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AN ANNOTATED LIST OF THE OLIGOCENE FISH FAUNA FROM THE OSÍČKO LOCALITY (MENILITIC FM.; MORAVIA, THE CZECH REPUBLIC)

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Abstract. The present article provides an annotated list of the Oligocene fish fauna from the Menilitic Formation of a new Osíčko locality (Silesian Unit), collected from two different parts of the formation, i.e., Subchert Member and Dynów Member. The specimens were classified as *Keasius* sp., Elasmobranchii gen. et spec. indet., *Scopeloides glarisianus*, *Sardinella sardinites*, Clupeidae gen. et spec. indet., *"Glossanodon" musceli*, *Anenchelum glarisianum*, and Perciformes gen. et spec. indet. The composition of the assemblage suggests meso- to benthopelagic environments.

■ Elasmobranchii; Teleostei; Oligocene; Moravia; Menilitic Formation.

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Introduction

The Menilitic Formation is a distinctive lithostratigraphic unit represented by Lower Oligocene (Rupelian) sediments originated from the Paratethys area. These sediments, developed in the Ždánice, Subsilesian and Silesian Units, are exposed at many Moravian localities (and other parts of the Western Carpathians) and have yeilded numerous fish fossils (for reviews see e.g., Roth 1981, Stráník 1981).

Research on these fossil fish began in the 19th centuary – the oldest reference is possibly Heckel (1850) and is still continuing at the present time. They are represented by many Teleostei and Selachii families (for a review and complete list of the references see Kalabis (1981) and Gregorová (2011)).

Even after such long-term research new localities may provide information which can support (or occasionally contest) previous generally accepted results and ideas. The main goals of this contribution are: to briefly describe specimens from the Osíčko locality and comment on them within the context of other Moravian fish localities.

Material and methods

Specimens were collected in 2011 from the new Osíčko locality which is situated in the south of the village of Osíčko. The outcrop is discontinuously exposed on the right bank of the Moštěnka Creek (text-fig. 1; 49° 24' 50.761294'' N, 17° 45' 14.2363071'' E). The deposition is represented by sediments of the Menilitic Fm. (Silesian Unit, Menilite-Krosno Group of nappes) and specimens were collected from two collecting points (text-fig. 1C; P1 and P2). The sediments at point P1 are represented by grey to grey-brown claystones, and calcareous shales corresponding to the Subchert Member. Point P2 is situated at a higher stratigraphical position with exposed light brown marlstones (their lithology is typical for the Dynów Member). For details regarding the geology and sedimentology of the formation see Stráník (1981), Krhovský et al. (2001), and Švábenická et al. (2007).

The fossils are preserved in the bedding planes (rarely in the middle of the sediment layer) and they are occasionally accompanied by ichnofossils, such as regurgitates, coprolites and traces of burrowing (the ichnofossils are not described herein).

The specimens were left unprepared, or with only slight mechanical preparation using needles. They are housed in the collection of the National Museum, Prague (NM) under the following numbers: Pc 02870 – Pc 02892.

Abbreviations: SL – standard length.

Systematic palaeontology

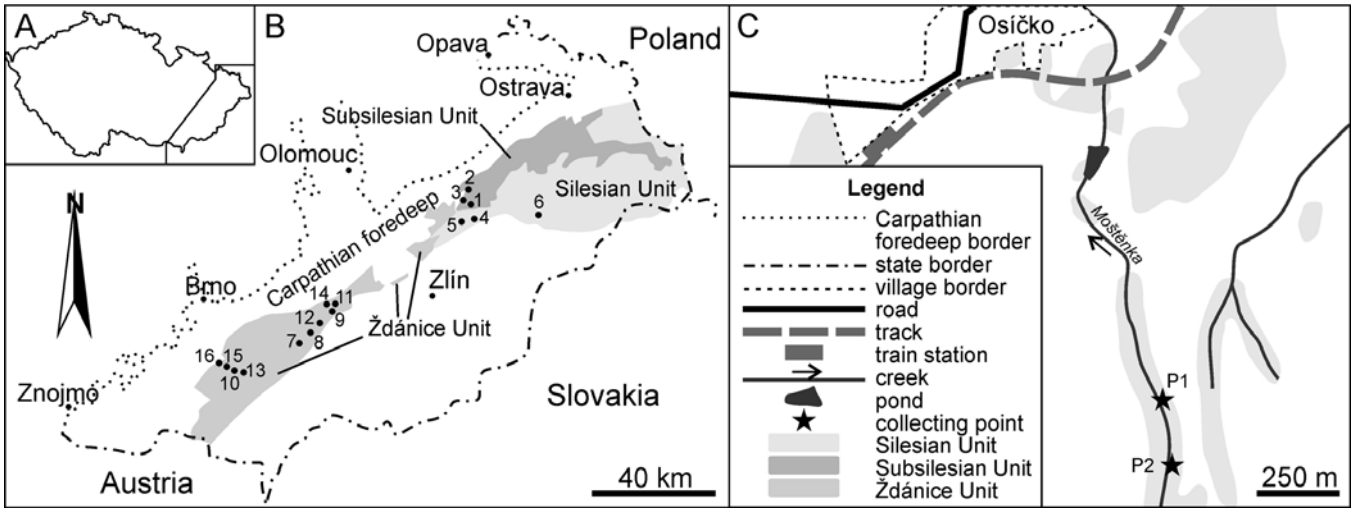
Family **Cetorhinidae Gill, 1862**

Genus ***Keasius* Welton, 2013**

***Keasius* sp.**

M a t e r i a l : NM Pc 02878a, b, Pc 02879; collected from the Dynów Mb.

R e m a r k s : The specimens are represented by well preserved distal parts of isolated branchiospines, their half-elliptical bases are preserved only as an imprint on the surface of the sediment. Due to incomplete preservation, the specimens are classified using open nomenclature.



Text-fig. 1. The geographic position of the localities mentioned in the text. A – position within the Czech Republic. B – Detailed map of the area. Subsilesian Unit: 1 – Kelč, 2 – Špičky, 3 – Horní Těšice; Silesian Unit: 4 – Loučka, 5 – Osíčko, 6 – Rožnov pod Radhoštěm; Ždánice Unit: 7 – Bohuslavice, 8 – Jestřabice, 9 – Kožušice, 10 – Křepice, 11 – Litenčice, 12 – Mouchnice, 13 – Nikolčice, 14 – Nítkovice, 15 – Nosislav, 16 – Židlochovice. The distribution of the units according to Čtyřoký and Stráník (1995). C – map of the Osíčko vicinity with distribution of the Silesian Unit sediments (gray spots) and collecting points (P1 and P2). The distribution of the Silesian Unit sediments according to Stráník (1999).

The Oligocene – middle Miocene branchiospines were traditionally classified in the genus *Cetorhinus* BLAINVILLE, 1816, in particular as *C. parvus* LERICHE, 1910. Welton (2013), however, transferred this species into the new genus *Keasius*. The specimens were found in many Moravian localities, namely Kelč, Špičky, Litenčice, Nikolčice, Mouchnice, Rožnov pod Radhoštěm, and Nítkovice (Kalabis and Schultz 1974, Kalabis 1975a, b, Schultz 1982, Gregorová 1988, 2011, 2012, Gregorová and Požár 2003).

Branchiospines are usually found mainly as isolated elements, but articulated specimens are also known (see Hovestadt and Hovestadt-Euler 2012). The recent *C. maximus* (GUNNERUS, 1765) is a coastal pelagic and semi-oceanic filter-feeder of the boreal to warm-temperate waters (Compagno 2002); the distribution in the water column is usually in the range of 200 to 2000 m, but they have also been sighted in the surface waters and in the oceanic basins at 2000 to 4000 m (Compagno 2002).

Elasmobranchii gen. et sp. indet.

Text-fig. 2A

M a t e r i a l : NM Pc 02876a, b, Pc 02883a, b, Pc 02884, Pc 02885; collected from the Dynów Mb.

R e m a r k s : The specimens are represented by isolated amphicelous vertebrae. They appear as rounded objects with a small notochordal foramen in the middle region. The maximum size does not exceed 9 mm in diameter. They are distributed in several strata of the Dynów Mb., usually accompanied by ichnofossils and remains of "*Glossanodon*" skeletons. Due to the lack of any other preserved morphological features, more exact determination is not possible. Isolated elasmobranchian vertebra centrae were described only from the Litenčice locality in the Moravian region as *Keasius parvus* and ?*Carcharias* sp. (Gregorová 2011).

Family **Gonostomatidae GILL, 1893**

Genus ***Scopeloides* WETTSTEIN, 1886**

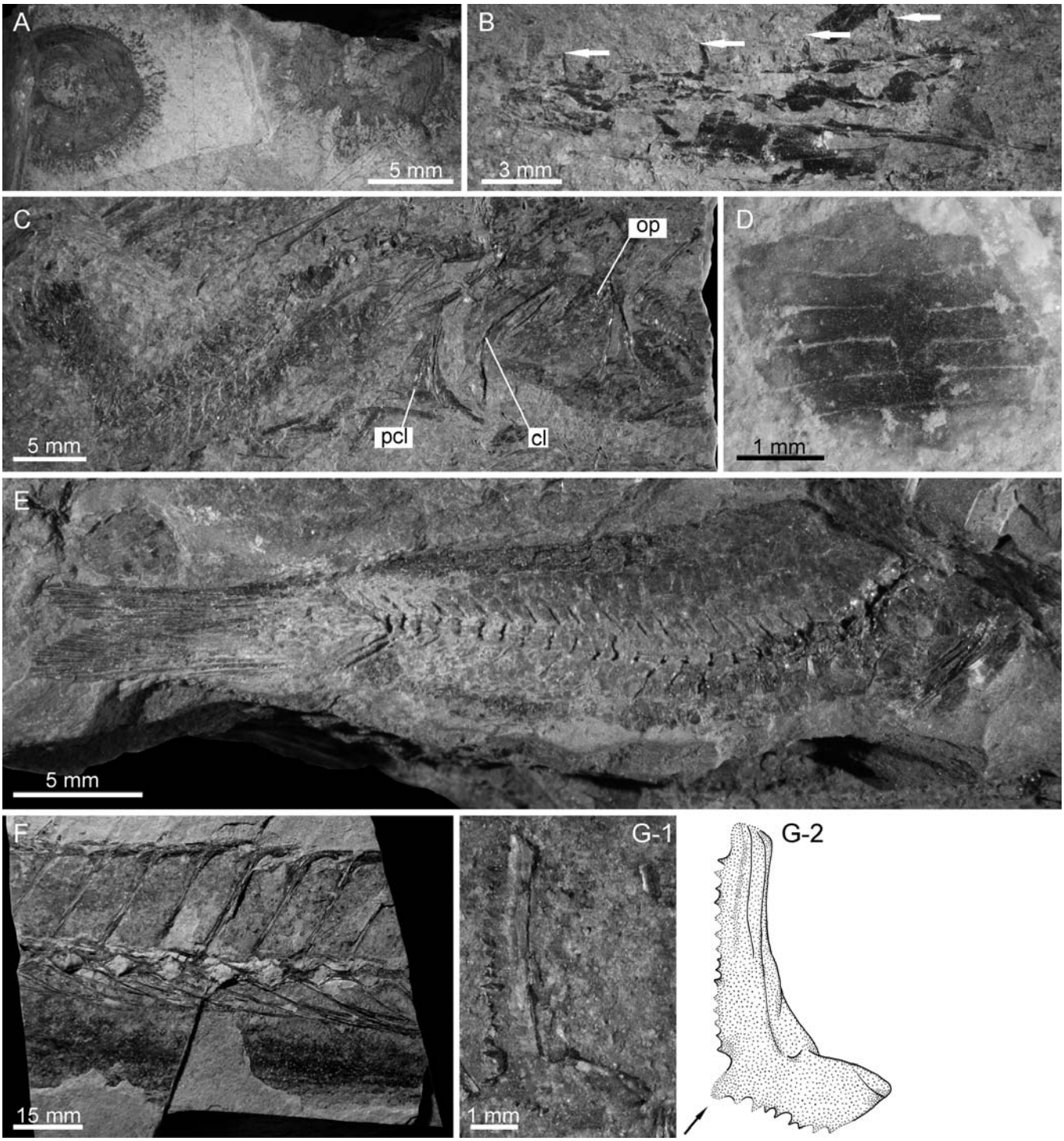
***Scopeloides glarisianus* (AGASSIZ, 1844)**

Text-figs 2B, C

1844 *Osmerus glarisianus*; Agassiz, vol. 5, p. 102, tab. 62, figs 3–4.
1886 *Scopeloides glaronensis* (AGASSIZ); Wettstein, p. 56, taf. 2, figs 7–13.
1901 *Scopeloides glarisianus* (AGASSIZ); Woodward, p. 255.
1908 *Thrissopteroides ? minutus*; Priem, p.6, pl. 1, figs 5–6.
1908 *Copeichthys morgani*; Priem, p. 8, pl. 1, figs 9–11.
1929 *Mrazecia mrazeci*; Paucă, p. 115.
1934 *Mrazecia mrazeci* PAUCĂ; Paucă, p. 608, text-figs 10–11, pl. 2, figs 4–5, pl. 3, fig. 6.
1948 *Scopeloides glarisianus* (AGASSIZ); Kalabis, p. 136, pl. 1, fig. 1.
1960 *Scopeloides glarisianus* (AGASSIZ); Danilchenko, p. 27, text-fig. 3, pl. 2, fig. 1.
1967 *Scopeloides glarisianus* (AGASSIZ); Arambourg, p. 43, text-figs 14, 15, 17, pl. 2, figs 2–7, 9.
1968 *Scopeloides glarisianus* (AGASSIZ); Jerzmańska, p. 395, text-fig 3.
1977 *Scopeloides glarisianus* AGASSIZ; Ciobanu, p. 67, pl. 16, fig. 1.
1977 *Scopeloides paucai*; Ciobanu, p. 68, pl. 17, fig. 1.
1989 *Scopeloides glarisianus* (AGASSIZ, 1844); Gregorová, p. 89, pl. 7.
1989 *Scopeloides* sp.; Gregorová, p. 89, pl. 1, fig. 1.
1997a *Scopeloides glarisianus* (AGASSIZ); Gregorová, p. 124, text-figs 1–5, pl. 1, figs 1–5, pl. 2, figs 1–6.
2005b *Scopeloides glarisianus* (AGASSIZ); Prokofiev, p. S99, figs 5–6.
2011 *Scopeloides glarisianus* (AGASSIZ); Gregorová, p. 9, pl. 3, fig. 2.

M a t e r i a l : NM Pc 02887a, b, Pc 02888; collected in the Subchert Mb.

R e m a r k s : The species is represented by isolated dentary and a disarticulated skeleton at the locality. Although



Text-fig. 2. A – Elasmobranchii gen. et spec. indet. specimen NM Pc 02876b; B – *Scopeloides glarisianus* dentary NM Pc 02888 (the white arrows mark the tips of the "fang-like" teeth); C – *S. glarisianus* disarticulated skeleton NM Pc 02887a; D – *Sardinella sardinites* scale NM Pc 02886; E – Clupeidae gen. et spec. indet. articulated skeleton without head NM Pc 02889; F – *Anenchelum glarisianum* body fragment NM Pc 02880a; G – Percoidei gen. et sp. indet. preoperculum (G-1) and its interpretation (G-2) NM Pc 02891. The arrow shows the enlarged spine in the angle between rami verticalis and horizontalis. Abbreviations: cl – cleithrum; op – operculum; pcl – postcleithrum.

the dentary is crushed, it is possible to recognize its low elongated shape with typical dentition: small teeth alternate with large teeth (their tips are marked by white arrows in text-fig. 2B). The disarticulated skeleton consists of only 15 vertebrae (others are not preserved) and a strongly disarticulated head and pectoral girdle bones. The specimen was determined on the basis of morphology of the cleithrum, the postcleithrum, and organization of the caudal skeleton. Other morphological data are not sufficiently preserved. The species was found at the Moravian localities Bohuslavice, Kelč, Špičky, Horní Těšice, Mouchnice, Litenčice, Nikolčice, Nosislav, Židlochovice, Křepice, Rožnov pod Radhoštěm, and Loučka (Kalabis 1948, 1975a, b, Kalabis and Schultz 1974, Gregorová 1988, 1989, 2011, Přikryl et al. 2012 and unpublished data).

The species was characterized as mesopelagic or bathypelagic (Prokofiev 2005b or Jerzmańska 1968 respectively), similar to the recent genus *Gonostoma*.

Family **Clupeidae Bonaparte, 1831**

Genus ***Sardinella* Valenciennes, 1847**

***Sardinella sardinites* (Heckel, 1850)**

Text-fig. 2D

1850 *Meletta sardinites*; Heckel, p. 227, pls 23–24.
1850 *Meletta longimana*; Heckel, p. 231, pl. 25.
1850 *Meletta crenata*; Heckel, p. 233, pl. 26.
1901 *Clupea crenata* (Heckel); Woodward, p. 151.
1901 *Clupea sardinites* (Heckel); Woodward, p. 152.
1934 *Clupea longimana* (Heckel); Paucă, p. 601, pl. 1, figs 3a–3b, pl. 5, figs 2, 5.
1934 *Clupea sardinites* (Heckel); Paucă, p. 603, pl. 1, fig. 1.
1938 *Clupea sardinites* Heckel; Weiler, p. 11.
1958 *Clupea longimana* Heckel; Jonet, p. 36, pl. 3, figs 6, 9, 11.
1958 *Clupea sardinites* Heckel; Jonet, p. 37, pl. 4, figs 4–5, 10, pl. 8, fig. 8.
1960 *Clupea sardinites* Heckel; Jerzmańska, p. 371, pl. 5, fig. 1, pl. 6, fig. 1.
1968 *Clupea sardinites* Heckel; Jerzmańska, p. 390, text-fig. 2.
1977 *Clupea sardinites* Heckel; Ciobanu, p. 46, pl. 7, fig. 1.
1977 *Clupea longimana* Heckel; Ciobanu, p. 47, pl. 7, fig. 2.
1978 *Clupea sardinites* Heckel; Szymczyk, p. 394, text-figs 4–5, pl. 58, figs 1–3, 5.
1980 *Sardinella sardinites* (Heckel); Danilchenko, p. 9.
1991 *Clupea sardinites* (Heckel); Pharisat, p. 27, figs 13–15.
2003 *Clupea sardinites* (Heckel); Gregorová and Požár, p. 195, fig. 3, photo 3.
2006 *Sardinella sardinites* (Heckel); Carnevale et al., p. 686, fig. 4
2011 *Clupea sardinites* (Heckel); Gregorová, p. 8.

M a t e r i a l : NM Pc 02886, Pc 02890, Pc 02892 and unnumbered specimens; collected from the Subchert Mb. and Dynów Mb.

R e m a r k s : Commonly found specimens are represented by scales, typical clupeid forms with transversal striae (text-fig. 2D) which distinguish them from other fish scales. They are practically the same as those described by Symczyk (1978) and they are distributed at both collecting points.

The specimens were traditionally classified in the genus *Clupea* Linnaeus, 1758, but according to the unpublished thesis by Nedvědová (2012), the Moravian clupeid specimens pertain to the genus *Sardinella*. This conclusion is in accordance and confirms results published earlier by Danilchenko (1980) and Carnevale et al. (2006).

The species (as scales and isloated bones) is widely distributed in Moravian localities, e.g., Litenčice, Kelč, Špičky, Rožnov pod Radhoštěm (Kalabis and Schultz 1974, Kalabis 1975a, b, Gregorová and Požár 2003 and others).

Clupeids are typically marine coastal and schooling, mainly pelagic fishes found in all seas from 70° N to about 60° S (Whitehead 1985).

Clupeidae gen. et sp. indet.

Text-fig. 2E

M a t e r i a l : NM Pc 02889; collected from the Subchert Mb.

R e m a r k s : The specimen is represented by an articulated postcranial section of a skeleton; with ca. 24 preserved vertebrae and insufficiently preserved fins. The body is covered by typical clupeid scales which are also preserved in the surrounding sediment. A more detailed description is not possible untill preparation of the specimen is completed which may reveal other features.

Family **Argentinidae Bonaparte, 1846 vel Osmeridae Regan, 1913**

Genus ***Glossanodon* Guichenot, 1867**

***"Glossanodon" musceli* (Paucă, 1929)**

Text-fig. 3

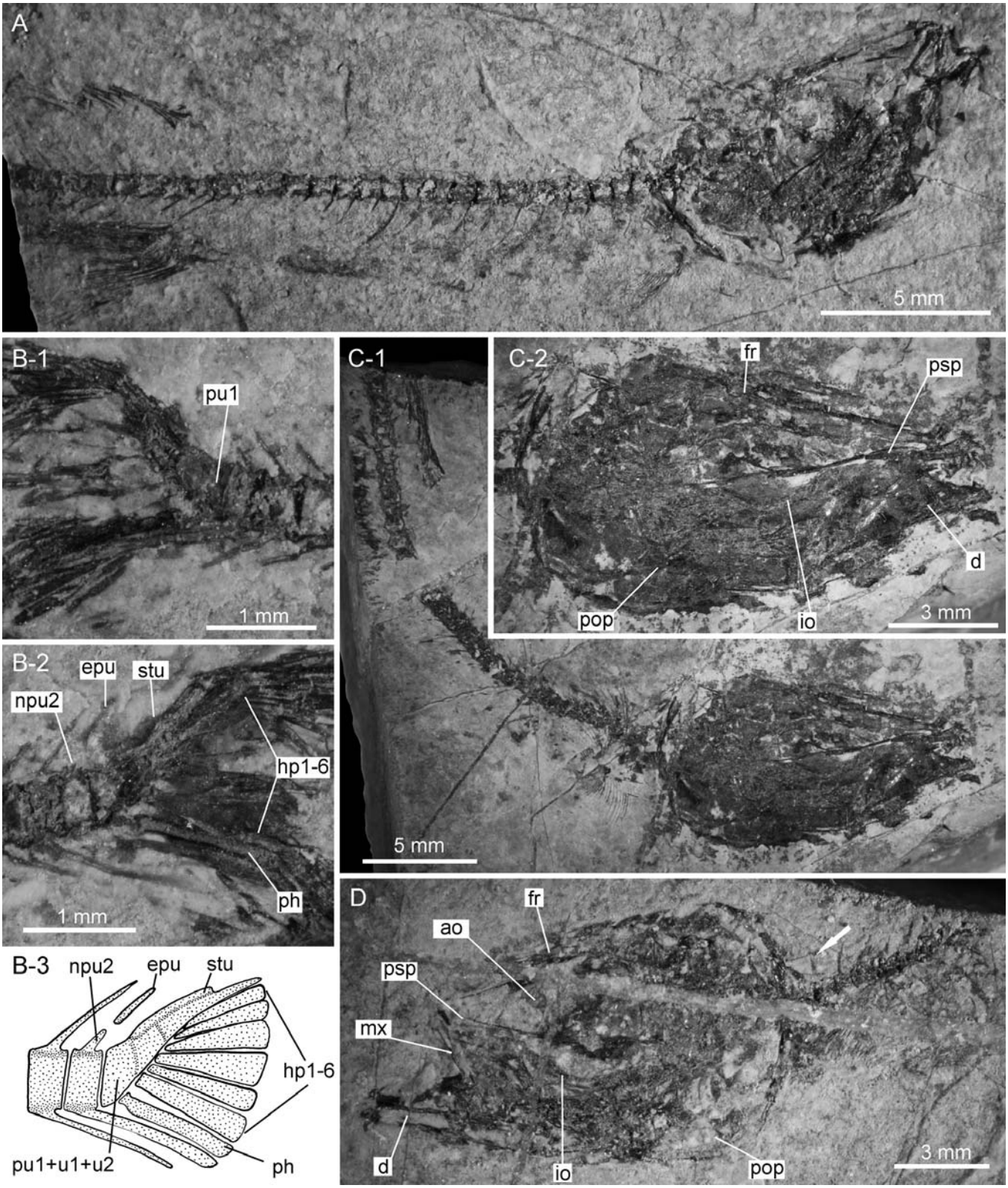
1929 *Nemachilus musceli*; Paucă, p. 114.
1934 *Nemachilus musceli* Paucă; Paucă, p. 598, pl. 2, figs 1–2.
1958 *Nemachilus Musceli* Pauca; Jonet, p. 44, pl. 5, fig. 7.
1967 *Glossanodon musceli* (Paucă); Jerzmańska, p. 200, text-figs 2, 4, 6, 8, 10, pl. 1, figs 1–2.
1968 *Glossanodon musceli* (Paucă); Jerzmańska, p. 394.
1974 *Glossanodon musceli* (Paucă); Kalabis and Schultz, p. 187, pl. 1, fig. 2.
1977 *Glossanodon musceli* (Paucă); Ciobanu, p. 65, pl. 15, fig. 1.
2003 *Glossanodon musceli* (Pauca); Gregorová and Požár, p. 196, photo 4.
non 2005a *Austromalotus musceli* (Paucă); Prokofiev, p. 10, figs 4–6.
2011 *Glossanodon musceli* (Paucă); Gregorová, p. 8, pl. 3, fig. 1.

M a t e r i a l : NM Pc 02870a, b – Pc 02875a, b, Pc 02877a, b; collected from the Dynów Mb.

R e m a r k s : The collected specimens are rather fragmentary, with a long slender body and maximal body depth close behind the head. It is possible to recognized ca. 47 vertebrae (22+25). The fin rays are insufficiently preserved and their numbers are not clearly discernable. The pectoral fin is totally unreadable. The dorsal fin is situated in the middle of the body length (with ca. 10 rays); the ventral fin (with more than seven rays) is shifted slightly anteriorly. Although the anal fin is not completely preserved in any of the specimens, the caudal peduncle in specimen Pc 02780a appears to be formed by 6–7 vertebrae (judging by the last preserved anal fin ray). The skull bones are crushed and therefore, hardly readable (it is however possible to identify some of them, or their general positions; see text-figs 3C-2 and 3D). The fragmentary caudal skeleton (text-figs 3B–1, 2) was tentatively reconstructed (text-fig. 3B–3).

The specimens were traditionally classified as *Glossanodon musceli* (Argentinidae), but Prokofiev (2005a) revised Caucasian and Turkmenistan Protacanthopterygii on the basis of important morphological features which have been overlooked for many years. His results showed that his specimens pertain to the family Osmeridae (rather than to the Argentinidae) and were thus placed in the new genus *Austromallotus*.

Material from the Osíčko locality cannot be similarly classified mainly due to the unsatisfactory preservation. The important morphological features, such as (1) presence of the notch on the dorsal edge of the operculare, (2) transformation of the neural spines on the anterior abdominal vertebrae (significant shortening is not present in all specimens, or it is not clearly visible), and (3)



Text-fig. 3. ***"Glossanodon" musceli*** **A – nearly complete specimen NM Pc 02875a; B – caudal skeleton of specimens NM Pc 02871b and NM Pc 02871a (B-1 and B-2 respectively; part and counterpart) and its tentative reconstruction (B-3); C – specimen NM Pc 02873a, general view (C-1) and detail of the head (C-2); D – specimen NM Pc 02874a (the white arrow shows normally developed neural spine on the anterior abdominal vertebra). Abbreviations: ao – antorbitale; d – dentale; epu – epurale; fr – frontale; hp1-6 – hypurals 1-6; io – infraorbitals; mx – maxillare; npu2 – neural spine of second preural vertebra; ph – parhypurale; pu1 – first preural vertebra; pop – preoperculum; psp – parasphenoideum; stu – stegurale; u1 – urale 1; u2 – urale 2.**

arrangement of 1st and 2nd infraorbitals (if they are in contact or not) are not recognizable, or they were destroyed or are different from those described by Prokofiev (2005a). Furthermore, the studied specimens show a longer caudal peduncle (6–7 vertebrae) and slightly different morphology of the caudal skeleton than in *A. musceli* (according to Prokofiev 2005a: fig. 6c). Thus it is impossible to unify both forms and the specimens described herein are classified traditionally as members of the genus *"Glossanodon"*. A higher taxonomical position of the taxon

is uncertain due to the lack of clarity regarding construction of the circumorbital series.

The species (sensu Paucă, 1929) is distributed in many Moravian localities, such as Litenčice, Kelč, Špičky, Nikolčice, Mouchnice, Rožnov pod Radhoštěm and others (Kalabis and Schultz 1974, Kalabis 1975a, b, Gregorová 1988, 2011, Gregorová and Požár 2003).

As was mentioned above, the construction of the circumorbital series is unclear and thus also any concrete higher taxonomic position. Consequently it is difficult to estimate the bathymetric demands of these specimens. If we take into account the original classification (i.e., Argentinidae) these are found at a depth of 1000 m, but adults are commonly taken from the margin of the continental shelves (Weitzman 1997).

Family **Trichiuridae Rafinesque, 1810**

Genus ***Anenchelum* Blainville, 1818**

***Anenchelum glarisianum* Blainville, 1818**

Text-fig. 2F

1818 *Anenchelum glarisianum*; Blainville, p. 314.
1844 *Anenchelum glarisianum* DeBlainville.; Agassiz, vol. 5, p. 70, pl. 37, figs 1–2.
1850 *Lepidopides leptospondylus*; Heckel, p. 240, pl. 22.
1859 *Anenchelum Glarisianum* Blainville; von Rath, p. 122, pl. 3, fig. 5.
1886 *Lepidopus glaronensis*; Wettstein, p. 42, pl. 5, figs 1, 3–6, 9–10, pl. 6, figs 1–3, 5–8.
1901 *Lepidopus glarisianus* (Blainville); Woodward, p. 477.
1934 *Lepidopus glarisianus* (Blainville); Paucă, p. 615, text-figs 15–17, pl. 3, fig. 3.
1958 *Lepidopus glarisianus* Blainville; Jonet, p. 58, pl. 6, fig. 2.
1960 *Lepidopus glarisianus* (Blainville); Danilchenko, p. 143, text-fig. 29, pl. 14, figs 1–2.
1968 *Lepidopus glarisianus* (Blainville); Jerzmańska, p. 463, text-fig. 23, pl. 7, fig. 1.
1977 *Lepidopus glarisianus* Blainville; Ciobanu, p. 119, pl. 40, fig. 1.
1977 *Anenchelum glarisianum* Blainville; Ciobanu, p. 120, pl. 41, figs 1–2.
1991 *Lepidopus glarisianus* (Blainville); Pharisat, p. 60, text-figs 47-50.
2003 *Anenchelum glarisianum* Blanville; Gregorová and Požár, p. 200, photos 8–10.
2010 *Anenchelum glarisianum* Blainville; Gregorová, p. 142, photos 1–11.
2011 *Anenchelum glarisianum* Blainville; Gregorová, p. 17, pl. 6, figs 1–2.

M a t e r i a l : NM Pc 02880a, b, c, Pc 02881a, b, Pc 02882a, b; collected from the Dynów Mb.

R e m a r k s : The specimens are represented by fragments of the body and a disarticulated head. The elongated body is composed of vertebrae with straight neural spines which are articulated with the pterygiophores of the dorsal fin. Ribs are attached to the ventral margin of the vertebrae. In the disarticulated head it is possible to recognize the premaxillare, maxillare, and dentale. The teeth are large, with marked striation.

The species is common in Moravian localities, such as Litenčice, Kelč, Špičky, Nikolčice, Mouchnice, Nítkovice, Jestřabice, Kožušice, Rožnov pod Radhoštěm (Kalabis and Schultz 1974, Kalabis 1975a, b, Gregorová and Požár 2003, Gregorová 2010, 2011).

Today living trichiurids are benthopelagic predators of the continental shelf and slope with depth up to 2000 m (in tropical and temperate regions; Gago 1998).

Perciformes gen. et sp. indet.

Text-fig. 2G

M a t e r i a l : one specimen NM Pc 02891; collected from the Subchert Mb.

R e m a r k s : The specimen is represented by an isolated preoperculum, preserved partly as an imprint, partly as a fossilized bone. Its ramus horizontalis is short (and robust) whereas the ramus verticalis is about twice longer. Both arms join together at almost a right angle. The posterior edge of the preoperculum is irregularly serrated, with one enlarged spine at the flexion point (see arrow in text-fig. 2G). The distal part of the enlarged spine is incompletely preserved. Classification of the specimen is difficult even though its morphology is relatively specific and it is comparable with some percichthyids, moronids, or polyprionids (see Schultz 2000: pl. 1, figs 18, 20, pl. 2 figs 29, 32). Although it is not possible to determine the specimen precisely, it is possible to say, that it does not belong to the species *"Serranus" budensis*.

Discussion

As was pointed out by Gregorová (1997b), the fossil fish remains found in the Subchert Mb. of the Moravian localities are very rare. The published material is concerned with the Litenčice locality (Gregorová 1997b, Bubík et al. 2006) where the assemblage is represented by Myctophidae, Trichiuridae, Clupeidae, Gadidae, Phosichtyidae, and Teleostei indet. and accompanied by remains of terrestrial flora. All these findings are related to the Pteropod Horizon.

Baciu (2010) reported *Keasius parvus*, *Clupea*, *Vinciguerria*, *Anenchelum*, Gadidae, *Palimphyes*, and Myctophidae from the same locality and horizon. Brzobohatý (1981) described clupeid scales from the Subchert Mb. captured in the Křepice – 5 borehole.

Clupeidae, *Sardinella sardinites*, *Scopeloides glarisianus*, and an unspecified perciform were found in the Subchert Mb. at the Osíčko locality. The fossils are accompanied by undetermined fish bones (numerous debris), and fragments of carbonized and mineralized (? malachitized) organic material. The Subchert Mb. documents isolation of a sedimentary area from the World Ocean (Švábenická et al. 2007) which resulted in an insufficiently ventilated environment (Báldi 1980) which was then followed by mass mortality as documented by the Pteropod Horizon (Krhovský 1993).

The assemblage collected from the Dynów Mb. is characterized by the presence of *Keasius* sp., undetermined elasmobranchs and 3 types of Teleostei fishes, namely *Sardinella sardinites*, *"Glossanodon" musceli*, and *Anenchelum glarisianum*. These are commonly accompanied by fishes with light organs (mainly Myctophidae and Gonostomatidae) and other additional types of fishes at other Moravian localities (for conclusive data and the latest results see

Gregorová 1997b, 2011). The depletion of fish with light organs maybe an artificial result and more related to the limited number of findings.

From a bathymetric point of view, in accordance with other Moravian localities, the fish composition suggest mesopelagic to benthopelagic environments.

From the biostratigraphical point of view (sensu Kotlarczyk and Jerzmańska 1976, Kotlarczyk et al. 2006), the presence of *Scopeloides glarisianus* (in the Subchert Mb.) suggests the beginning of the IPM1 Zone while the *"Glossanodon"* fossils (in the Dynów Mb.) indicate the IPM2 Zone. On the other hand it is necessary to mentioned the fact that this biostratigraphic division is not completely valid (if at all) and in some parts of the Paratethys individual zones obviously overlap (Gregorová 1997b).

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