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Deformities in Cirrhinus mrigala (Ham. -Buch.) Cultured in Fish Ponds of District Kathua, Jammu Region, of the Union Territory of Jammu & Kashmir

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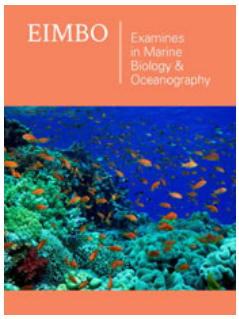

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Abstract

Seventeen adult anomalous specimens of Cirrhinus mrigala (Ham.-Buch.)were seen among fish collections from freshwater fish ponds of Kathua district and have been elaborated. Morphological deformities observed are truncated body with dorsal protuberance (twelve specimens), post dorsal truncated body with a depression on left side (one specimen), curved trunk (one specimen), injured truncated caudal peduncle (two specimens) and highly truncated deflexed caudal peduncle and aberrant anal and caudal fin (one specimen). Radiological study has revealed various vertebral anomalies viz. lordosis, kyphosis, scoliosis, ankylosis, trough, vertebral overlapping and duplication. Multiple factors known to induce anomalies in fishes have also been described.

Keywords: Cirrhinus mrigala; Morphological and skeletal deformities; Kathua; Fish ponds; Multiple factors

Introduction

Cirrhinus mirgala, a major Indian carp, is well distributed in rivers, streams and ponds of district Kathua of Jammu region [1-2]. In district Kathua, in order to increase fish production in inland waterbodies, various ponds have been renovated, under Central Govt. sponsored schemes, and stocked with Indian, including C. mrigala, and exotic carps. During the present survey seventeen deformed specimens of C. mrigala (Ham.-Buch.) were seen along with normal specimens and have been described. Teratology in natural and reared C. mrigala has earlier been reported [3-11] and their frequencies are rapidly increasing in cultured waters. These malformed fishes have unattractive shape, poor growth, low survival percentage and low price in fish market and are a big loss to the aquaculturists. There is no immediate record of human health problems by consumption of deformed fishes but due to rising water pollution may be a serious concern in future. The purpose of this study is to identify/diagnose the deformities and there causes among pond cultured fishes in Jammu region.

Material And Methods

Seventeen deformed specimens of C. mrigala were noticed among fish collections made by fishermen from fish ponds, Kathua district. These were studied for morphological characteristics, parasitic infestation and photographed. For radiological observations, deformed and normal specimens were X-rayed (AGFA). For water quality analysis samples from various fish ponds were collected in plastic containers and analyzed by standard methods [12].

Observations

Normal Cirrhinus mrigala (Ham. Buch.)

Body is streamlined. Dorsal fin installation is more towards snout tip than caudal fin base. There is a wide space between longest pectoral fin ray and pelvic fin origin, pelvic fin ray and anal fin origin and anal fin ray and caudal fin base (Figure 1a). X-ray analysis has revealed the presence of 35 amphicoleous vertebrae, after complex vertebrae, in streamlined vertebral column. Air bladder is bilobed, anterior lobe is globular and large and posterior lobe elongated (Figure 1b).

Figure 1a: Normal *Cirrhinus mrigala*.

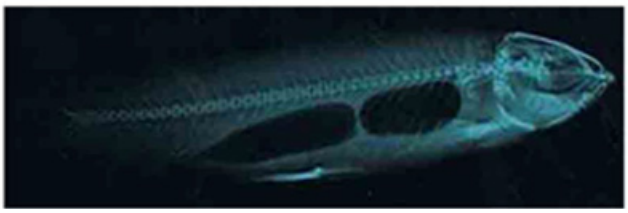

Figure 1b: Xray photograph of normal *Cirrhinus mrigala*.

Deformed fishes

Deformities observed in seventeen adult specimens of Cirrhinus mrigala (Ham.-Buch.) reared in fish ponds of Kathua district, Jammu region, are described in Table 1 (Figure 2.1a - 2.17b).

Table 1: Morphological, vertebral and air bladder characteristics of deformed *Cirrhinus mrigala* collected from fish ponds in Kathua district.

	Size (Length cm)/ Weight (gm)	Morphological Characteristics	Placement of Fins	Radiological Analysis	
				Vertebral	Air bladder
2.1	32cm/368g	Truncated body with dorsal protuberance (Figure 2.1a).	Normal	16^{th}-18^{th} vertebrae thick, fused overlap and have lost their biconcave structure. Intervertebral spaces not clear. Highly reduced 17^{th} vertebra forms an angle (kyphosis) of dorsally curved vertebral column (Figure 2.1b).	Anterior lobe normal and posterior lobe displaced.
2.2	32cm/ 212g	Truncated body with a dorsal protuberance (Figure 2.2a).	Displacement of pectorals and anal fins.	Dorsally curved vertebral column between 16th – 21^{st} vertebrae form a lordosis and a kyphosis. 16^{th} – 17^{th} vertebrae thick. Intervertebral spaces between 15^{th} – 17^{th} vertebrae reduced and thick (Figure 2.2b).	Posterior end of anterior lobe extends over posterior lobe
2.3	32.3cm/ 296gm	Truncated body showing a dorsal protuberance (Figure 2.3a).	Displacement of pectoral, pelvic and anal fins. (Reduction in space between longest pectoral & pelvic base & longest pelvic anal fin base and longest anal and caudal fin base).	16^{th} vertebra opaque and short 15^{th} vertebra forms a minor angle (kyphosis) of dorsally curved vertebral column (Figure 2.3b).	Anterior lobe normal and posterior lobe compressed and highly reduced.
2.4	34cm/ 414g	Truncated body with a dorsal protuberance (Figure 2.4a).	Displacement of pectoral, pelvic and anal fins.	17^{th}-18^{th} vertebrae short and thick, 18^{th} vertebrae forms a minor angle of dorsally curved vertebral column (Figure 2.4b).	Anterior lobe normal and posterior reduced.
2.5	32.5cm/384g	Truncated body with a dorsal protuberance (Figure 2.5a).	Displacement of pectoral, pelvic and anal fin.	15^{th} – 16^{th} vertebrae thick. 16th vertebra forms an angle (kyphosis) of dorsally curved vertebral column (Figure 2.5b).	Air bladder lobes 3 and middle lobe rudimentary.
2.6	33cm/331g	Truncated body and dorsal protuberance (Figure 2.6a).	Displacement of pectoral, pelvic and anal fins.	15^{th}-17^{th} vertebrae thick. 17^{th} degenerated, compressed and opaque vertebra forms an angle (kyphosis) of dorsally curved vertebral column (Figure 2.6b).	Normal
2.7	32cm/356g	Truncated body and dorsal protuberance (Figure 2.7a).	Displacement of pectoral, pelvic and anal fins.	13^{th} – 16^{th} thick vertebrae overlap and form an angle (kyphosis) of dorsally curved vertebral column (Figure 2.7b).	Posterior lobe short and displaced
2.8	33.5cm/310g	Truncated body and dorsal protuberance (Figure 2.8a).	Displacement of pectoral fins.	13^{th} – 16^{th} vertebrae and their intervertebral spaces thick. 15^{th} vertebra form a minor angle (kyphosis) of dorsally curved vertebral column (Figure 2.8b).	Normal

2.9	31cm/320g	Truncated body and dorsal protuberance (Figure 2.9a).	Displacement of pectoral and pelvic fins.	15^{th} – 17^{th} vertebrae thick. 17^{th} vertebra degenerated and opaque. 16^{th} vertebra forms a minor angle (kyphosis) of dorsally curved vertebral column (Figure 2.9b).	Posterior lobe displaced and attenuated
2.10	32.2cm/284g	Truncated body and dorsal protuberance (Figure 2.10a).	Displacement of pectoral, pelvic and anal fins.	15^{th} thick and opaque vertebra forms a minor angle of dorsally curved vertebral column (Figure 2.10b).	Air bladder is a single elongated lobe.
2.11	33.5cm/320g	Truncated body and dorsal protuberance (Figure 2.11a).	Displacement of pectoral and pelvic fins.	16^{th} and 17^{th} vertebrae thick, truncated and overlap. 16^{th} vertebra forms a minor angle (kyphosis) of dorsally curved vertebral column (Figure 2.11b).	Air bladder lobes not separate
2.12	32cm/294g	Truncated body with a dorsal protuberance and left side bulge (Figure 2.12a).	Normal	17^{th} – 19^{th} vertebrae fused, degenerated with rudimentary centra. 16^{th} vertebra forms an angle (kyphosis) of dorsally curved vertebral column (Figure 2.12b).	Posterior lobe short and displaced
2.13	29.5cm/260g	Injured and bulbous caudal peduncle and displacement of anal fin (Figure 2.13a).	Longest anal fin ray extends base of caudal fin.	29^{th} - 30^{th} vertebrae, opaque and fused (ankylosis) (Figure 2.13b).	Normal
2.14	27.5cm/255g	Injured caudal peduncle with compressed and highly truncated caudal fin base (Figure 2.14a).	Dorsal fin installation is towards caudal fin base. Longest anal fin ray extends beyond caudal fin base.	Vertebral column curved upward between 23^{rd} – 35^{th} vertebrae. 32^{nd} – 35^{th} vertebrae thick and undifferentiated. Urostyle and caudal bones not clear (Figure 2.14b).	Air bladder lobes attenuated.
2.15	24cm/250g	Truncated caudal peduncle and depression on left side (Figure 2.15a).	Dorsal fin placement is towards caudal fin base. There is short gap between longest pectorals & pelvicsfin base, pelvic fins extend anal aperture &the latter extends caudal fin base.	Irregular fusion and reduction in vertebral thickness from anterior to posterior end. After 20th vertebra vertebral column and caudal fin bones not clear (Figure 2.15b).	Anterior lobe short and posterior rudimentary
2.16	27cm/330g	Curvature in trunk region. Displaced pectoral, pelvic and anal fins (Figure 2.16a).	Reduction in space between longest pectoral fin ray and pelvic fin base. Pelvic fin ray and anal fin base and anal fin ray and caudal fin base.	Vertebral column dorsally curbed between 1^{st} -12^{th} vertebrae. Inter vertebral spaces between 10^{th} – 11^{th} vertebrae thick and form an minor angle (kyphosis) of dorsally curved vertebral column (Figure 2.16b).	Air bladder lobes displaced and short
2.17	25cm/320g	Highly truncated caudal penducle with a dorsal depression beyond dorsal fin. Anal and caudal fin displaced (Figure 2.17a).	Dorsal fin placement is towards caudal fin base. Anal and caudal fins, with rudimentary fin rays installed on posterior flat end of caudal peduncle. Degenerated caudal fin is placed on upper half and anal fin on its lower half.	1) Vertebral column slightly curved between 1^{st}-16^{th} normal vertebrae. 2) Posteriorly, vertebral column between 17^{th} -36^{th} vertebrae is w-shaped resulting in one kyphosis and double lordsis 3) 32^{nd} - 36^{th} vertebrae, forming ascending limb of W shaped vertebral column, duplicated. The later are connected to an elongated bony structure supporting anal fin rays. 4) Vertebral column between 37^{th} – 40^{th} vertebrae, including urostyle, curved anteriorly (scoliosis) and forms a lateral trough with central descending and posteriorly ascending limb of W shaped vertebral column. 5) Caudal fin bones not clear. Dorsal to 37^{th} and 40^{th} vertebrae are degenerated caudal fin rays (Figure 2.17b).	Anterior lobe elongated and posterior lobe rudimentary.

Figure 2.1a: *Cirrhinus mrigala* showing minor dorsal protuberance.

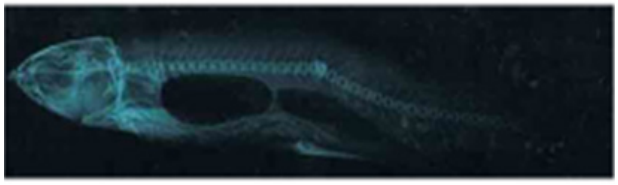

Figure 2.1b: X ray photograph of *Cirrhinus mrigala* showing Vertebral kyphosis.

Figure 2.2a: *Cirrhinus mrigala* showing dorsal protuberance and displacement of pectoral and fins.

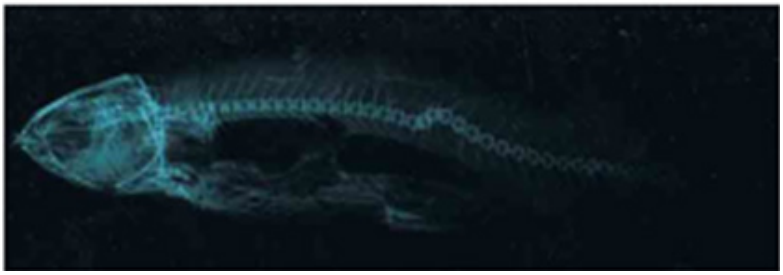

Figure 2.2b: X ray photograph of *Cirrhinus mrigala* showing vertebral Lordosis and kyphosis.

Figure 2.3a: *Cirrhinus mrigala* showing dorsal protuberance and displacement of pectoral, pelvic and anal fins.

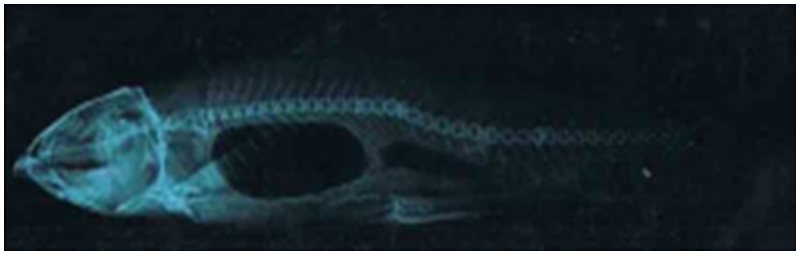

Figure 2.3b: X ray photograph *Cirrhinus mrigala* showing aminor kyphosis.

Figure 2.4a: *Cirrhinus mrigala* showing dorsal protubrance and displacement of pectoral, pelvic and anal fins.

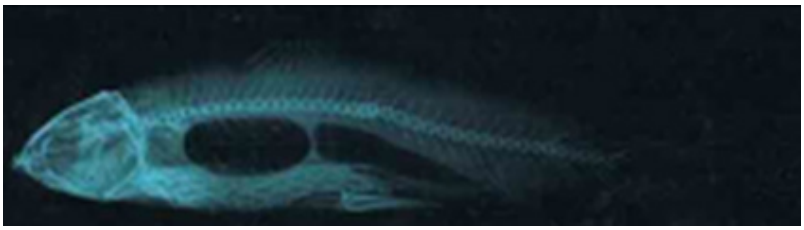

Figure 2.4b: X ray photograph of *Cirrhinus mrigala* showing minor vertebral kyphosis.

Figure 2.5a: *Cirrhinus mrigala* showing dorsal protuberance and displacement of pectoral, pelvic and anal fins

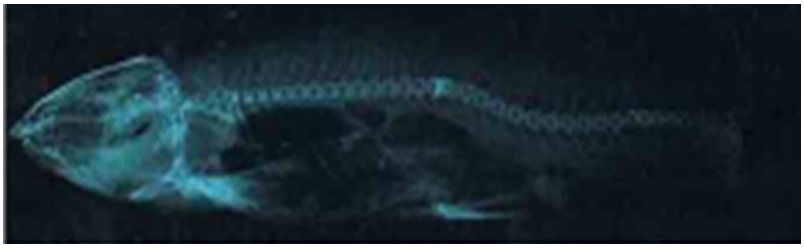

Figure 2.5b: X ray photograph of *Cirrhinus mrigala* showing vertebral kypohosis.

Figure 2.6a: *Cirrhinus mrigala* showing a dorsal protuberance and displacement of pectoral, pelvic and anal

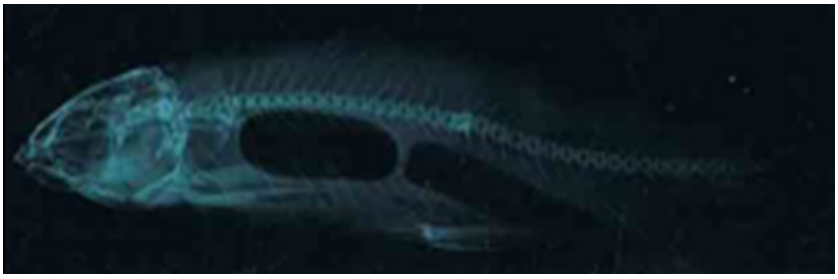

Figure 2.6b: X ray photograph of *Cirrhinus mrigala* showing a minor vertebral kyphosis.

Figure 2.7a: *Cirrhinus mrigala* showing dorsal protuberance and minor displacement of pectoral, pelvic and anal fins.

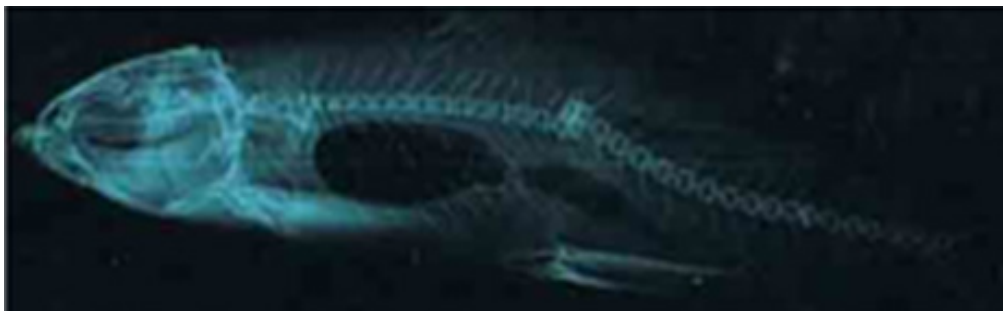

Figure 2.7b: X ray photograph of *Cirrhinus mrigala* showing 13th -16th overlapping vertebrae and vertebral kyphosis.

Figure 2.8a: *Cirrhinus mrigala* showing dorsal protuberance and minor displacement of pectoral fins.

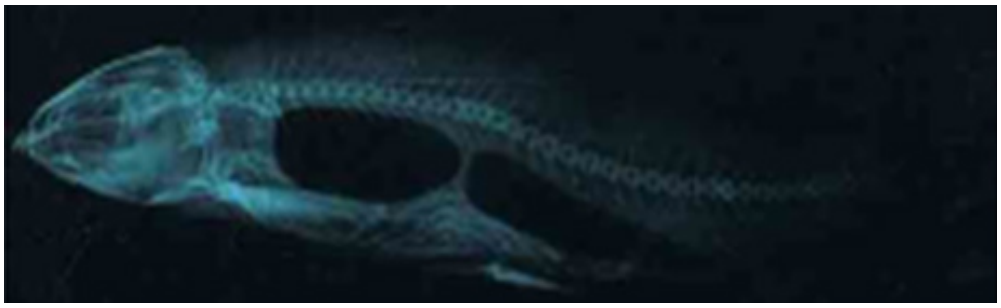

Figure 2.8b: X ray photograph of *Cirrhinus mrigala* showing minor Vertebral kyphosis.

Figure 2.9a: *Cirrhinus mrigala* showing dorsal protuberance and displacement of pectoral and pelvic fins.

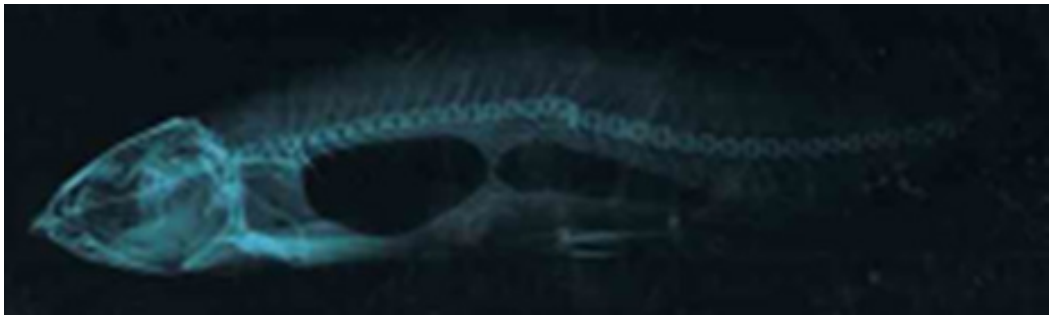

Figure 2.9b: X ray photograph of *Cirrhinus mrigala* showing vertebral kyphosis.

Figure 2.10a: *Cirrhinus mrigala* showing dorsal protuberance and displacement of pectoral, pelvic and anal fins.

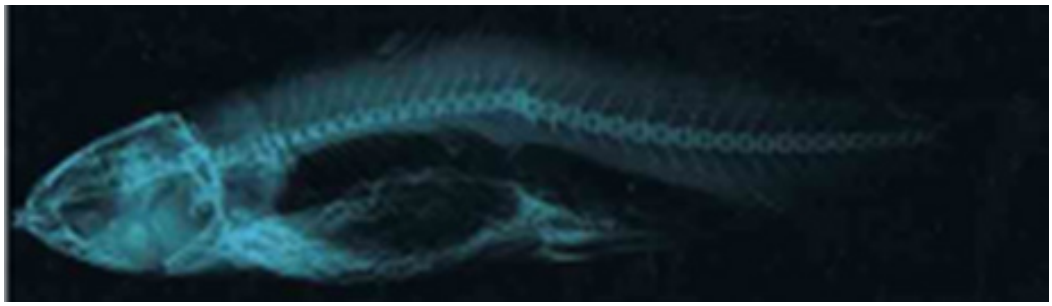

Figure 2.10b: X ray photograph of *Cirrhinus mrigala* showing vertebral kyphosis.

Figure 2.11a: *Cirrhinus mrigala* showing dorsal protuberance and displacement of pectoral and pelvic fins.

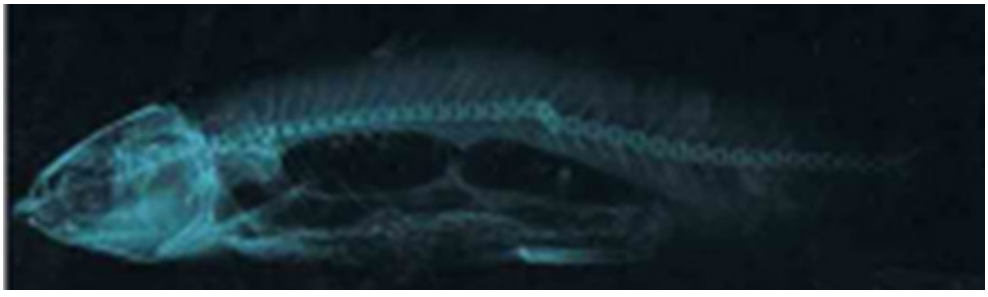

Figure 2.11b: X ray photograph of *Cirrhinus mrigala* showing vertebral kyphosis.

Figure 2.12a: *Cirrhinus mrigala* showing dorsal protuberance and left side bulge

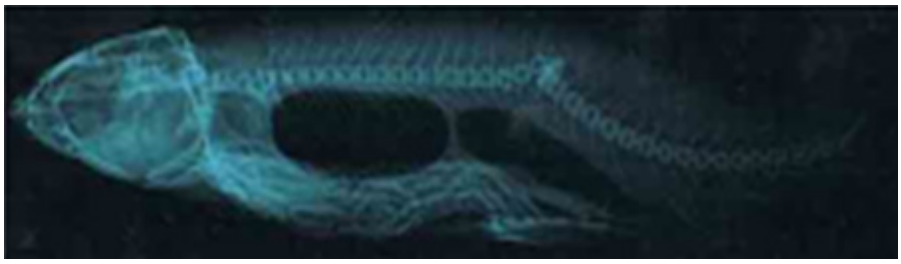

Figure 2.12b: X ray photograph of *Cirrhinus mrigala* showing short displaced 17th – 19th vertebrae and vertebral kyphosis.

Figure 2.13a: *Cirrhinus mrigala* showing injured caudal peduncal, bulbous caudal fin base and displacement of anal fin.

Figure 2.13b: X ray photograph of *Cirrhinus mrigala* showing short and opaque 29th – 30th vertebrae.

Figure 2.14a: *Cirrhinus mrigala* showing injured truncated caudal Peduncal, compressed caudal fin base and displacement of anal fin.

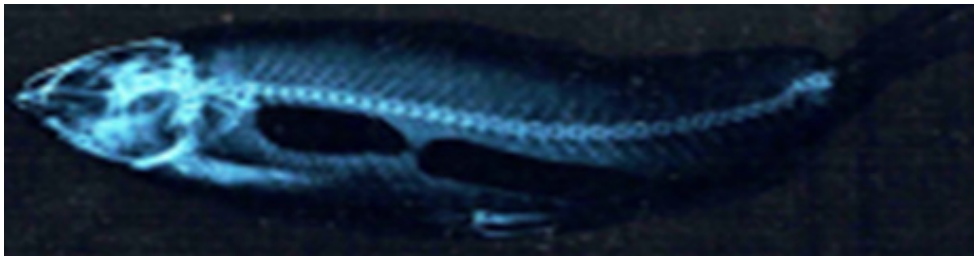

Figure 2.14b: X ray photograph of *Cirrhinus mrigala* showing undifferentiated and fused 32nd – 35th vertebrae.

Figure 2.15a: *Cirrhinus mrigala* showing truncated caudal peduncal, a depression on left side and displacement of pectoral, pelvic and anal fins.

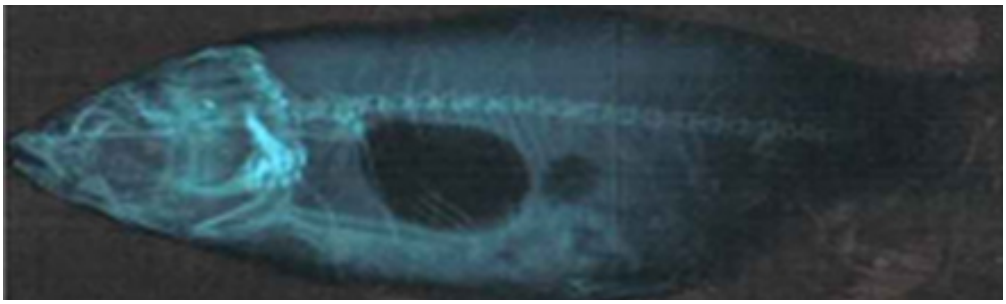

Figure 2.15b: X ray photograph of *Cirrhinus mrigala* showing irregular vertebral thickness and fusion.

Figure 2.16a: *Cirrhinus mrigala* showing dorsally curved trunk and displacement of pectoral, pelvic and anal fins.

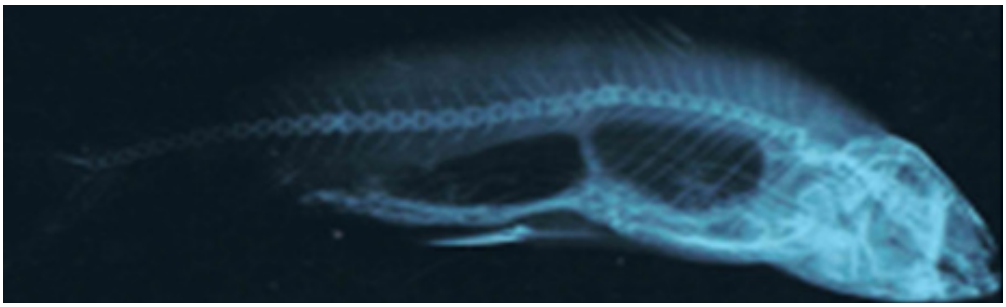

Figure 2.16b: X ray photograph of *Cirrhinus mrigala* showing dorsally curved vertebral column and minor kyphosis.

Figure 2.17a: *Cirrhinus mrigala* showing highly truncated, deflexed caudal peduncal, displaced dorsal and pelvic fins and aberrant anal and caudal fins.

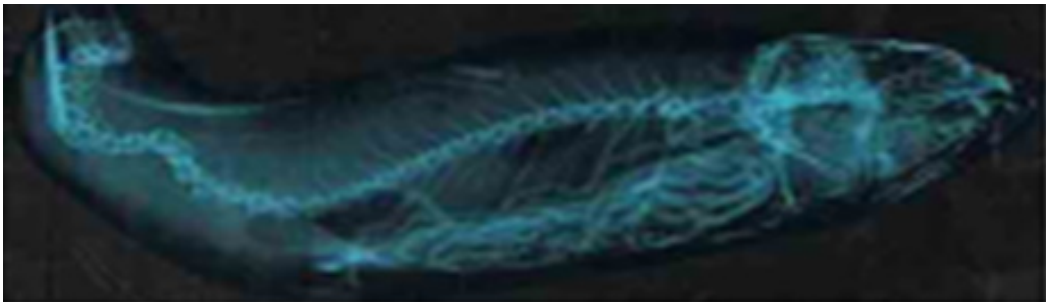

Figure 2.17b: X ray photograph of *Cirrhinus mrigala* showing vertebral column deformities and abnormal air bladder lobes.

Discussion

Record of only seventeen adult anomalous specimens of C. mrigala, among about 2000 fish specimens scanned, suggests a negligible percentage (>1%) of deformed fishes in Kathua ponds. This is either because they are less abundant or they have decreased survival as these easily fall prey to predators. Record of these adult deformed fishes suggests that these anomalies are not fatal, feeding is normal and are able to avoid predators. Several factors have been implicated for the appearance of fish deformities. Among abiotic factors alteration in one or more parameters like temperature, light, pH, salinity, low oxygen and inadequacy of key nutrients such as calcium and phosphorus. [12-20] have been attributed to cause fish deformities. Water quality characteristics of various fish ponds in Kathua district (Table 2) suggests that fish anomalies, under discussion, cannot be attributed to variation in abiotic characteristics of water or water pollution [21].

Table 2: Water quality of various fish ponds in Kathua district.

Parameters	Fish Breading Ponds	Larval Rearing Ponds	Stocking Ponds			
			I	II	III	IV
Air Temperature (°C)	35	35	35	35	35	35
Water Temperature (UC)	26	28	30	29	30	30
Turbidity (NTU)	3.6	8.5	13.2	31.8	21.2	21.2
pH	7.00	7.14	7.89	7.59	7.73	7.47
Conductivity (mS)	0.232	0.228	0.293	0.297	0.336	0.356
Salinity (PPT)	0.3	0.3	0.3	0.3	0.3	0.3
Total Dissolved Solids (PPT)	115.3	114.8	149.2	150.8	169.6	179.8
Free C02 (mgll)	17.60	10.56	11.44	10.81	9.00	8.80
DO (mg/I)	5.0	5.5	4.2	5.8	4.8	5.5
Carbonate (mg/I)	Nil	Nil	Nil	Nil	Nil	Nil
Bicarbonate (mg/I)	101.67	79.83	167.02	168.8	145.24	145.24
Chloride (mg/I)	7.38	5.91	6.65	8.13	7.35	6.80
Calcium (mg/I)	25.87	24.25	42	33.96	35.57	54.78
Magnesium (mg/I)	6.85	11.76	5.58	11.76	11.76	13.72
Total Hardness (mg/I)	92.7	108.80	127.70	130.80	137.10	193.10

Fish deformities have also been attributed to currents [22,23], cultural techniques [24-26], faulty methods followed in induced breeding [27], intensive rearing [28], stress [29-31], effects of unfavorable environmental conditions [6, 32] and cannot be ruled out in the present case.

Fish anomalies due to inbreeding [33-35] and genetic defects [36-38] are on record. As these abnormal fish specimen were not analysed genetically, hence it could not be ascertained whether these abnormities were hereditary or non-hereditary. Parasitic infection, reported to be a possible factor in development of skeletal malformation by [39-43] is ruled out in the present case as there was no visible infection on any deformed specimen of Cirrhinus marigala.

Fish deformities ascribed to dietary factors [44-46] are unexplainable as there is no detailed analysis of supplementary diet given to these cultured fishes. Two specimens of Cirrhinus mrigala showed injured truncated caudal peduncle (Figure 2.13 - 2.16) and is caused by biological or mechanical injury and wound healing

[9,10, 47-48]. Vertebral kyphosis in 12 fish specimens (Figure 2.12) and dorsally curved body in one fish specimen (Figure 2.15) is most probably caused by air bladder deformity [49-51].

Various types of anomalies in Cirrhinus mrigala, under discussion, can also be attributed to pesticides used in surrounding paddy fields and their ground water contamination and use of this contaminated water in fish ponds. Fish anomalies due to pesticides contaminated water/pesticides have also earlier been reported [52-56]. From the foregoing discussion it is clear that fish deformities are induced by multiple factors. Therefore, more research is needed to exactly identify the factors causing such deformities among cultured fishes.

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