

## Asymmetry in the trunk vertebrae of *Lota lota lacustris* (Walbaum)

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Received February 28, 1969

BEAMISH, R. J. and SCOTT, W. B. 1969. Asymmetry in the trunk vertebrae of *Lotalotalacustris* (Walbaum). *Can. J. Zool.* 47: 537-538.

The trunk vertebrae of *Lota lota lacustris* are shown to be asymmetrical, having the cavity accommodating the dorsal aorta displaced to the right in the region adjacent to the swim bladder.

*Lota lota*, the burbot or ling, is a holarctic fish and is the only totally freshwater species in the order Gadiformes (Anacanthini). The species inhabits a wide depth range, dwelling in shallow water and streams in spring and winter but having been captured at depths of up to 600 ft during the summer months (Van Oosten and Deason 1938). It may inhabit only shallow water during the early part of its life. Three subspecies have been described, two of which are said to inhabit northern North America.

This note describes the asymmetry of the vertebral column of *Lota lota lacustris* with particular respect to the ventral surface of the column and the cavities which accommodate the kidneys and the dorsal aorta. Twenty-five specimens of burbot of both sexes and of lengths ranging from 43 to 740 mm were obtained from five different areas in Ontario. All showed the asymmetry of the trunk vertebrae described below.

The trunk vertebrae of the burbot (Fig. 1) are quite robust; the centrum is amphicoelous, and the concavities enclose the remains of the notocord. The centrum has three conspicuous cavities in which are lodged the right and left kidney and the dorsal aorta. It is the position of the cavity containing the dorsal aorta (Fig. 1) that causes the asymmetry in the trunk vertebrae.

To identify the structures occupying these cavities, tissue was taken from the 12th, 13th, and 14th trunk vertebrae, sectioned and stained with hematoxylin and eosin. Both kidney tissue and a blood vessel identified as the posterior cardinal vein were present in the right and left dorsal cavities, and only the dorsal aorta was present in the third cavity. This asymmetrical cavity which contains the dorsal aorta is best

described by following the course of the aorta itself. The two roots of the aorta unite to form the median dorsal aorta anterior to the first vertebra (or occasionally at the middle of the first vertebra). The aorta then courses posteriorly along the ventral surfaces of the vertebrae to the right of the midline until at vertebrae 1 to 4, it passes abruptly dorsally and to the right. The cavity accommodating the dorsal aorta (Fig. 1, cavity B) is well formed on the right lateral aspect of vertebrae 4-7 (Fig. 2). This cavity and the contained aorta extend in this right lateral position to vertebrae 17-20 where they course ventrally and to the left. At vertebrae 20-23 this cavity and the contained aorta have assumed a midventral position (Fig. 2). The aorta then passes into the caudal region midventrally. The cavity maintains its midventral position in all the caudal vertebrae.

Transverse sections from burbot of 43 mm, 82 mm, and 138 mm total length were prepared histologically and stained with hematoxylin and eosin. These sections showed the position of the aorta as the centrum develops in the vertebral sections of young *Lota*. Ossification around the notocord is quite evident (Figs. 3, 4, 5).

Bony laminae can be seen radiating ventrally (Figs. 3, 4, 5) from the perichordal ossification. When fully ossified these form the adult centrum. The sections indicate that the cavities for the right and left kidneys are formed between what Schaeffer (1967) describes as the neural and haemal rudiments, or what Jollie (1962) calls the dorsal and ventral arch bases. The lateral cavity containing the dorsal aorta is formed ventral to the right haemal rudiments. The bony laminae that radiate from the perichordal ossification are shorter on the right side adjacent

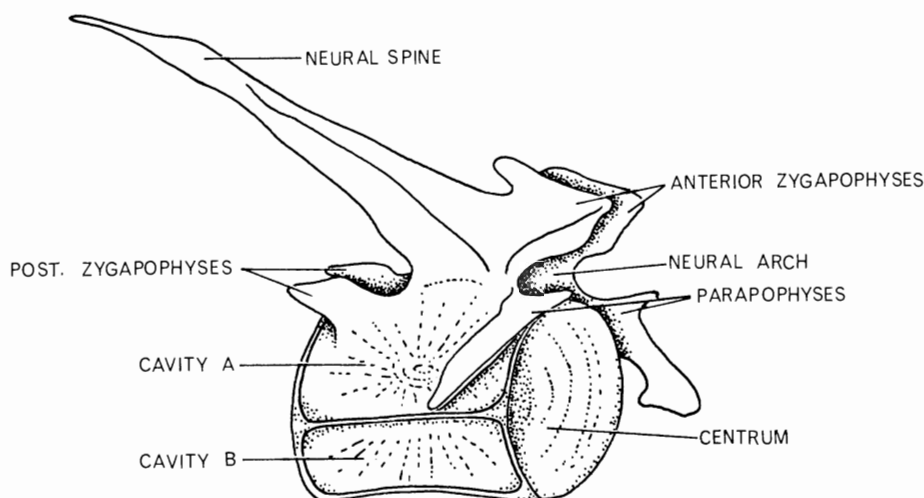


FIG. 1. Diagram of right lateral aspect of abdominal vertebrae. Cavity A contains kidney and cavity B contains the dorsal aorta.

to the dorsal aorta than on the left and hence a depression is formed.

It is evident in both dissection of adults and sections of young that the swim bladder of *Lota* is tightly applied to the vertebral column. The lateral position of the dorsal aorta may be an adaptation toward more efficient circulation. It is noteworthy that the dorsal aorta lies mid-ventrally anterior to the bladder and reassumes that position just at the posterior end of the swim bladder.

#### Acknowledgments

The asymmetrical condition of the vertebral column was drawn to our attention by Mr.

Vianney Legendre, Director, Research Laboratory, Quebec Wildlife Service, who also critically read the manuscript. We are most grateful to him for both services. We are also pleased to acknowledge the critical comments provided by Dr. T. S. Parsons. The drawing was prepared by Peter Buerschaper.

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fig 2

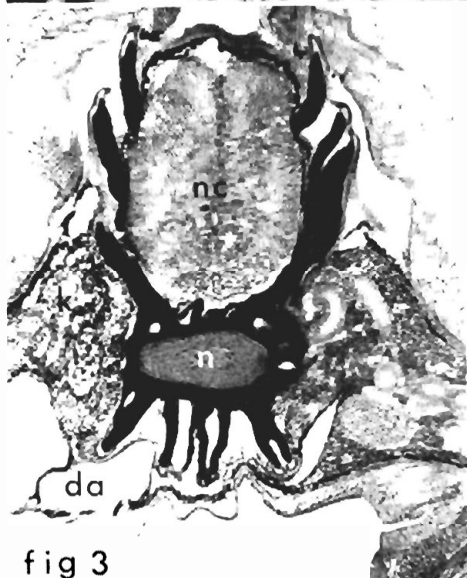


fig 3



fig 5

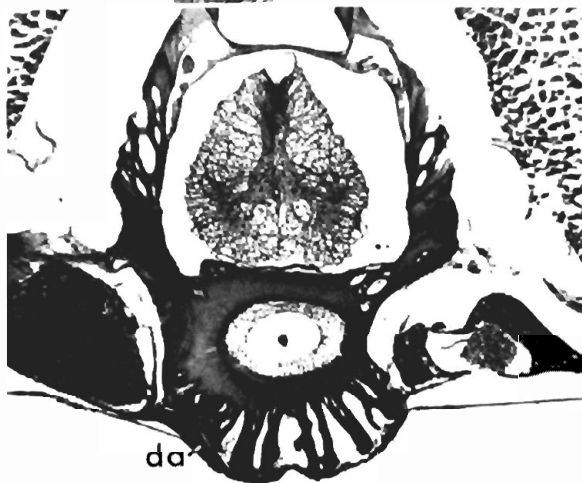


fig 4

FIG. 2. Cleaned vertebral column showing course of the asymmetrical cavity B. The position of the dorsal aorta on the first five vertebrae is outlined in black. FIG. 3. Cross section of an abdominal vertebra from a burbot 43 mm total length. FIG. 4. Cross section of an abdominal vertebra from a burbot 82 mm total length. FIG. 5. Cross section of an abdominal vertebra from a burbot 138 mm total length. *da* = dorsal aorta; *hr* = haemal rudiment; *k* = kidney; *n* = notocord; *nc* = nerve cord; *nr* = neural rudiment; *pc* = posterior cardinal vein.



fig 2

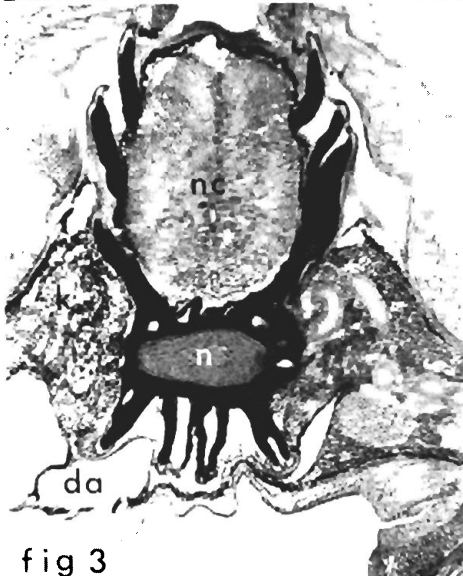


fig 3



fig 5

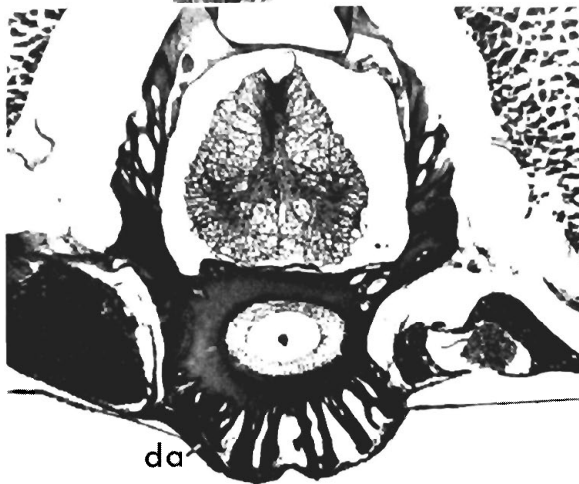


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