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## A Comparative Study of the Digestive Systems of Certain Teleosts with Special References to *Carpoides cyprines*

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A COMPARATIVE STUDY OF THE DIGESTIVE SYSTEMS OF CERTAIN TELEOSTS WITH SPECIAL REFERENCES TO CARPOIDES CYPRINUS

WALTER W. AITKEN

This article is a report of certain investigations being made in the Zoology Laboratories of the State University of Iowa, concerning the alimentation of some common Iowa fishes. The work includes both carnivorous and herbivorous types.

A comparative study of the alimentary tracts of herbivorous and carnivorous teleosts shows some very marked differences in size, shape, position, and appearance of digestive organs, and the presence or absence of pyloric caecae.

In noting similarities and differences in these two groups of fishes, it is observed that the herbivores do not possess pyloric caecae. Seemingly correlated with this fact is an extremely long intestine of large diameter, which can be said to furnish ample digestive area, obviating the necessity of pyloric caecae which are presumed to materially aid in digestion.

Aside from the general descriptions of the alimentary tract of fishes by Owen, 1866, very little, if any, comparative work has been done along this line. The present investigations seem to indicate that the food habits play the major role in the determination of the similarities and differences found in the alimentary tracts of teleosts, the size and shape of the coelomic cavity contributing only a minor part.

On account of the extensiveness of descriptive details in comparative anatomy, this paper can only deal with a small portion of the work being done. I shall therefore describe *Carpoides cyprinus* (Quillback), a common species of a typical herbivorous family, the Catostomidae, and compare *cyprinus* with a closely related species, *Macrostomatobus cyprinella* (Big-mouthed buffalo). *Carpoides cyprinus* is the commonest of the Catostomidae in the vicinity of Iowa City.

The oesophagus of *cyprinus* is wide and short, rather thick walled, and has its mucosa marked by longitudinal folds. The length of the oesophagus in fish weighing from 290 grams to 800 grams varies from 6/10 of a centimeter to 3 and 7/10 centimeters,

the with from 4/10 centimeter to 5/10 centimeter. There is no constriction at the juncture of the oesophagus and cardia.

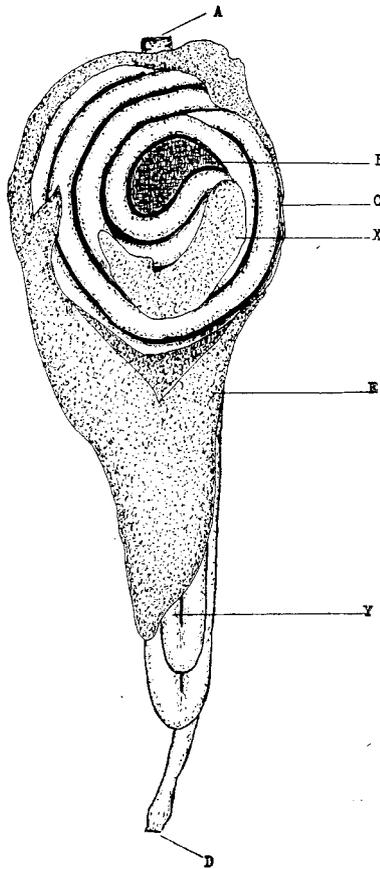
The stomach is somewhat bulbous in outline, the anterior portion slightly sub-spherical. The mucosa is finely wrinkled, and no distinction can be seen between a cardiac and a pyloric portion.

The intestine is large in diameter and extremely long. The walls are thick and the mucosa is fairly smooth. The width of the intestine is constant throughout the entire length. In some individuals, the length of the intestine runs to 7 times the body length, and in others as short as 3 times the body length. However, the average intestinal length is about 5 times the linear measurement of the fish. These observations were made on 50 individuals, and the lengths did not vary with sex. In all specimens of cyprinus examined, the convolutions or foldings of the intestine were consistent in their peculiar coiling. As demonstrated on Plate II, the intestine follows the same pattern in its curves and recurves as the intestine of cyprinella, the striking difference being in the fact that instead of the loops on the right side continuing parallel to the axis of the fish, they describe a clockwise coil as shown on Plate I, and curve around the ventral portion of the right lobe of the liver moulding that massive organ into irregular sections.

The liver is a large trilobed mass lying in a dorsal position. It completely invests the coiled portion of the intestine and the dorsal half of the stomach. The right lobe is slightly larger than the left lobe, the posterior portion spreading left and ventral. The left lobe is similar in shape to the right lobe but does not extend so far back in the body cavity. The two lobes are connected by a thin strip-like lobe which fits collarwise around the lateral and ventral portions of the cardia. The oiliness of the liver is quite noticeable.

The gall bladder is several times larger than the stomach, and is not invested by the liver, but lies posterior and dorsal to the stomach. The cystic duct follows the right lateral surface of the stomach, and empties into the cardia at a point anterior to the midsection. A large hepatic duct from the right lobe of the liver joins the cystic duct about half way between the fundus of the gall bladder and its stoma.

The spleen is bilobed in adult fish, and light red in color. The right and left halves are about equal, and the two portions lie in a lateral posterior position to the stomach. The volume of the spleen is relatively large, and lying embedded among the coils of the intestine is moulded into irregular shapes.



*Carpoides cyprinus*

PLATE I

This is a ventral view of viscera entire. Note how section of the right lobe of the liver marked "X," is immeshed in the intestinal coiling. The spleen is also moulded into irregular masses by the coils. A, oesophagus; B, spleen; C, intestine; D, anal opening; E, right lobe of liver; X, portion of right lobe of liver; Y, intestine coming straight from stomach, and making first curve to the left. Magnification;  $\frac{1}{2}$  natural size of fish 1430 grams.

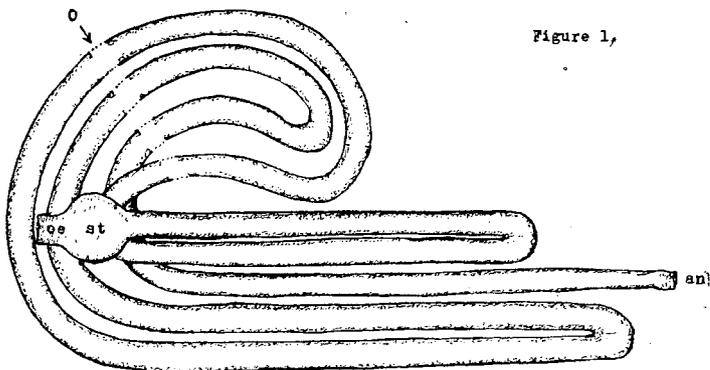


Figure 1,

*Carpoides cyprinus* (Magnification  $\frac{1}{2}$  nat. fish 1430 gms.)

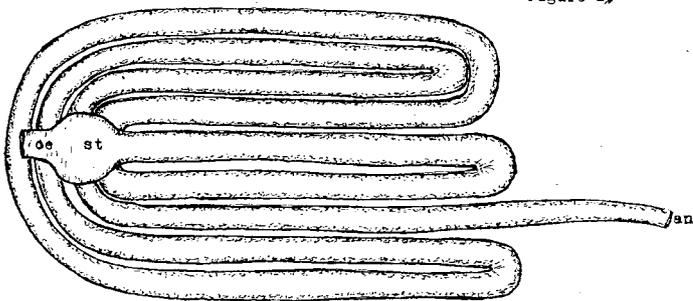


Figure 2,

*Macrostomatobus cyprinella* (Mag.  $\frac{1}{2}$  nat. fish 900 gms.)

PLATE II

Fig. 1. *Carpoides cyprinus* (Quillback) Dorsal view of intestine with folds spread to show convolutions. O indicates omitted length.

Fig. 2. *Macrostomatobus cyprinella* (Big-mouthed buffalo). Dorsal view of intestine with folds spread to show convolutions. Note that the loops are in the same pattern as in *cyprinus*.

Key for both figures: Oe, oesophagus; st, stomach; an, anal opening.

In *Macrostomatus cyprinella*, a fairly close similarity to *cyprinus* is noted in oesophagus and stomach. The most outstanding difference is in the coiling of the intestine.

The intestine is not as long in proportion to body length as is seen in *cyprinus*, rarely exceeding 3 times the body measurement. As in *cyprinus*, the intestine in *cyprinella* goes straight back from the stomach  $\frac{3}{4}$  of the body cavity length, it then curves to the left and describes a series of longitudinal folds as shown on Plate II. There are no coils in *cyprinella*. The diameter of the intestine is uniform throughout the tract, the walls are thin, and the mucosa is in fine wavy folds.

The liver is the same in shape, color, size, and position as in *cyprinus*. The gall bladder is also in the same position as in the other species, but is not quite so large. This discrepancy is attributed to a shorter intestine.

The spleen also fits the description of *cyprinus*.

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