

Caudal skeleton of the enigmatic Upper Paleocene xiphioid fish *Hemingwaya sarissa* Sytchevskaya & Prokofiev, 2002: a new interpretation, with some emendations to the diagnosis of the family (Teleostei: Xiphoidea: Hemingwayidae)

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Caudal-fin support of the enigmatic Upper Paleocene xiphioid family Hemingwayidae is redescribed and discussed. Based of new interpretations, several emendations to the diagnosis of this family are provided.

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An enigmatic xiphioid family Hemingwayidae recently described from the Upper Paleocene of Turkmenistan combines numerous primitive and advanced characters in its morphology (Sytchevskaya & Prokofiev, 2002). Among other details, this taxon is characterized by strongly unconsolidated caudal fin support. This archaic feature possibly resembles those in the ancestral form for both scombroids and xiphioids. On the other hand, such a structure perhaps reflects another functional orientation not associated with increase of basic properties of the caudal skeleton, but caused with maintenance of caudal-fin mobility in relation to the rather inflexible body (Sytchevskaya & Prokofiev, 2002: 182-183). Although the caudal skeleton of *Hemingwaya sarissa* is rather well preserved, some its structures are disputable in interpretation. In the present paper, I describe in detail the caudal-fin support of Hemingwayidae and provide some emendations to the diagnosis of this monotypic family.

The material examined was listed by Sytchevskaya and Prokofiev (2002).

Description of the caudal-fin support (Figs 1, 2)

Third and second preural vertebrae (PU-3 and PU-2). The centrum of PU-3 is cylindrical, weakly elongate, possesses a flat medial crest (mcr). The centrum of PU-2 is nearly quadrate in shape,

not elongate, has a medial crest, which is nearly as deep and pointed posteriorly as those on terminal centrum, but becoming flattened anteriorly. Anterior epi- and hypozygapophyses of PU-2-3 are well developed; posterior ones are nearly absent. Neural and haemal apophyses of PU-2 and PU-3 are long, posteriorly inclined (forming an angle of approximately 30° with longitudinal body axis), and fused with centrum. The lateral surfaces of PU-2 and PU-3 have coarse striated sculpture of longitudinally and diagonally running crests. The same striated sculpture formed by longitudinally oriented crests is present on the neural and haemal apophyses.

Terminal vertebra (TC). TC looks like a single element and retains the structure typical of urostylar vertebra. Formerly mentioned "neural" and "haemal spines" (Sytchevskaya & Prokofiev, 2002) are interpreted herein as the posterior ("urostylar") process of TC (ust) and the parhypural (ph), respectively. In most xiphioids (Palaeorhynchidae, Xiphiidae, Istiophoridae), the well-developed posterior process of TC is absent, but it is recently described for the Eocene family Blochiidae (Firestone & Monsch, 2001). The semi-circular element on posterior border of this vertebra described by Sytchevskaya & Prokofiev (2002) as "reduced terminal centrum" is possibly an artifact of preservation. Centrum of TC is massive, quadrate in shape, with strong and deep medial crest, being pointed and convex posteri-

only to forming the parhypurapophysis (phap). Anterior epi- and hypozygapophyses of TC are well developed; posterior ones are absent. Posterior process of TC is thick and apparently long, although only its proximal half is visible, while the distal one is covered by scutes (sc) and bases of outer caudal-fin rays. The visible portion of posterior process approximately half as high as vertebral centrum. The base of posterior (“urostylar”) process is opposed to the base of parhypural, and these elements are much less posteriorly inclined than previous neural and haemal spines, forming an angle of approximately 50–60° with longitudinal body axis. The sculpture of posterior process of TC and parhypural is the same as on previous neural and haemal spines. The parhypural is fused with terminal centrum, possesses a semicircular notch representing an opening for the caudal part of aorta (fca).

Hypurals. There are two (epaxial and hypaxial) hypural elements (hp) and no hypural notch in caudal skeleton. The hypurals is rather small, only 1.6 times as long as centrum of TC. The hypaxial hypural is wide, formed by incompletely fused hypurals 1 and 2. The trace of fusion (tf) of first and second hypurals looks like a flattened crest. The epaxial hypural is of the same width, but has much less conspicuous suture of fusion. In contrast to previous interpretation by Sytchevskaya & Prokofiev (2002), I suppose that the epaxial hypural is formed by hypurals 3 and 4 (instead of 4 and 5), while rod-like “element” (rl) treated earlier as “hypural-3” is interpreted by me as a fragment of the epaxial hypural. Its complete separation is possibly a result of longitudinal split of the epaxial hypural. This viewpoint is supported by the absence of any variants of hypural-5 (at least as cartilage in early ontogenetic stages) in the istiophorids (Potthoff et al., 1986), which are hypothesized as a sister taxon for the hemingwayids (Sytchevskaya & Prokofiev, 2002). In xiphiids, the fifth hypural is present as small cartilaginous element in earliest stages; however, in *Hemingwaya* both components of the epaxial hypural are nearly equal in size in adults. The sculpture of hypural elements represents rather fine longitudinally arranged crests.

I do not confirm the presence of separated narrow element along upper margin of the epaxial hypural, which, according to its position, was noted in the original description as “uroneural” (Sytchevskaya & Prokofiev, 2002: fig. 4d). As shown by additional preparation, the dorsal portion of the epaxial hypural was misidentified as

a separated element due to the presence of a rather distinct crest in this site (cr), as well as by some extension of its antero-dorsal corner.

Caudal-fin rays. The caudal fin is hypurosteagal. Outer lower-lobe principal rays cross the hypural fan on approximately three-fourths of length of the latter, and the upper-lobe ones extend slightly more anteriorly. Innermost caudal-fin rays cross the hypural fan on approximately half-length of the latter (most of them were removed during preparation). Caudal-fin rays 18+15 in number, of which 9+7 are procurrent ones.

Other characters. In addition, very slim ribs are found on the postanal vertebrae at mid-body in paratype nr. 4782/93. In all the other specimens, they are not visible due to exclusively extensive development of external scutes. Thus, the number of abdominal vertebrae is possibly the same (approximately 15–20) as of caudal ones. By this fact, the anal fin is dramatically penetrated anteriorly in the abdominal region. But all the anal-fin pterygiophores observable are similarly small, short and leaf-like, and anteriorly directed, which is very unusual for xiphioids.

As a consequence, I propose the following emendations to the original diagnosis of the family Hemingwayidae:

Caudal-fin skeleton as shown in Figs 1, 2. Number of abdominal vertebrae nearly the same as of caudal ones. Anal fin strongly penetrated in abdominal region. Preanal vertebrae up to 8 in number.

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