anal fin rays	7±1.33 [a]	7.6±1.59 [a]
Tail fin length (cm)	5±0.88 [a]	8.5±1.54 [a]
No. of tail fin rays	11±1.43 [a]	10±2.65 [a]
Lateral line(cm)	29±2.67 [a]	28±3.55 [a]

During the present research abnormal curvature was found in two carp species *C. catla* and *L. rohita* from the Rice Canal, District Larkana, Sindh was mainly due to the malnutrition, poor water quality and indiscriminate fishing pressure. Some researchers have proposed that the inward curvature (Lordosis and Scoliosis)and abnormal lateral curvature may be caused by genetic factors, environmental stressors, water quality or inadequate levels of vitamins and minerals (Baeverfjord *et al.*, 1998; Fjelldal *et al.*, 2020; Fraser *et al.*, 2019). However, pollutants such as heavy metals and hazardous exposure to aquatic systems have a crucial influence. All these contaminants disrupt fish physiology and due to such characteristics major changes in fish physiology happened and these changes directly lead to anomalies in the body skeleton of fish (Bengtsson, 1974; Imed *et al.*, 2008). The continuous addition of contaminants in the canal water disrupt habitat structure and clearcut harms the environmental developments and hence skeletal abnormalities are extremely relevant markers in fish populations (Boglione *et al.*, 2015; Ytteborg *et al.*, 2020).Such malformations can limit swimming efficiency, increase susceptibility to disease, and reduce market value. A number of researchers have proposed that there are several nutritional influences and biotic and abiotic factors of the environment that are involved in the development of skeletal deformities (Jafri *et al.*,1998; Haga *et al.*, 2003; Narejo *et al.*, 2007; Georgakopoulou *et al.*, 2010; Parveen *et al.*, 2021). The proposals of the aforesaid professors are in support of the idea of contemporary research. The various body parameters of both the aberrant fishes were compared with the normal ones resulting as no dissimilarity among the measurements of reported fishes. So, it was decided that single homogenous population of both fishes (C. catla and L. rohita) available in Rice canal, District Larkana. (Narejo 2010; Khan *et al.*, 2015; Jalbani *et al.*, 2016; Dars *et al.*, 2023) variety of authors like suggested this claim. Our findings are supported by prior work results, as these abnormalities in fish skeletan structures and spinal curvature are also consistent with other research findings (Jafri *et al.*, 1998; Narejo *et al.*, 2007; Parveen *et al.*, 2021). However, it is important to note that no significant changes or abnormalities in the morphometric parameters and growth patterns like length and weight measurements were detected. The damaged fish populations were recorded in the same homogenous groups and on the other hand normal fishes were shown in genetically diverse groups. These 129 discoveries are consistent with other researchers (Narejo, 2010; Khan *et al.*, 2015; Jalbani *et al.*, 2016; Dars *et al.*, 2023). Although certain changes in morphometric structures have been reported, these differences may have been caused by malnutrition or environmental diseases (Boglione *et al.*, 2019; Santos *et al.*, 2020).

Conclusions and Recommendations

The results of this study suggest that the malformations of the fish bones could be attributable to environmental stress, nutrient shortage and anthropogenic activities. Therefore, the study accentuates the importance of accessing and managing skeletal anomalies in fresh

water fish to improve their health and economic viability.

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Novelty Statement

This investigation presents the first combined evaluation of vertebral abnormalities and morphometric associations in local fish species from the Indus River systems in Sindh, Pakistan, emphasizing their conservation and ecological significance.

Author's Contribution

Bushra Shaikh: Performed the experiment and prepared the initial draft of the manuscript as Ph.D. scholar.
Naeem Tariq Narejo and Ayaz Hussain Qadri: Designed and conceived the idea of this experiment.
Muhammad Hanif Chandio: Proofread the literature and edit the manuscript.
Faheem Saddar and Athar Mustafa Laghari: Collected fish samples for the research.
Farzana Hashim: Helped in data reviw.
Ghulam Abbas: Helped in literature review, manuscript editing, data review and revised final draft of the manuscript.
Munawar Lal, Shafiq ur Rehman and Shahnaz: Rashid, helped in writing, format and bibliography.

Generative AI and AI-assisted technology statement
The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest
There is no conflict among authors on the current research.

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