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Deformities in *Cirrhinus mrigala* (Ham.Buch.) cultured in fresh water fish ponds in Jammu district, Jammu and Kashmir State, India

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Abstract

Fifteen deformed specimens of *Cirrhinus mrigala* (Ham.Buch.) showing morphological and vertebral anomalies were seen in the collections made by the fishermen from various fresh water ponds in Jammu district and have been described .Possible causes of fish aberrations have also been discussed.

Keywords: Malformation, morphological and vertebral, Cirrhinus mrigala , multiple factors

Introduction

Cirrhinus mrigala, a major Indian carp, is well distributed in lotic and lentic waters of Jammu (Dutta and Kour,2005). The state fishery department of Jammu and Kashmir has stocked this fish in various cold and warm water fish ponds in Jammu region and is giving excellent results. During fish survey in Jammu district, deformed specimens of mrigal, cultured in fish ponds of Jammu, were seen alaong with normal fishes and have been elaborated. Earlier, Sarkar and Kaushak (1958), Aggarwal and Mahajan (1980), Rath et .al (1995), Gupta et al. (2002), Narejo et.al (2007) , Amitabh and Firoz (2010) ,Dutta (2016), Dutta and Gupta (2010) and Dutta et.al (2006,2010,2011) have described some abnormal specimens of *Cirrhinus mrigala.* The objective of this study is to aware the fishery department and fish biologists about increasing problems of fish teratology in cultured waters , to analyse the causes of rising problems of fish deformities in fish farms in the country and suggest some remedial measures and determine possible causes of fish anomalies. Deformed animals, due to abnormal shape fetch low price in the market and is a serious loss to the aquaculturists.

Materials and Method

Malformed specimens of *Cirrhinus mrigala* cultured in fresh water fish ponds of Jammu were purchased from fish market and studied for morphological characteristics, parasitic infestation and photographed. Normal and deformed specimens were radiographed with digital X-Ray machine (Rays, India) for detailed skeletal analysis. For water quality characteristics of ponds water samples were collected in plastic containers and analysed by standard methods (APHA,1998). For DO analysis water samples were fixed in BOD bottles at the spot.

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Results and Discussion

In a normal streamlined *Cirrhinus mrigala* dorsal fin origin is more towards the snout than the caudal region, longest pectoral fin ray falls short of pelvic fin origin, longest pelvic fin ray falls short of anal fin origin and longest anal fin ray falls short of bilobed caudal fin (Fig. 1a). Lateral line, with 42-44 well developed scales, is streamlined. There are 35 amphicoelous vertebrae, after complex vertebrae, as revealed by X-Ray examination (Fig. 1b).

Fifteen aberrant specimens of *Cirrhinus mrigala* observed during the present study are described as below:

1. *Cirrhinus mrigala* (Ham.Buch.) showing deformed post-dorsal region and overlapping of anal and caudal fin (Fig 2a)

In this deformed specimen, dorsal fin origin is slightly posterior to the middle of the body. Placement of dorsal, pectoral and pelvic fin is like a normal fish. Anal fin overlaps the caudal fin.

Whereas in normal fish ,anal fin falls short of caudal fin base . There is no deviation in fin rays from a normal fish.

There are 37 amphicoelous vertebrae in this aberrant fish, as revealed by X-Ray examination(Fig 2b). Various vertebral deformities in this abnormal fish, after the complex one, are made out as below:

a. Vertebral column between 23^{rd} to 37^{th} vertebrae, after 1^{st} -22^{nd} normal vertebrae, is irregular.

i. 23^{rd} – 27^{th} vertebrae are clustered and enlarged;

ii. 28^{th} -32^{nd} vertebrae posteriorly directed and

iii. 33^{rd} -37^{th} vertebrae upwardly placed and concave.

b. Urostyle not clear.

From X-Ray analysis, it is clear that truncated post dorsal region in this specimen of *Cirrhinus mrigala* is caused by irregular vertebral column between 23^{rd}-37^{th} vertebrae.

2. *Cirrhinus mrigala*(Ham.Buch.) showing pre dorsal hump(Fig.3a)

In this abnormal fish, dorsal fin origin is anterior to the middle of the body, longest anal fin ray reaches origin of bilobed caudal fin. Placement of pectoral and pelvic fin is like a normal fish. The number of fin rays in dorsal , pectoral, pelvic ,anal and caudal fin are same as in normal fish.

Like a normal fish, the number of vertebrae, after complex vertebrae, are 35 in this aberrant fish(Fig.3b).. Various vertebral deformities in this abnormal fish, after the complex ones, are made out as follows:

a. Vertebral column is upwardly directed between 1^{st} -7^{th} vertebrae and downward curved posteriorly and results in Kyphosis(Λ).Except 6^{th} and 7^{th} fused vertebrae, forming angle of Kyphosis, all other vertebrae in vertebral column are normal.

From the radiological study it is clear that pre dorsal hump in the fish is caused by vertebral column Kyphosis.

3. *Cirrhinus mrigala*(Ham.Buch.) showing truncated post-dorsal region and disposition of fins(Fig. 4a)

Body, post dorsally, in this aberrant fish is truncated with a trough. Dorsal fin origin is slightly anterior to the middle of the body, longest pectoral ray falls short of pelvic fin origin and longest pelvic ray falls short of anal fin origin. Longest anal ray ,however, extends beyond origin of bilobed caudal fin.

Like normal fish, the number of vertebrae, after complex vertebrae, is 35 in this aberrant fish(Fig.4b). Various vertebral deformities with respect to size, shape , displacement and coalescence, after the complex ones, are given as below:

a. Vertebral column concave between 1^{st} -10^{th} vertebrae:

i. 1^{st} -6^{th} vertebrae have normal intervertebral space.

ii. 7^{th} -9^{th} vertebrae are enlarged and fused.

iii. 9^{th} and 10^{th} vertebrae have reduced intervertebral space.

b. Vertebral column between 11^{th} -20^{th} vertebrae forms a dome.

c. Vertebral column between 20^{th} - 26^{th} vertebrae form Kyphosis

d. 27^{th} -35^{th} vertebrae have normal inter-vertebral space and vertebral column curved downward.

e. Urostyle normal.

From the X-Ray analysis it is clear that truncated post dorsal region and disposition of fins in this specimen of *Cirrhinus mrigala* is due to dome and Kyphosis in the vertebral column.

4. *Cirrhinus mrigala*(Ham.Buch.) showing truncated post-dorsal region with a dorsal trough and a caudal fin base dome and overlapping of anal and caudal fin (Fig. 5a)

In this aberrant fish, except the overlapping of anal and caudal fin ,there is normal placement of other fins . Fin rays in dorsal ,pectoral, pelvic and anal fin are same as in normal fish. Fin rays in caudal fin are, however, not clearly differentiated .

Like normal fish, the number of vertebrae, after complex vertebrae, is 35 in this aberrant fish(Fig.5b).Various vertebral deformities with respect to size, shape , displacement and coalescence are made out as below:

a. Vertebral column normal between 1^{st} -24^{th} vertebrae .

b. Vertebral column upwardly directed between 25^{th} -34^{th} vertebrae and results in Lordiosis(V).

c. 35^{th} vertebra along with normal urostyle and caudal bones form kyphosis(Λ).

Radiological analysis confirms that a post dorsal depression and dorsal caudal base dome is caused by vertebral lordiosis and kyphosis.

5 *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal trough and dome(Fig.6a)

In this deformed fish, due to post-dorsal trough followed by a dome, longest anal ray reaches the origin of bilobed caudal fin .However, number of fin rays in anal and caudal fin are normal. Placement and number of fin rays in other fins is like a normal fish.

There are 35 amphicoelous vertebrae after the complex vertebrae ,as revealed by X-Ray examination(Fig.6b). Various vertebral anomalies in aberrant fish, with respect to size,shape, displacement and coalescence of vertebrae , after the complex ones, are made out as follows:

a. 1^{st} -15^{th} vertebrae normal.

b. 16^{th} -18^{th} vertebrae are undifferentiated.

c. Vertebral column between 19^{th} -29^{th} vertebrae forms trough in which:

i. 19^{th}-21^{st} vertebrae form descending limb,

ii. 22^{nd} – 24^{th} vertebrae base and

iii. 25^{th}-29^{th} vertebrae form ascending limb

d. 30^{th} -35^{th} vertebrae are normal with normal inter-vertebral spaces.

e. Urostyle is normal.

X-Ray analysis shows that deformed post dorsal trough followed by a dome in this specimen of *Cirrhinus mrigala* is due to vertebral trough.

6. *Cirrhinus mrigala* (Ham.Buch.) showing a post-dorsal trough and over-lapping of anal and caudal fin(Fig.7a)

In this aberrant fish,placement and number of fin rays in dorsal, pectoral and pelvic fin is just like a normal fish. However, anal fin extends beyond the caudal peduncle and overlaps the bilobed caudal fin .

An x-ray observation reveals the presence of 34 vertebrae(Fig 7b) after the complex vertebrae. Various vertebral anomalies noticed , with respect to size,shape, displacement and coalescence of vertebrae , after the complex ones, are discussed as under :-

a. 1^{st} -24^{th} vertebrae normal .

b. Between 25^{th} -34^{th} vertebrae, vertebral column is directed upwards giving a trough shape to the vertebral column. Inter-vertebral spaces reduced.

c. Urostyle is normal.

From the radiological study, it is clear that post dorsal trough and overlapping of anal and caudal fin in this specimen of *Cirrhinus mrigala* is caused by upward curvature of vertebral column between 25^{th}-34^{th} vertebrae.

7. *Cirrhinus mrigala* (Ham.Buch.) showing absence of caudal region (Fig. 8a)

This deformed fish was characterized by absence of a greater portion of post dorsal region including caudal peduncle and caudal fin. Posteriorly, body is blunt and anal fin is situated at the posterior lower half of caudal region. Dorsal fin origin is much posterior to the middle of the body. Number of fin rays in anal fin is 8.

Like normal fish, the number of vertebrae, after complex vertebrae, is 35 in this aberrant fish(Fig. 8b). Various vertebral deformities with respect to size, shape , displacement and coalescence, after the complex ones, are made out as follows:

a. Verterbral column between 1^{st} -26^{th} verterbrae runs almost in middle of the body with normal interverebral space and vertebral thickness.

b. Between 27^{th}-35^{th} vertebrae ,vertebral column forms a S-shaped structure with fused and undifferentiated vertebrae.

c. Urostyle and caudal fin absent.

Radiological study confirms the absence of caudal fin.

8. ***Cirrhinus mrigala* (Ham.Buch.) showing a hump in dorsal fin region followed by trough in post dorsal region (Fig.9a)**

Placement and number of fin rays in dorsal , pectoral and pelvic fins, in this aberrant fish are like normal fish. However, longest anal ray almost reaches base of bilobed caudal fin.

In this abnormal fish(Fig.9b), there are 37 amphicoelous vertebrae , as revealed by X-ray analysis . Various vertebral anomalies with respect to size, shape, displacement and coalescence of vertebrae, after the complex ones, are made out as follows:

a. 1^{st} -13^{th} vertebrae normal with normal intervertebral spaces & thickness.

b. Vertebral column ,between 14^{th} -20^{th} vertebrae forms Kyphosis (Λ):

i. 14^{th} -16^{th} fused vertebrae form one arm of Λ and there is no differentiation of inter vertebral spaces

ii. Angle of Λ is formed by 16th vertebrae.
iii. Vertebral column between 17th-20th vertebrae forms descending arm.
c. Posteriorly, vertebral column is normal.
d. Urostyle is normal.

From X-Ray analysis it is clear that hump in dorsal fin region and trough in post dorsal region in this specimen of *Cirrhinus mrigala* is caused by vertebral kyphosis.

9. *Cirrrhinus mrigala* with curved caudal peduncle and absence of caudal fin (Fig 10a)

In this aberrant specimen of *Cirrhinus mrigala* due to absence of caudal region , dorsal fin is located more towards the posterior side than towards the snout.Placement of pectoral and pelvic fins is like a normal fish. Anal fin extends beyond the posterior end of the body. Caudal fin absent.

There are 34 amphicoelous vertebrae, after the complex vertebrae in this aberrant fish (Fig 10b). Various vertebral deformities in this abnormal fish, after the complex ones, are made out as follows:

a. 1st-24th vertebrae normal.
b. Vertebral column between 25th-31st vertebrae, following body curvature, is curved.
c. 32nd and 34th vertebrae fused and form a hook .
d. Urostyle and caudal fin absent.

From X-Ray analysis, it is clear that post dorsal semi-circular body shape is followed by the vertebral column

10. *Cirrhinus mrigala* (Ham.Buch.) showing highly truncated caudal peduncle(Fig 11a)

Dorsal fin is located more towards the caudal fin base than towards the snout, pectoral fins falls short of pelvic fin, pelvic fins extend to the origin of anal fin and anal fin reaches the bilobed caudal fin base.

X-Ray study of the aberrant fish reveals the presence of 33 vertebrae after complex vertebrae. Various vertebral deformities with respect to size, shape , displacement and coalescence, after the complex ones, are made out as follows:

a. 1st -12th vertebrae are normal.
b. Vertebral column spirally coiled betwen 16th-26th vertebrae:
i. 16th- 18th vertebrae spirally coiled and form undifferentiated vertebral mass
ii. 19th and 20th veretebrae are well demarcated , but intervertebral spaces are slightly elongated.
iii. Vertebral column between 24th-26th vertebrae again form undifferentiated spiral mass.
c. Posteriorly , after 27th vertebrae, vertebral column is lunar shaped.
d. Urostyle normal.

From the radiological study, it is clear that truncated caudal peduncle in this specimen of *Cirrhinus mrigala* is caused by spirally coiled vertebral column between 16th- 26th vertebrae.

11. *Cirrhinus mrigala* (Ham.Buch.) showing pre-dorsal hump and mid dorsal depression(Fig 12a)

Placement of fins and number of fin rays is as in a normal fish.

Like normal fish, the number of vertebrae, after complex vertebrae, is 35 in this aberrant fish(Fig. 12b).and various vertebral deformities are made out as follows:

a. 1st five vertebrae are fused and along with complex vertebrae form a dome(Kyphosis).
b. Posteriorly vertebral column between 6th-27th vertebrae forms a V (lordiosis) in which :
i. 6th-18th vertebrae form descending arm of V.
ii. 19th vertebra forms angle of V.
iii. 20th-27th vertebrae form ascending arm of V.

Intervertebral spaces between 18th-20th vertebrae are reduced.

c. Vertebral column between 28th-35th vertebrae is like normal fish.
d. Urostyle and caudal bones normal.

From the above discussion it is concluded that pre-dorsal hump and a post dorsal depression is caused by a kyphosis and lordiosis in vertebral column.

12. Cirrhinus *mrigala* (Ham.Buch.) showing post dorsal depression and ventral bulge in pelvic and anal region(Fig 13a)

Dorsal fin in this aberrant fish is located almost in the middle of the body and anal fin extends beyond caudal fin base. Placement of other fins and number of fin rays is like normal fish.

There are 39 amphicoelous vertebrae, after complex vertebrae, in this aberrant fish(Fig 13b). Various vertebral deformities in this abnormal fish are:

a. Vertebral column forms a V (lordiosis) between 1st -32nd vertebrae in which:

i. 1st seventeen vertebrae , after complex vertebrae, forms descending arm.
ii.18th vertebra forms angle.
iii. Vertebral column between 19th – 32nd forms ascending arm of V.
iv. Intervertebral spaces of 15th-20th vertebrae reduced,

b. Vertebral column between 33rd-35th vertebrae normal.
c. Urostyle normal.

From the radiological observations it is clear that post dorsal depression and a ventral bulge between pelvics and anal fin is caused by vertebral column lordiosis.

13. *Cirrhinus mrigala* (Ham.Buch.) showing highly truncated post dorsal body and a bulge between anal and pelvic fins (Fig 14a)

Dorsal fin is located more towards caudal fin .Like normal fish, pectoral fins fall short of pelvics. Due to post dorsal truncated body, pelvics reach upto the base of anal and anal extends beyond the caudal fin base.

Like normal fish, the number of vertebrae, after complex vertebrae, is 35 in this aberrant fish(Fig. 14b). Various vertebral deformities with respect to size, shape , displacement and coalescence, after the complex ones, are made out as follows:

a. Vertebral column between 1st- 32nd vertebrae ,after complex vertebrae forms undifferentiated patches of vertebral mass.
b. Posteriorly vertebral column between 33rd-35th vertebrae normal.
c. Urostyle normal.

From the X-Ray analysis it is concluded that, shortening of body in this fish is due to formation of undifferentiated patches of vertebral mass.

14 . *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal truncated body (Fig 15a)

Unlike normal fish, pectorals extend upto pelvics and pelvics extend upto anal origin. Due to shortening of caudal peduncle anal fin extends beyond caudal fin base.

There is no deviation in the number of fin rays in dorsal ,pectoral ,pelvic ,anal and caudal fin in a normal fish.

X-Ray analysis has revealed the presence of 35 vertebrae and urostyle. Following aberrations have been observed in vertebral column of this deformed fish (15b):

a. 1st nine vertebrae after complex vertebrae are normal.
b. Vertebral column between 10th-30th vertebrae forms patches of undifferentiated vertebral masses.
c. Posteriorly , vertebral column between 31st - 35th vertebrae normal.
d. Urostyle normal .

From the above X-Ray analysis, it is clear that truncated body resulted due to shortening of intervertebral spaces and formation of compact vertebral masses at various places in the vertebral column.

15. *Cirrhinus mrigala* (Ham.Buch.) with pre-dorsal dome , post dorsal depression ,anal bulge and curved truncated caudal peduncle.(Fig 16a)

Due to the anal bulge and caudal peduncle dome, anal fin extends beyond the caudal fin base. Placement of other fins and number of fin rays is like normal fish.

The number of vertebrae, after complex vertebrae, is 44 in this aberrant fish(Fig. 16b).Vertebral column forms a zig-zag pattern from anterior to posterior side .Various vertebral deformities are made out as follows:

a. Vertebral column between 1st-17th vertebrae forms Kyphosis (Λ) in which:
i. Ist five vertebrae form anterior limb.
ii. 6th-7th vertebrae form angle.
iii. 8th-17th vertebrae form posterior limb .
b. Vertebral column between 18th -22nd vertebrae is directed upwards and along with 8th- 17th vertebrae forms a V (Lordiosis)in which
i. 8th- 17th vertebrae form anterior arm.
ii. 18th vertebra forms angle of V .
iii. 19th-22nd vertebrae form posterior arm.
c. Posteriorly vertebral column between 23rd-31st vertebrae forms a dome in which
i. 19th-22nd vertebrae form one side of dome.
ii. 23rd-26th vertebrae form roof.
iii.27th-31st vertebrae form posterior side of dome.
d. Vertebral column between 32nd-40th vertebrae, along with 27th-31st vertebrae forms a trough in which

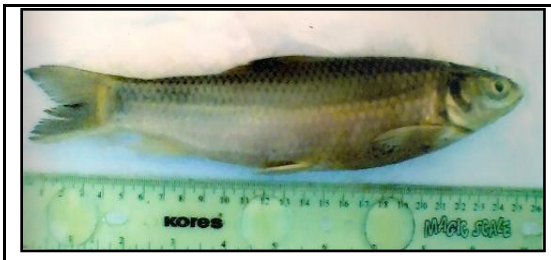

Fig. 1a : Normal specimen of *Cirrhinus mrigala*

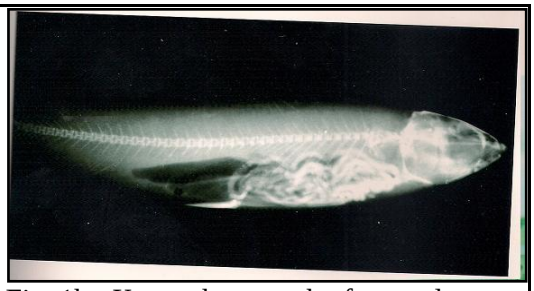

Fig. 1b : X-ray photograph of normal specimen of C*irrhinus mrigala.*

Fig 2a : *Cirrhinus mrigala* (Ham.Buch.) showing deformed post-dorsal region and overlapping of anal and caudal fin

Fig 2b : X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing deformed post-dorsal region and overlapping of anal and caudal fin

Fig 3a : *Cirrhinus mrigala*(Ham.Buch.) showing pre dorsal hump

Fig. 3b : X- ray photograph of *Cirrhinus mrigala*(Ham.Buch.) showing pre dorsal hump

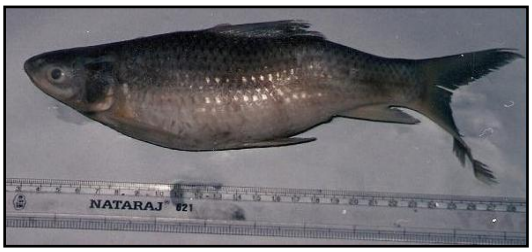

Fig. 4a : *Cirrhinus mrigala*(Ham.Buch.) showing truncated post-dorsal region and disposition of fins

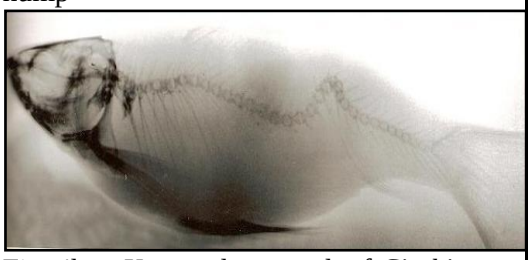

Fig. 4b : X- ray photograph of *Cirrhinus mrigala*(Ham.Buch.) showing truncated post-dorsal region and disposition of fins

Fig. 5a: *Cirrhinus mrigala*(Ham.Buch.) showing truncated post-dorsal region with a dorsal trough and a caudal fin base dome and overlapping of anal and caudal fin

Fig. 5b: X- ray photograph of *Cirrhinus mrigala*(Ham.Buch.) showing truncated post-dorsal region with a dorsal trough and a caudal fin base dome and overlapping of anal and caudal fin

Fig. 6a: *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal trough and dome

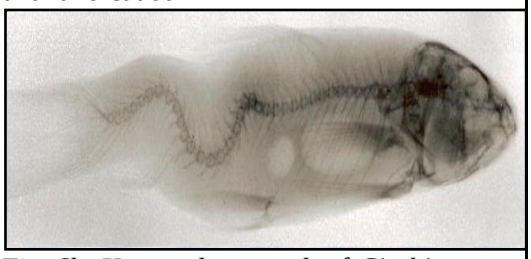

Fig. 6b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal trough and dome

Fig. 7a : *Cirrhinus mrigala* (Ham.Buch.) showing a post-dorsal trough and over-lapping of anal and caudal fin

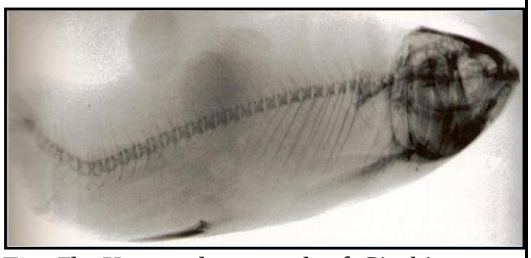

Fig. 7b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing a post-dorsal trough and over-lapping of anal and caudal fin

Fig. 8a: *Cirrhinus mrigala* (Ham.Buch.) showing absence of caudal region

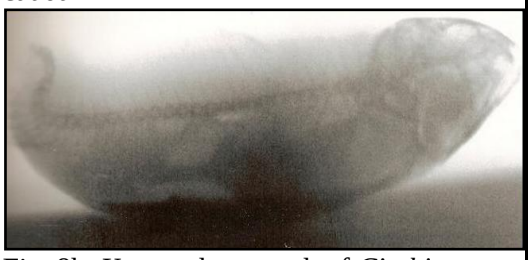

Fig. 8b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing absence of caudal region

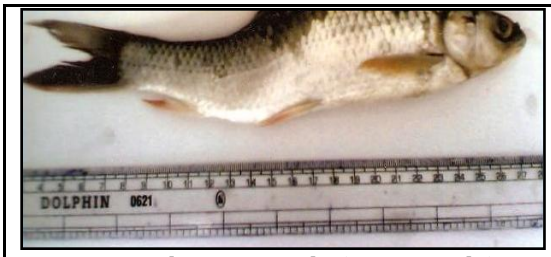

Fig. 9a: *Cirrhinus mrigala* (Ham.Buch.) showing a hump in dorsal fin region followed by trough in post dorsal region

Fig. 9b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing a hump in dorsal fin region followed by trough in post dorsal region

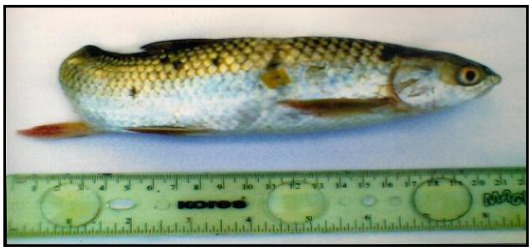

Fig. 10a: *Cirrrhinus mrigala* with curved caudal peduncle and absence of caudal fin

Fig. 10b: X- ray photograph of *Cirrrhinus mrigala* with curved caudal peduncle and absence of caudal fin

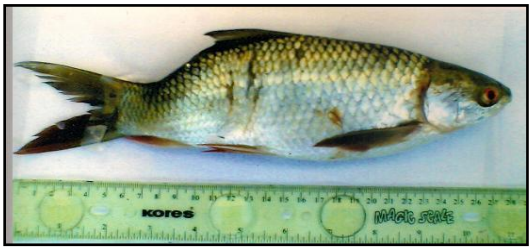

Fig. 11a: *Cirrhinus mrigala* (Ham.Buch.) showing highly truncated caudal peduncle

Fig.11b:X-ray photograph of *Cirrhinus mrigala* ——---(Ham.Buch.) showing highly truncated caudal peduncle

Fig. 12a: *Cirrhinus mrigala* (Ham.Buch.) showing pre- dorsal hump and mid dorsal depression

Fig. 12b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing pre- dorsal hump and mid dorsal depression

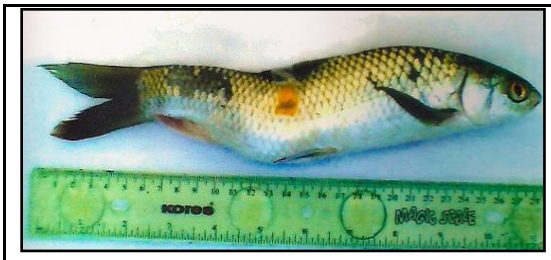

Fig. 13a: *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal depression and ventral bulge in pelvic and anal region

Fig. 13b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal depression and ventral bulge in pelvic and anal region

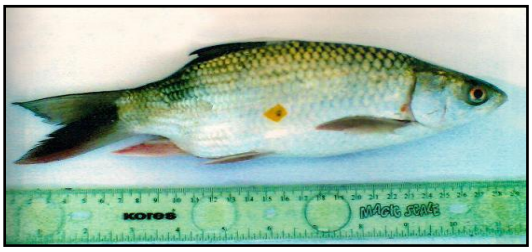

Fig. 14a: *Cirrhinus mrigala* (Ham.Buch.) showing highly truncated post dorsal body and a bulge between anal and pelvic fins

Fig. 14b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing highly truncated post dorsal body and a bulge between anal and pelvic fins

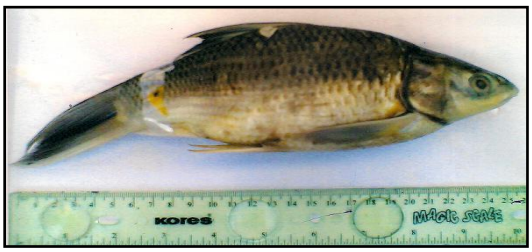

Fig. 15a: *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal truncated body

Fig. 15b: X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) showing post dorsal truncated body

Fig. 16a : *Cirrhinus mrigala* (Ham.Buch.) with pre- dorsal dome , post dorsal depression ,anal bulge and curved truncated caudal peduncle

Fig. 16b : X- ray photograph of *Cirrhinus mrigala* (Ham.Buch.) with pre- dorsal dome , post dorsal depression ,anal bulge and curved truncated caudal peduncle

i. 27^{th} -31^{st} vertebrae represent anterior side of trough .

ii. 32^{nd}-36^{th} vertebrae form bottom.

iii. 37th-40th vertebrae represent posterior side of trough.

e. Vertebral column between 41^{st}-44^{th} vertebrae is like a normal fish .

f. Urostyle and caudal bones normal.

g.

From the X-Ray analysis ,it is clear that abnormality in this specimen of *Cirrhinus mrigala* resulted due to irregular pattern of vertebral column.Deformed specimens of *Cirrhinus mrigala*, observed in the collection are adults. Therefore, it can be inferred that various anomalies in these specimens are not fatal. Percentage of deformed fishes in fish collections is below 1% as only 15 deformed specimens were seen among more than 2500 fish specimens. Fish anomalies in cultured fishes are attributed to a combined effect of multiple factors by various workers. Among physico-chemical parameters fish anomalies have been attributed to fluctuations in one one or other parameters like light, temperature, pH, salinity fluctuations, free carbon dioxide and low dissolved oxygen level etc (Hubbs,1959; Lee and Williams 1970;Turner and Farley,1971; Lee and Menu ,1981; Johnson and Katavic, 1984; Polo et.al., ,1991;Martens et.al, 2006 and Lall and Lewis – Mccrea,2007). Water quality analysis of various ponds (Table I) has revealed optimum levels of abiotic characteristics and as such anomalies, under discussion, cannot be attributed to these abiotic factors.

Table I: Physico-chemical characteristics of various fishponds in Jammu district

Parameters	**Fish breeding Pond**	**Larval rearing Pond**	**Stocking ponds**		
			1	**2**	**3**
Air temperature(˚C)	28	32	31	32	32
Water Temperature(˚C)	25	29	28	28	28
Turbidity (NTU)	6	10.5	26.5	27.1	28.2
pH	7.34	8.69	8.73	8.37	8.82
Conductivity (mS)	0.338	0.385	0.368	0.365	0.354
TDS (PPT)	340	196.7	133.6	231	177.2
Salinity (PPT)	0.5	0.3	0.2	0.4	0.3
D.O (mg/l)	5.29	7.14	6.14	8.71	8
Carbon dioxide (mg/l)	13.2	Absent	Absent	Absent	Absent
Carbonate (mg/l)	Absent	10.71	10.71	13.89	13.89
Bicarbonate (mg/l)	172.47	148.86	94.40	94.40	127.08
Chloride(mg/l)	7.86	8.78	20.68	14.98	16.80
Calcium (mg/l)	35.57	21.02	24.5	40.42	27.48
Magnesium(mg/l)	11.75	11.31	10.73	13.71	10.28

Fish abberations caused by pollutants have been described earlier by Cheng et.al. (2006), Jawad et.al(2010), Al Mamry et.al.(2010), Akioye et.al(2010) , Gupta et.al(2010) and Dutta et.al(2011, 2013).Various anomalies in *Cirrhinus mrigala* cannot be attributed to pollutants as the water quality parameters of various fish ponds are optimum and indicate absence of pollution(Table I) .These ponds are also free from sewage and industrial pollutants entry. Anomalies induced by hereditary factors have been described by Legardere et.al(1993) ,Daisei et al. (1995). Fish teratology due to inbreeding and dense stocking rate in fish farms has been reported by Kirpichkinov (1971), Wohl Farth and Maov (1971),Aulstad and Kittlesen(1971) and Piron (1978). A very low percentage of abnormal fishes in ponds of the area rules out the abnormalities, under discussion, due to heredity, inbreeding and dense stocking rate. According to Poston (1967), Dabrowski et.al (1988), Maddison and Dalsgaard (1995) and Halver et.al (1969), nutritional deficiency can induce fish aberrations. Nutritional deficiency as a probable cause of deformities in the

presently described fishes is difficult to explain as there is no record of analysis of supplementry diet given to the fish. Absence of caudal region in two specimens of *Cirrihinus mrigala* may be attributed to predation or injury and is in agreement to the findings of Singh Kohli and Goswami (1986-87), Dutta and Gupta(2010), and Dutta et.al (2011 ,2013). Anomalies in fishes have also been ascribed to parasitic infestation by Stauth (2004) and Dutta (2016). Among the presently studied fishes there is no external sign of any disease/parasite.Thereefore various anomalies under discussion cannot be attributed to any parasitic infestation. From the above discussion it is clear that fish teratology is very complex and is caused by multiple factors as has also been concluded by Baumann et.al.(1991), Al Harbi(2001), Boglione et.al(2001), Cahu et.al.(2003), Cheng et.al(2006), Evans and Neff (2009) and Dutta et.al.(2011,2015). This aspect of fish biology requires continuous monitoring from developmental to adult stage.

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