The fin-to-limb transition: what does the fossil fish *Hyneria* tell us?

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Hyneria is one of the very first fish of Late Devon, which dwelt on the territory of the modern state of Pennsylvania 370 million years ago. Its maximal length was estimated to 2.5 m and it was considered a top predator fish in its ecosystem. But, the greatest interest for the study of *Hyneria* is in the microanatomical features of its skeleton which are able to shed light on evolutionary transition of fins into limbs.

Hyneria belongs to the tristichopterid family which is closely related to tetrapods (i.e. the group of extant four-legged animals). Regrettably, the fossil bones of this giant fish were found disarticulated and in a limited quantity. This is the reason why it remains difficult to describe the entire skeleton in details. However fortunately, at our disposal there is the fossil of the humerus, the long bone of the upper arm or forelimb that runs from the shoulder to the elbow, which is the key element for the given research project.

The study of anatomical, microanatomical and histological features of the humerus used modern approaches by 3D segmentation of the structures. For this purpose phase-contrast synchrotron microtomography on 3 different levels of resolution and the high-end software VGStudio MAX for the analysis and visualization were applied.

The results of the study were compared with data of a close relative – the most famous and better preserved fish from tristichopterid family *Eusthenopteron*. This fish dwelt on the territory of modern Canada. Thus, by studying the inner organization of the bone tissue and comparative analysis was found that *Hyneria* possessed primitive microanatomical features. This finding serves as a confirmation that this organism was at an early stage of development of four-legged animals. Furthermore, by studying lines of bone growth along with the microanatomical organization of the bone tissue and comparative analysis it was found that the rate of bone growth of *Hyneria* was relatively slow. Moreover, the results suggest that the given fossil humerus belonged to an organism, which was in a transitional developmental stage. This hypothesis was based on the fact that the given fossilized *Hyneria* has demonstrated a mixture of juvenile and adult histological features.

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