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OSTEOLOGICAL AND MORPHOLOGICAL ANALYSIS OF THE SCABBARDFISH *ANENCHELUM GLARISIANUM* BLAINVILLE, 1818 (TRICHIURIDAE) FROM THE MENILITIC FORMATION OF THE MORAVIAN PART OF THE WEST CARPATHIANS (OLIGOCENE, RUPELIAN)

OSTEOLOGICKÁ A MORFOLOGICKÁ ANALÝZA DRUHU *ANENCHELUM GLARISIANUM* BLAINVILLE, 1818 (TRICHIURIDAE) Z MENILITOVÉHO SOUVRSTVÍ MORAVSKÉ ČÁSTI ZÁPADNÍCH KARPAT (OLIGOCÉN, RUPEL)

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Abstract

Gregorová, R. 2010: Osteological and morphological analysis of the scabbardfish *Anenchelum glarisianum* BLAINVILLE, 1818 (Trichiuridae) from the Menilitic Formation of the Moravian part of West Carpathians (Oligocene, Rupelian). – Acta Mus. Moraviae, Sci. geol., 1, 95, 141–149, Brno (with Czech summary).

Osteologická a morfologická analýza druhu Anenchelum glarisianum BLAINVILLE, 1818 (Trichiuridae) z menilitového souvrství moravské části Západních Karpat (Oligocén, rupel).

A detailed osteological and anatomical analysis of the abundant articulated and disarticulated skeletons of *Anenchelum glarisianum* BLAINVILLE, 1818 was undertaken. Restoration of the validity of the fossil genus *Anenchelum* referred previously to recent genus *Lepidopus* GOUAN, 1770 published by BANNIKOV and PARIN (1995) was confirmed herein on the fossil material from the Moravian part of the Menilitic Formation. It also allowed us to enhance our knowledge of the osteology and morphology of this taxon.

Key words: Menilitic Formation, Carpathians, *Anenchelum*, Trichiuridae, Oligocene, Rupelian.

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Introduction

Fossil remains of the scabbardfish *Anenchelum glarisianum* BLAINVILLE, 1818 are very abundant in the fish assemblage from the Menilitic Formation of the Carpathians. The first notification from the Moravian part came from HECKEL (1849–1850); he describes them as *Lepidopides leptospondylus* and *Lepidopides dubius* from the Nikolčice locality. Subsequent field research in the last century confirmed its presence at all known localities of Dynów Marsltone (the middle part of the Menilitic Formation), (GREGOROVÁ 1997).

According BANNIKOV and PARIN (1995) almost all fossil scabbardfishes were recorded in the Tethys and Paratethys regions, dating from Eocene – Pliocene. The most ancient species *Lepidopus eocaenicus* was described by DANILTSHENKO (1962) from the Dabakhan Formation of Georgia and *Anenchelum paucivertebrale* from the Kumsky Ho-

rizon of the Northern Caucasus by BANNIKOV and PARIN (1995); both from the Middle Eocene. From the Oligocene of the Carpathians and Alps around ten species were described that have been synonymised (WOODWARD 1901, PAUCA 1930, DANILTSHENKO 1960, JERZMANSKA 1968, KALABIS, 1975 b) with *Lepidopus glarisianus* (BLAINVILLE). This species was originally described in the fossil genus *Anenchelum*. However, WETTSTEIN (1886) and WOODWARD (1901) synonymized *Anenchelum* with *Lepidopus*, which has been accepted by subsequent authors. The reason for this initial plurality of species name is without doubt the fact, that fossil records of this elongated fish are very often fragmentary. BANNIKOV and PARIN (1995) revised the generic position of the fossil scabbardfish from the Tethys and Paratethys and restored the original name *Anenchelum* as a member of the subfamily Aphanopodinae. According to these authors, it is most likely that *Anenchelum* also includes Oligocene species *Lepidopus brevicauda* (RATH) from Switzerland, *Lepidopus hungaricus* BÖHM from Hungary, *Lepidopus angustus* DANILTSHENKO from the Caucasus (DANILTSHENKO 1980, DZHAFAROVA 1988) and early Miocene *Lepidopus lednevi* MENNER. The middle Miocene *Lepidopus lateralis* DANILTSHENKO of East Paratethys and more recent species belongs to *Lepidopus* (BANNIKOV and PARIN 1995).

Abbreaviation
Ar = articular, Cl = cleithrum, Cor = coracoid, De = dentary, Fr = frontal, Hy = hyomandibula, Iop = interopercle, Mtp = metapterygoid, Mx = maxilla, Op = opercle, Pmx = premaxilla, Pt = pterygoid, Qu = quadratum, Sop = subopercle

Order Perciformes
Family Trichiuridae RAFINESQUE, 1810
Subfamily Aphanopodinae GILL, 1863

The following characters permit the referral of our specimens to the subfamily Aphanopodinae (TUCKER 1956): orbits entering upper profile of head, lower hind margin of operculum convex, snout gently sloping; head profile rising very gradually from tip of snout to origin of dorsal fin without forming a sagittal crest, a notch between the spinous and soft part of dorsal fin; spinous part of dorsal fin shorter than soft part.

Genus *Anenchelum* BLAINVILLE, 1818

Anenchelum glarisianum BLAINVILLE, 1818
Photos 1–11

1818. *Anenchelum glarisianum* BLAINVILLE, p. 314 (non vidi, fide WETTSTEIN, 1886).
1850. *Lepidopides leptospondylus* HECKEL, p. 239.
1886. *Lepidopus glaronensis* (BLAINVILLE), WETTSTEIN, p. 42, pl. 5, figs. 1, 3, 5, 10, pl. 6, figs. 1, 3, 5, 6, 7, 8.
1958. *Lepidopus glarisianus* – BLAINVILLE, 1818, JONET, p. 58, pl. 6, fig. 2 (cum syn.).
1975. ? *Lepidopus glarisianus* (BLAINVILLE, 1818), KALABIS, fig. 2.
1977. *Lepidopus glarisianus* BLAINVILLE, 1818, CIOBANU, p. 119, pl. 40, fig. 1.
1977. ? *Anenchelum glarisianum* BLAINVILLE, 1818, CIOBANU, p. 120, pl. 41, fig. 1, 2.
2003. *Anenchelum glarisianum* BLAINVILLE, 1818, GREGOROVÁ and POŽÁR, p. 200, fig. 5, photos 8, 9, 10.

Material: Litenčice locality Ge29506, Ge29569, Ge29780, Ge29823, Ge29824, Ge29826, Ge29827, Ge29828, Ge29829, Ge29830, Mouchnice locality Ge29825, Nítko-

vice locality Ge29403, Ge29404, Ge29405, Ge29832, Jestřabice locality Ge29833, Kožušice locality Ge29406.

All specimens come from the Dynów Marlstone, which corresponds to the Nannoplankton zone NP 23.

The following characters allow to range the specimens to the *Anenchelum glarisianum* Blainville, 1818: spinous dorsal fin long with 35 rays and with 76–77 soft rays – slightly more numerous (2–4) than oposite caudal vertebrae; 33–35 abdominal and 74 caudal vertebrae; additional dorsal pterygiophores in the interneural spaces intercalated among the main series and unrelated to neural spines of vertebrae.

Formula: Vert: 109 (33 –35 +75), ID 35, IID 74–77, A II+68, V I , P 15–17

Description:

Comment: Due to the fragmentary nature of the studied material some length parameters are estimated according to the relative values counted from the complete skeletons.

Body very elongated, strongly compressed, with very slender caudal peduncle. Size of the specimens ranges from 1 350 mm (Ge29823, estimated) to 90 mm (Ge29824). Maximum body depth is just behind the head and represents 5.6 % of Standard Length (specimen Ge29824). Head elongated, its length is one seventh of the animal's Standard Length and more than twice as long as the depth of its head. Owing to the narrowness of the frontal bones, the orbit is situated close to the dorsal profile of the head; its horizontal diameter represents about 22 % of Head Length. Preorbital distance is always less than postorbital. Caudal part of the body represents about 57 % of Standard Length (Ge29824). Dorsal fin divided into spinous and soft part near the separation of the abdominal and caudal part of the body; the base of the soft part is longer than the base of the spinous part. Anal fin with a strongly enlarged (at least in the juvenile) spine at the origin (preanal spine) and at least 68 soft rays; first anal pterygiophore (interhemal) considerably larger than subsequent ones, but not separated from them by an enlarged space.

Osteology

Skull (Photo 1): Osteology of the skull is based primarily on the specimens Ge29826, Ge29830. Neurocranium low and narrow. Frontal straight or very weakly convex, supraoccipital crest low. The slender parasphenoid projects into the lower part of the orbit.

Lower jaw

Dentary (Photo 2): Dentary is narrow in its anterior part but continuously increases in height posteriorly. There are two caniniform teeth on the anterior part of the bone. They are oval in cross section, with a tapered anterior margin; on the posterior margin near the tip they have a cutting edge. A small typical notch is below in lateral view on the caniniform tooth. Other dentary teeth are lanceolate, flattened, the last fifth of the toothed margin of the bone is toothless. There are 13 teeth until the first caniniform tooth (counted from the back). Articular large with low articular process.

Upper jaw (Photo 3)

Maxilla: Maxilla is sheathed by the preorbital, closely connected to premaxilla, somewhat enlarged posteriorly, does not extend to the vertical part of the anterior edge of the orbit.

Premaxilla: The bone is large in its anterior part, with a low ascending process, slightly curved. As in the lower jaws in the anterior part of the premaxilla inside the tooth row, there are two strong caniniform teeth separated by a distance shorter than their length.

Photo 1. *Anenchelum glarisianum* BLAINVILLE, 1818, Frontale, Parasphenoid (Ge29406)

Photo 2. *Anenchelum glarisianum* BLAINVILLE, 1818, Dentary, Articular (Ge29404)

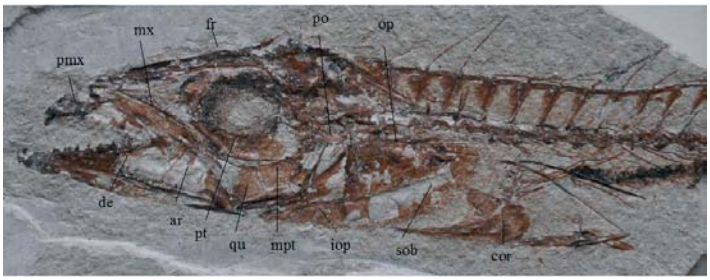

Photo 3. *Anenchelum glarisianum* BLAINVILLE, 1818, (Ge29826)

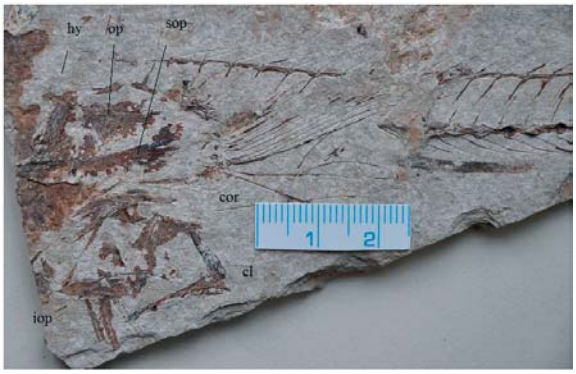

Photo 4. *Anenchelum glarisianum* BLAINVILLE, 1818, (Ge29830)

They are longer than the caniniform teeth of the lower jaw. Other teeth are in shape and size similar to lower jaw teeth.

Quadrate (Photo 3): The quadrate is a triangular bone, thickened and prolonged along the posterior edge, with the base dorsal and abutting against the metapterygoid.

Metapterygoid (Photo 3): The metapterygoid is a broad sheet of bone which forms a portion of the roof of the posterior part of the mouth. Anteriorly and dorsally the metapterygoid abuts against the pterygoid.

Hyomandibula (Photo 4): The hyomandibula is short irregularly shaped bone, its two heads articulating with the cranium and its opercular process ending in an articulation for the opercle.

Photo 5. *Anenchelum glarisianum* BLAINVILLE, 1818, Opercle (Ge29569)

Photo 6. *Anenchelum glarisianum* BLAINVILLE, 1818, Subopercle (Ge29832)

Photo 7. *Anenchelum glarisianum* BLAINVILLE, 1818, Cleithrum (Ge29403)

Photo 8. *Anenchelum glarisianum* BLAINVILLE, 1818, Coracoid (Ge29833)

Opercular bones (preopercle, opercle, interopercle, subopercle), (Photos 5, 6): The preopercle is moderately wide and slightly curved. The interopercle is an oval bone, pointed in its anterior part. The opercle is low, strongly elongated, with a rounded posterior edge and a shallow notch above. Along the lower edge, the opercle is bordered by an elongate and wing-like subopercle. The free margin of the subopercle is convex, as in Aphanopodinae and Lepidopodinae.

Pectoral girdle (Photo 7, 8): The cleithrum is large, curved in the upper third at nearly a right angle; and has a flat pointed process. A large scapula and rounded coracoid are situated posteroventral to this process. The lower edge of the coracoid corresponds to the ventral profile of the body. Above, it is joined to the base of the pectoral fin. The ventral postcleithrum is narrow and rib shaped, directed posteroventrally from the upper edge of the scapula.

The pectoral fin is elongated; the rays are extremely long, their distal end reaching as far back as the 15th vertebra (across the length of 11 vertebrae). The upper rays of the pectoral are shorter; therefore the fin is pointed in its ventral part.

Ventral fin: The articulation of the pelvic girdle is markedly posterior to the pectoral fin base as mentioned also by Bannikov and Parin (1995). The fins are reduced to two small flattened triangular spiny elements without soft rays. In the specimen Ge29826, the pelvic bone and fins are completely preserved. The pelvic bone is one third longer than the pelvic spine that corresponds almost to two vertebrae situated above. In the very small specimen (Ge29831) the pelvic spine is comparatively much longer, and corresponds to 7–8 vertebrae.

Photo 9. *Anenchelum glarisianum* BLAINVILLE, 1818, Vertebral column in the abdominal and caudal region (Ge29780)

This is an example of allometric growth in this animal, as the spines are generally more developed in the juvenile and young specimens of this species, than in the adults.

Vertebral column (Photo 9): There are 34–35 abdominal (based on specimens Ge29780, Ge29824, Ge29828) and 74–75 caudal vertebrae (Ge29780, Ge29824). They are tapered in the middle and shortened in the caudal peduncle. The abdominal part of the vertebral column represents less than 50 % of the length of the caudal section. The first abdominal vertebra starts above the vertical of the praeopercle as well as the origin of the spiny dorsal fin. The neural and haemal spines of the vertebrae are slender, pointed, inclined posteriorly and reach the body profile. The slope of the neural spines is usually less than that of the haemal spines. The neural spines of the first four anterior vertebrae are flattened. The spines of the vertebrae of the caudal peduncle are very short and directed back. The three last vertebrae form the caudal skeleton, the hypural plate is mostly covered by the split proximal ends of the caudal fin rays. Ribs short, slender, strongly inclined back. No epineurals and parapophyses were observed in the material.

Photo 10. *Anenchelum glarisianum* BLAINVILLE, 1818, Additional dorsal pterygiophores (Ge29823)

Dorsal fin (Photo 10, 11): The dorsal fin is composed of spiny and soft parts and is divided by a characteristic notch. There are 35 spiny and 75 soft dorsal fin rays. The spiny dorsal fin starts at the vertical part of the preopercle and ends in the region of the end of the abdominal part of the vertebral column. In the specimen Ge29823 there is a section with the two last spiny dorsal rays and the first soft rays preserved. The first soft ray is 1, 5 times and the second soft ray 1, 8 times longer than the last spiny dorsal ray. This is one of the important characteristics that allow referral of our specimens to the subfamily Aphanopodinae. The soft rays are branched into longitudinal halves.

The dorsal pterygiophores are hook-shaped, with a horizontal base following the dorsal profile of the body and lanceolate proximal part, that forms an angle with the base and, as a rule, touches the neural spine. Usually one dorsal pterygiophore corresponds to one neural spine. But in the region of the middle of the body two additional pterygiophores are placed in the interneural spaces, and therefore the number of dorsal fin rays is somewhat higher than the number of corresponding vertebrae. The first inserted

pterygiophores are between 3rd and 4th, second between 8th and 9th and the third between 11th and 12th caudal vertebrae (Ge29780, Ge29824).

The additional pterygiophores, unrelated to the neural spines of the vertebrae, are typical for the members of the subfamily Aphanopodinae (TUCKER 1956). As such, the longer spiny dorsal fin divided by a characteristic notch from he soft dorsal fin, combined with the presence of the additional pterygiophores, prohibit the taxonomic referral of this taxon to the recent genus *Lepidopus*.

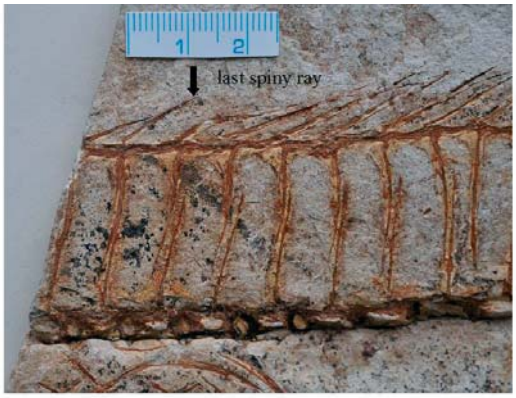

Photo 11. *Anenchelum glarisianum* BLAINVILLE, 1818, Division of spiny and soft dorsal fins (Ge29823)

Anal fin (Photo 9): In the Trichiuridae at the origin of the anal fin, there are two spines represented by the notation i+I: of these, the anterior is a minute spinule while the second is enlarged as a keel scute or as a stout spine. In our material the first spine is not observable. The second anal spine is well developed. We see the same phenomenon in the keel scutes of the pelvic fin. In the small (in juvenile specimens the spine is more developed than in the larger specimens).

There are 68 soft rays; in the anterior part of the anal fin they are very short, in the posterior part they are longer. Pterygiophores of the anal fin in terms of structure and size are equivalent to those of dorsal fin. The first anal pterygiophore is enlarged. *Anenchelum* is similar to *Lepidopus* in the absence of a visible gap, very characteristic of the Aphanopodinae, between the first and second interhemals. Anal fin terminates under the end of the dorsal fin.

Caudal skeleton and fin: Three last vertebrae bear the caudal fin, which is relatively small, and forked. A bifid hypural plate supports the caudal fin; there are I, 8–7, I rays.

Paleoecology

Anenchelum is a representative of the subfamily Aphanopodinae which includes two extant genera *Aphanopus* and *Benthodesmus*, that can be considered as benthopelagic with a depth range from 200 up to1700 m. For example, *Aphanopus* is mesopelagic as juveniles and bathypelagic when mature. They migrate to midwater depth at night and feed on crustaceans, cephalopods and fishes (mostly macrourids, morids and alepocephalids). They are mature at 80 to 85 cm SL (NAKAMURA and Parin 1993). Our fossil specimens come from the adults and juveniles. It fits very well with the similar ecology of the gonostomatids and myctophids that are together with *Anenchelum* very frequent in the Dynów Marlstone of the Menilitic Formation. In contrast to the representatives of the subfamily Aphanopodinae, the recent genus *Lepidopus* lives in the epipelagic environment. As such this systematic revision helps to support the hypothesis of deep sea conditions in the Paratethys basin during the sedimentation of the Dynów Marlstone.

Souhrn

Detailní osteologická a morfologická analýza fosilního artikulavaného a disartikulovaného materiálu prokázala platnost restorace fosilního rodu *Anenchelum* ruských autorů

Bannikova a Parina (1995). Tento taxon byl velmi dlouho řazen k recentnímu rodu *Lepidopus*. Delší tvrdá dorsální ploutev, oddělená zářezem od měkké části dorsální ploutve a přítomnost přídavných pterygioforů dorsální ploutve v mezineurálním prostoru vylučuje taxonomickou příslušnost tohoto taxonu k recentnímu rodu *Lepidopus*.

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