



Original article

Some anatomical description of the splanchnic organs of Nigerian local reed fish (*Erpetoichthys calabaricus*)

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ABSTRACT

Introduction: Fish is an important source of protein. The economic importance of fish production has led to industrialization of fishing. Encroaching activities on their natural habitats have led to the depleting population of both food and wild fishes, such as *Erpetoichthys calabaricus* that are near threatened. Because little or no anatomical information is available on *Erpetoichthys calabaricus*, there is a need to investigate the anatomy of *Erpetoichthys calabaricus* to provide the basic data for this species of fish.

Methods: Five females *Erpetoichthys calabaricus* was used for this study. The reed fishes were subjected to cold shock and then dissected for gross observation. The body parameters were measured using plastic tape rule and all data subjected to statistical analysis using Graph pad Prism 4.0

Results: The average head length was (3.5 ± 0.26) cm while its body length was (17.9 ± 0.10) cm. Most of the visceral organs were located cranially while the liver and a pair of kidneys extends caudally to the anal pore. However, the lungs did not extend to the caudal most of the coelomic cavity. The length of the gastrointestinal tract spanned from the base of the head to the anal pore. Two flexures were present in the stomach: the cranial and the caudal flexures.

Significance: The splanchnic anatomy investigated in this study was generally similar to other species of fish. Conclusively, the data generated would be useful for comparative fish anatomy and conservation of the fish.

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Introduction

The Nigerian local reed fish is rope-like and resembles the eel fish. They are distributed in Central and West Africa, inhabiting the freshwater rivers in Nigeria (Ekpo, 2013). The reed fish (*Erpetoichthys calabaricus*) belongs to the family *Polypteridae* and order *Polypteriformes* (Helfenrath *et al.*, 2021). *Erpetoichthys calabaricus* is characterized by the absence of ventral fin with elongated, anguilliform body (Greenwood, 1984) while the dorsal fin is furnished with series of individual spines that support its rays and membrane (Burgess, 1983).

Although fish is a main source of aquatic animal protein (Tidwell and Allan, 2001), *Erpetoichthys calabaricus*, is important in generating income as they are used for ornaments being a beautiful sight in the aquarium, in fish sport, and a source of animal protein (Ekpe and Asikpo, 2019). Also, *Erpetoichthys calabaricus* has been demonstrated to be useful for surveillance of heavy metal pollution in water bodies (Ayotunde *et al.*, 2011). Although human activities put the Nigerian local reed fish under threat (Laleye *et al.*, 2014, Laleye

et al., 2020), its lack of adequate inquiry and studies have also led to its assumed scarcity and poor cultivation (Ekpo, 2013, Ekpe and Asikpo, 2019) as only attempts on its sexual dimorphism based on body size (Ekpe and Asikpo, 2019) and regenerative ability of its rayed fins have been documented (Nikiforova and Golichenkov, 2012). *Erpetoichthys calabaricus* is gaining interest as an experimental animal for molecular and genetic studies in investigating the reparative and regenerative mechanism in vertebrates as knowledge of the anatomy of fish is important in the understanding of the evolution of vertebrates (Helfenrath *et al.*, 2021). Unlike several reports on marine fishes and other snake-like freshwater fishes such as the eels (Popper and Tavolga, 1981, Hellberg and Bjerkds, 2000, Alabssawy *et al.*, 2019, Shin *et al.*, 2022, Zulfahmi *et al.*, 2022), detailed information on the anatomy, especially the visceral organs of *Erpetoichthys calabaricus* is lacking, which will help in effective rearing of the fish. Also, the data generated will be useful in the comparative anatomy of Pisces. Finally, this work will provide baseline data for clinical and experimental studies, hence the need to carry out this research work.

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Materials and methods

Five Nigerian local female reed fish were trapped with a fishing net set in the stream, against the freshwater flow. They were immediately put in an open plastic container filled with fresh water scooped from the stream and transported to the Department of Veterinary Anatomy laboratory, University of Ibadan. The plastic container has an open roof for aeration. The reed fishes were anesthetized by cold shock and placed on the dissecting board. The external morphology of the fish was carefully observed. The whole-body dimensions were measured using plastic tape and a meter rule. The fishes were then dissected using a scalpel and a pair of scissors as the skin was thick and scaly. The cut was made on the ventral surface from the point of the genitals to the baseline region of the head before reflecting the skin to view the internal organs *in situ*. The specimens were prevented from drying out by the periodic addition of normal saline.

Statistical Analysis

The body parameters such as the whole-body length (WBL) of the fish, fish head length (FHL) and width (FWL), the pectoral (PFL), caudal (CFL), dorsal (DFL) and caudolateral (CLF) fin length, GIT, (GCL) and the egg size (EGS), were measured from the widest points on the animal, and subjected to Student's t-test using Graph Pad prism version 4.0

Results

The average head length of the *Erpetoichthys calabaricus* used for this work was derived as 3.5 ± 0.26 cm with its width as 2.4 ± 0.04 cm while the whole-body length and width are derived as 17.9 ± 0.10 cm and 2.41 ± 0.04 cm, respectively. The pectoral and caudal fins average values derived are 3.0 ± 0.18 cm and 2.9 ± 0.18 cm, respectively. The dorsal fin average value derived is 11.3 ± 0.25 cm while that obtained for the caudolateral (pelvic) fin is 1.8 ± 0.12 cm. Also, the gastrointestinal tract (GIT) spanned the entire length of the coelomic cavity, measuring an average value of 16.2 ± 0.15 cm. The average size of an egg within the ovaries was about 0.5mm to 1mm in diameter.

Also, the *Erpetoichthys calabaricus* used for this study had a slim snake-like scaly body that was generally blackish brown at the dorsum but pale white ventrally. It had dorsal fins with spines that numbered 16-18. The last dorsal fin appeared to continue with the caudal fin in both orientation and direction just at the beginning of the tail. The head is narrow and dorso-ventrally flattened. The cranial part of the head bore a pair of short tactile-like structure. The base of the head bore the pectoral fin. At the caudal region, cranial to the anal pore was a caudolateral fin. The anal pore, slit-like structure was situated at the base of the anal fin (Figure 1).

The coelomic cavity spanned through the whole trunk, from the base of the head to the anal pore. It contained the visceral organs:

air sac (lung), esophagus, stomach, intestine, spleen, liver, kidney, and urinary bladder. The bulk of the visceral organs appeared more cranially located in the coelomic cavity (Figure 2).

There was the presence of an air sac or gas bladder at the base of the head. It ballooned caudally to reach the spleen on the right side of the cavity. The oesophagus was a short whitish tube that extended from the base of the mouth to the stomach. It expanded before entering the stomach. The stomach was elongated and rather fusiform in shape. It had two flexures: cranial and caudal flexure. The stomach ran caudally and dorsally to the intestine to make a caudal flexure. Cranially, it ran ventrally to the intestine before entering the intestine at the junction where a blind sac was formed. The intestine presented little or no coils, but a tube-like structure that extended from the stomach to the anal pore. The spleen was small, reddish with a half-bean shape appearance. It was located cranioventral to the stomach, just at the cranial flexure of the stomach. The liver appeared dark red, located at the base of the head where it was expanded but progressively narrowed and elongated towards the caudal aspect. The liver measured about three-quarters the entire length of the coelomic cavity. The kidney is situated on the dorsum of the fish. It had a light brown coloration. The kidney (head) extends from the caudal flexure of the stomach to reach the anal pore. The urinary bladder, a thin fibrous structure that expanded when filled with urine was situated cranial to the anal pore, on the midline. The pair of ovaries contained numerous eggs. The eggs were contained in a serous membrane or sac which terminated in an ovarian opening at the anal pore. The eggs occupied the coelomic cavity from the cranial to the caudal extent. The extent of the egg was from the caudal fin to the cranial fin, at the ventral aspect of the fish. The egg arrangement was bilateral, and ventrolateral, reaching the dorsal wall of the cavity (Figure 3).

Discussion

This study is basically on some aspects of the anatomy of the Nigeria reed fish although there is literature available on the anatomy of many fishes, especially on the splanchnology (Johansen and Lenfant, 1967; Maina and Maloiy, 1985; Hellberg and Bjerkås, 2000; Icardo *et al.*, 2010), information on the reed fish is scarce. The Nigeria reed fish is long, and snake-like with all the primary fins present however the anal fin may be mistaken for a ventral fin due to its ventrolateral location, so it appears more like a pelvic fin. Therefore, the anal pore is situated between the anal fin and the pelvic fin.

The visceral organs present in the reed fish are generally present in most pisces. Therefore, the presence of an air sac is not peculiar to *Erpetoichthys calabaricus*, and the visceral organs reported in this study correspond to the findings of Kobelkowsky and Terán-Martínez (2020) in *Eugerres mexicanus*. The air sac does not occupy a large portion of the coelomic cavity but is reported to occupy a large volume in other species (Whitehead and Blaxter, 1989).

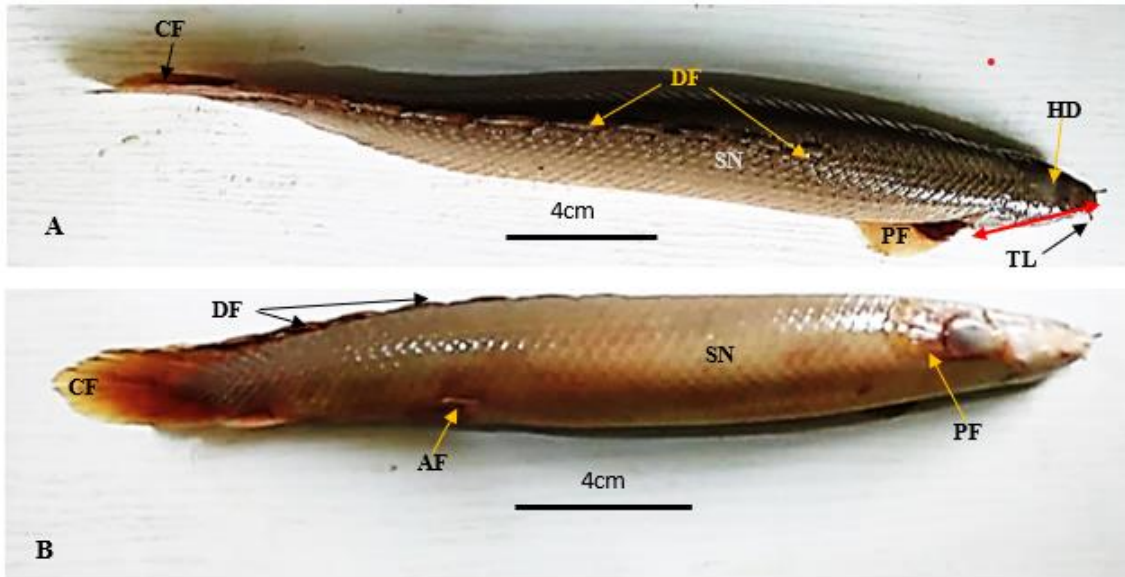


Figure 1: In (A): The dorsal view of the *Erpetoichthys calabaricus* showing the head (HD), pectoral fin (PF), dorsal fin (DF), caudal fin (CF) and the tactile (TL). In (B), the right lateral view with the caudal fin (CF), dorsal fin (DF), pectoral fin (PF) and anal fin (AF). Note the scaly thick skin (SN) and the extent of the head (HD), marked by red arrow.

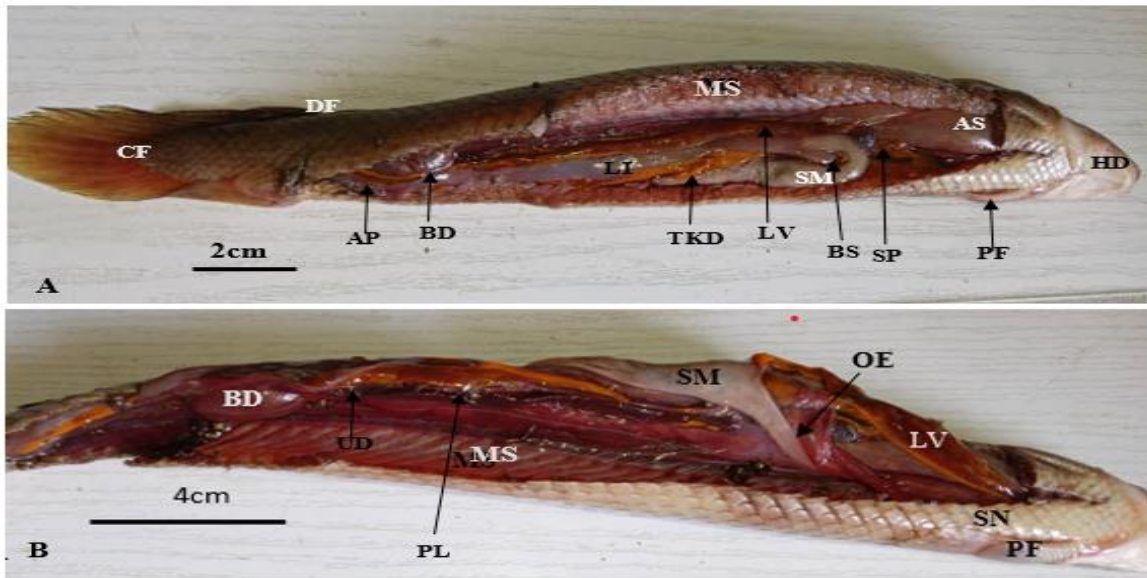


Figure 2: In (A): The muscle (MS) of *Erpetoichthys calabaricus* was reflected to show the visceral organs: the air sac (AS), the spleen (SP), blind sacs (BS), the stomach (SM), the liver (LV), the trunk kidney (TKD), large intestine (LI). Also, note the head (HD), pectoral fin (PF), dorsal fin (DF), caudal fin (CF). In (B), the tactile (TL). In (B), The visceral organs are reflected in a pleural like thin membrane (PL) to show the oesophagus (OE) terminating into the stomach (SM), the liver (LV), urinary bladder (BD) and urinary duct (UD). Also note the pectoral fin (PN), the skin (SN) and the reflected muscle (MS) and head kidney.

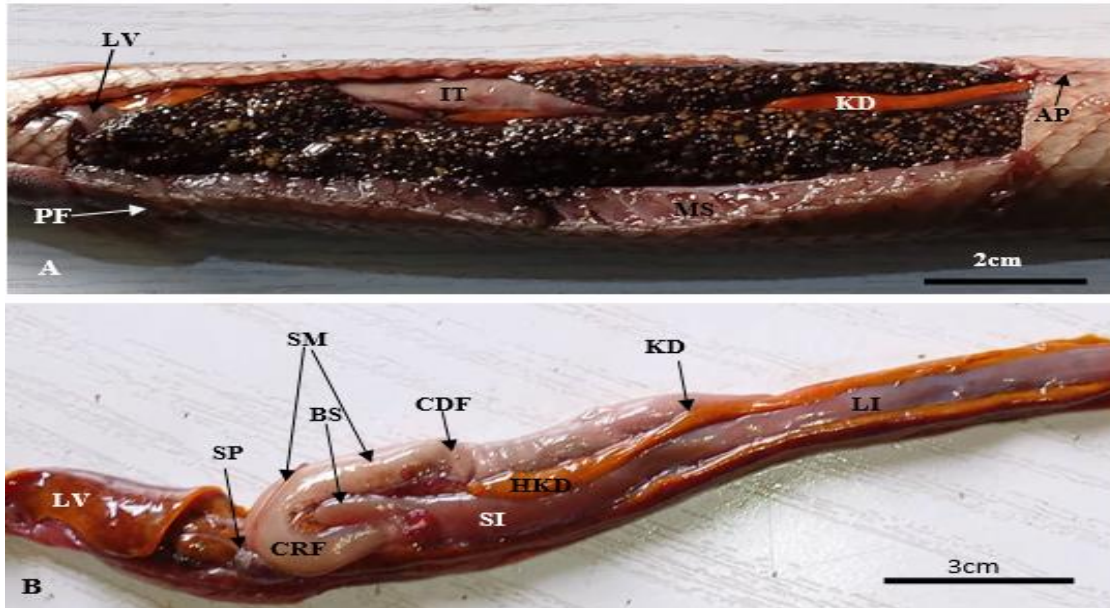


Figure 3: In (A): The liver (LV), intestine (IT), kidney (KD) of *Erpetoichthys calabaricus* almost buried in by the eggs (EG) that extend from the base of the head to the anal pore (AL). Also observe the muscle (MS) thickness at the trunk. In (B), observe the liver (LV) at the cranial part, was a sheet that roll over itself. The spleen (SP) is cranial to the cranial flexure (CRF) of the stomach (SM). The cranial flexure continues ventrally into the small intestine, also opening into a dorsal blind sac (BS). The head of the kidney (HKD) extends from just the caudal flexure (CDF)

Discussion contd.

The entire gastrointestinal tract measured almost equal to the whole length of the fish which may be adapted to their choice of feed which are mainly smaller animals such as snails, worms, and insects could be species specific. The visceral organs contained in the long cylindrical coelomic cavity conform to the elongated cylindrical shape of *Erpetoichthys calabaricus*. This is similar to the report on *Eugerres mexicanus* (Kobelkowsky and Terán-Martínez, 2020). The point at which the oesophagus blends with the stomach appears to be dilated. This was not reported in *Eugerres mexicanus*, Wrasses, and parrot fishes because of the absence of stomachs in these species (Kobelkowsky and Terán-Martínez, 2020; Helfman *et al.*, 2009). The cranial flexure of the stomach in *Erpetoichthys calabaricus* corresponds to the reports on the stomach of Wolffish (Hellberg and Bjerkås, 2000). The stomach in the *Erpetoichthys calabaricus* continues distally with the intestine at a constricted junction where a blind sac is formed. The significance of the blind sac is not known. The intestine in the reed fish is not coiled like in the wolffish reported by Hellberg and Bjerkås (2000) but continues distally maintaining a larger diameter towards the anal pore. The intestine of the *Erpetoichthys calabaricus* is relatively long compared to the rest of the gastrointestinal tracts, about four

times the length of the stomach and twice the length of the oesophagus. The cranial location of part of the liver relative to the stomach in the reed fish is similar to the findings reported in Wolffish (Hellberg and Bjerkås, 2000). The paired kidneys do not fuse at any point but are connected to the urinary bladder by urinary ducts (archinephric ducts). The urinary bladder is separated from the air sac unlike in the report of Kobelkowsky and Terán-Martínez (2020) in *Eugerres mexicanus*.

Conclusion

The splanchnology of *Erpetoichthys calabaricus* is therefore important in providing the basic information for further research on this priceless ornamental fish for its survival and use as an animal model in aquatic research where there is low water-oxygen can be exploited. Further research using light microscopy and electron microscopy is encouraged.

Conflict of interest

There is no conflict of interest.

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