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Study of Morphological and Anatomical Abnormalities in Freshwater Fish Species: An Observational Series of Case Studies

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Abstract: ***The objective was to detect abnormal external morphology related to abnormal anatomy of vital organs of two freshwater fish species Heteropneustesfossilis Bloch and Oreochromis sp., Linnaeus found in local market, West Bengal. The results show abnormal body features along with deformed caudal fins and operculum. The fish specimen (Oreochromis sp.) indicated bilobed (brown colour) liver in which longer left lobe and shorter right lobe and gills observed red coloured, asymmetrical gill filaments with many raptures while gonads (testes) observed asymmetrical, white colour, segmented and immature growth. Other fish specimen (H. fossilis) revealed that liver is trilobed (reddish brown colour) in which dorsal side appeared tumour on left lobe and right lobe connected with extra small lobe and gills observed red coloured, asymmetrical gill filaments, condensed of gill lamellae and arches while gonads (ovaries) asymmetrical, black colour and possibilities of follicular atresia and upper part of right ovary contained a tumour like or necrotic tissues. It is concluded that the abnormal morphologies lead to abnormal anatomy of liver, gills, and gonads (testes and ovaries). It is suggested further to analysis the physico - chemical parameters of the habitat especially aquatic ecosystem as well as study with other fish species.***

Keywords: Fish species, Freshwater fish, Morphological abnormalities, Anatomical anomalies; Vital organs

1. Introduction

According to FAO [1] and Salim, [2] edible fish is an important nutritive diet for human beings. The morphological and anatomical abnormalities in fish species do not contribute as a diet and these abnormalities may hamper economic loss due to less availability in the market. The aberrations occurred may be due to many factors viz. pollution, alteration of physico - chemical conditions of the habitat, nutrition, injuries from trauma, genetic factor, etc. [3 - 6]

Moreover, many wild and reared fish species such as *Hemisorubim platyrhynchos*, *Dicentrarchuslabrax*, *Oreochromis* sp., *Mozambique tilapia*, *Catlacatla*, *Barbusbarbus*, *Bariliusbendelisis*, *Cirrhinusmrigala*, *Puntius sarana*, *Tor putitora*, *Heteropneustesfossilis*, *Mystusbleekeri*, *Labeorohita*, *Clarias gariepinus*, *Aphanius fasciatus*, *Sparus aurata*, *Sahyadriadenisonii*, etc. were found with the morphological and anatomical abnormalities in the national and international studies. [3, 5 - 12]

Besides these, several investigators reported abnormalities of vital organs viz. liver, gills, and gonads in different fish species. [10, 13 - 20]Both morphological and anatomical features could be a suitable biomonitoring tool.

An attempt was undertaken to detect abnormal external morphology related to abnormal anatomy of vital organs viz. liver, gills, and gonads of two freshwater fish species *H. fossilis* Bloch and *Oreochromis* sp. Linnaeusavailable in local market, West Bengal.

2. Materials and Methods

Fish species: Two fish species, *Heteropneustesfossilis* and *Oreochromis* sp. were collected from the local fish seller of wholesale market of West Bengal. Just died fish of 2 species were selected for the case study.

External morphological features: All two fish species were observed visually for abnormal external gross morphology compared to normal species. The gross abnormal morphology was studiedas length of the body (in cm), body weight (in gm), any curvature on neck, trunk, and tail region andany deformity in caudal fins through visual observation.

Anatomical features: After opening viscera, the abnormal anatomical features were studied for the vital organs like liver, gills, and gonads of each fish specimen. The size and shape (in cm) as well as certain abnormal features were measured for three different organs and compared to control fish specimen. The measurement of organs was done by using ImageJ tool (version 1J 1.49) developed by National Institute of Health, Bethesda, MD, USA. [21]

All these morphological and anatomical features were photographed, and images with descriptions are represented in the results section.

3. Results

Morphological features

Fig 1describes the external morphology of two species as normal (A and B) compared to abnormal features (a and b). In Fig 1a, for *Heteropneustesfossilis*, the abnormal morphological features viz. swollen near cervical region, followed by compression before caudal fin and the fin is asymmetrical (not homocerecal), rapture fin rays were observed (length = 23.1 cm and body weight = 380 gm) in comparison with control (Fig 1A) specimen (length = 28.1 cm and body weight = 150 gm). In Fig 1b, for *Oreochromis* sp., the abnormal morphological features viz. opened opercular region, followed by a curvature before caudal fin and raptured fin rays were observed (length = 18.1 cm and body weight = 152 gm) when compared to normal (Fig 1A) specimen (length = 18.2 cm and body weight = 130 gm).

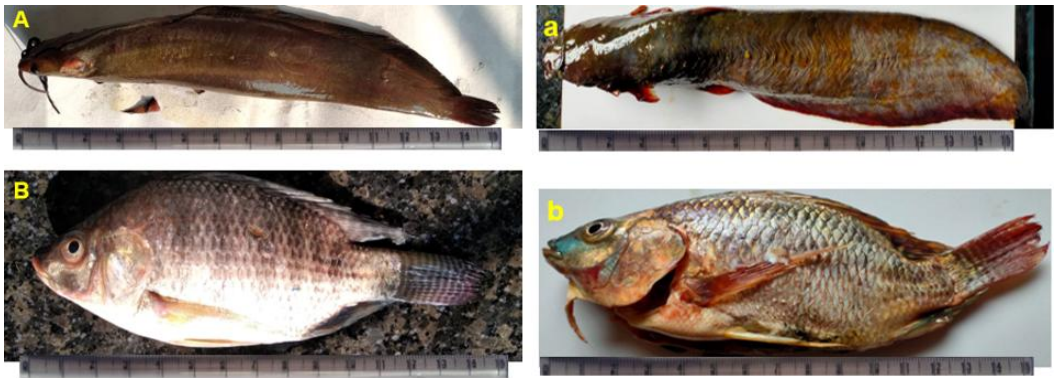


Figure 1: Normal and abnormal morphology of two freshwater fish species (A = *Heteropneustesfossilis* and B = *Oreochromis* sp.)

Anatomical features

Fig 2 (a - f) describes the normal and abnormal anatomy of liver, gills, and gonads for studied fish specimen (*Oreochromis* sp.). The anatomy of abnormal liver was obtained bilobed (brown colour) in which longer left lobe (7.0 cm) and shorten right lobe (2.5 cm) when compared to normal liver (left = 4.5 cm and right = 3.0 cm) (Fig 1b and a). In case of the abnormal anatomy of gills (3.1 cm), red colour gill filaments asymmetrical with many raptures when compared to normal (4.5 cm) gills (Fig 1 d and c). For abnormal gonads (testes), asymmetrical (left = 6.0 cm and right = 5.0 cm), white colour, segmented and immature growth were observed when compared to normal (left = 6.2 cm and right = 3.5 cm) testes (Fig 1 f and e).

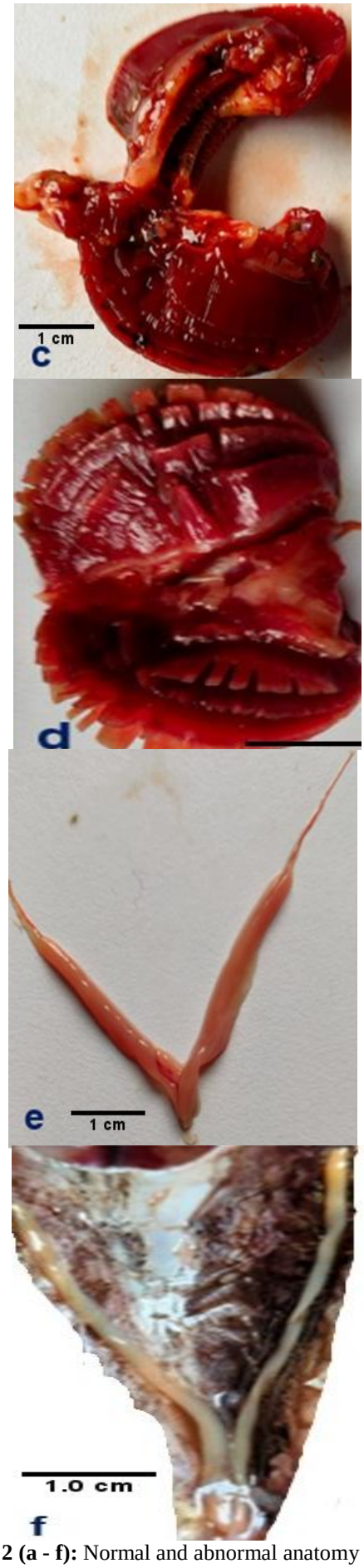
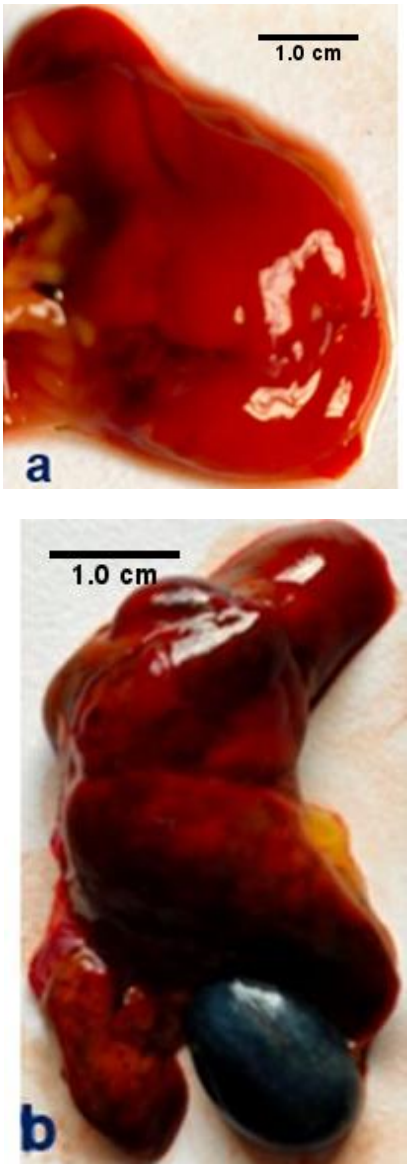


Figure 2 (a - f): Normal and abnormal anatomy of vital organs of two freshwater fish specimen *Oreochromis niloticus* (a & b = Liver, c & d = Gill, and e & f = Gonad)

Fig 3 (a - f) describes the abnormal anatomy of liver, gills, and gonads for studied fish specimen (*Heteropneustesfossilis*). The anatomy of abnormal liver was obtained trilobed (reddish brown colour) in which dorsal side appeared tumour on left lobe (1.5 cm), and right lobe (2.0 cm) connected with extra small lobe (1.8 cm) and a large gall bladder when compared to normal liver (left = 4.5 cm and right = 1.9 cm) (Fig 2b and a). In case of the abnormal anatomy of gills (3.0 cm), red colour gill filaments asymmetrical, condensed of gill lamellae and arches when compared to normal (3.9 cm) gills (Fig 2 d and c). The abnormal anatomy of gonads (ovaries), asymmetrical (left = 5.7 cm and right = 6.2 cm), black colour and possibilities of follicular atresia and upper part of right ovary contained a tumour like or necrotic tissues when compared to normal (left = 5.8 cm and right = 5.6 cm) mature ovaries (Fig 2 f and e).



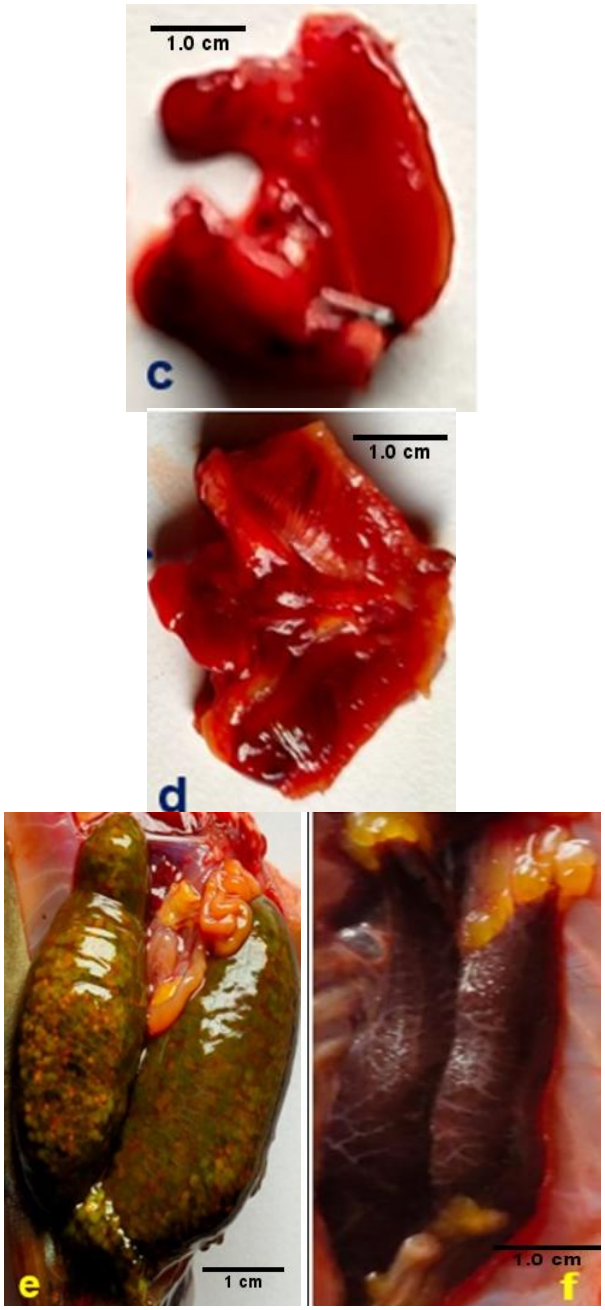


Figure 3 (a - f): Normal and abnormal anatomy of vital organs of two freshwater fish specimen *Heteropneustesfossilis* (a & b = Liver, c & d = Gill, and e & f = Gonad)

4. Discussion

The present case series evaluated on abnormal morphology and anatomy in comparison with normal features of two freshwater fish species such as *Heteropneustesfossilis* and *Oreochromis niloticus*. These abnormalities cause due to several factors viz. pollution, alteration of physico - chemical conditions of the habitat, nutrition, injuries from trauma, genetic factor, etc., which have been reported in national and international studies. [3, 4, 6, 10, 12, 22 - 30]

In this study, morphological abnormalities were observed mainly body shape affected such as swollen near cervical region, followed by compression before caudal fin along with asymmetrical shape (not homocerecal), rapture fin rays in *H. fossilis* and opened opercular region, followed by a curvature before caudal fin and raptured fin rays in *Oreochromis* sp. when compared to normal shape of fish species. Some similarities were observed in the previous studies with fish species viz. Danio rerio, *Clarias Gariepinus*, *Ameiurus nebulosus*, *Labeorohita*, *Cirrihinusmrigala*, *Catlacatla*. [3, 7, 8, 12, 31 - 33]

On the other hand, anatomical anomalies of liver, gills and gonads were observed with special reference to gross morphology and colour in the studied fish species. The fish specimen (*Oreochromis* sp.) observed a brown coloured liver with bilobed structure in which longer left lobe and shorter right lobe was obtained quite long size when compared to normal liver. It is well established that bilobed liver is found in *Oreochromisniloticus* [13, 19]but very long size of the lobe, a small tumour like structure in small lobe and brown colour arethe abnormalities. In case of the abnormal anatomy of gills, red colour gill filaments asymmetrical with many raptures were observed when compared to normal gills of *Oreochromis* sp. These structural abnormalities in gills may be due to mechanical or environmental impact, which is supported by Strzyzewska et al. [18] (2016) and Strzyżewska - Worotyńska et al. [34]. In the present case study in *Oreochromis* sp., abnormal gonads (testes) were observed as asymmetrical size and shape, white colour and immature growth were observed when compared to normal testes. According to Rajasilta et al., [17] the malformation of gonads as asymmetrical in the fish (*Clupea harengusmembras*) due to the variation of water condition.

In another case study with *H. fossilis*, the anatomy of abnormal liver was obtained trilobed (reddish brown colour) in which dorsal side appeared a swollen structure on left lobe, and right lobe connects with extra small lobe when compared to normal liver. Some earlier studies evidence viz. liver tissue lesions due to exposure of insecticides to *Cirrhinusmrigala*. [35, 36]In case of the abnormal anatomy of gills of *H. fossilis*, red colour gill filaments asymmetrical and condensed when compared to normal gills. Similar findings like lamellar fusion and destruction gill filaments and gill arches were obtained in the same fish specimen due to the exposure of insecticide at different concentration. [35, 36]The abnormal anatomy of gonads (ovaries), asymmetrical shape and size, black colour and possibilities of follicular atresia and upper part of right ovary contained a tumour like or necrotic tissues when compared to normal mature ovaries, which is supported by earlier study of Rajasilta et al. [17]

5. Conclusion

The present observational case study, the abnormal external morphologies such as swollen near cervical region, compression before caudal fin and the fin is asymmetrical (without homocerecal shape), rapture fin rays in *H. fossilis* and opened opercular region, followed by a curvature before caudal fin and raptured fin rays in *Oreochromis* sp. were recorded in comparison with normal specimen. These abnormal morphologies also lead to abnormal anatomy of liver, gills, and gonads (testes and ovaries). Both abnormal morphology and anatomy in the studied fish is a key indication of habitat condition and it is suggested further to analysis the physico - chemical parameters of the habitat

especially aquatic ecosystem. More abnormalities in different fish species may cause economic loss because fish is an important diet. Further research should be carried out related to the other fish species of local market.

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Conflict of interest
As per authors no conflict of interest in the present study.

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