

COMMENTED LIST OF THE LOWER OLIGOCENE FISH FAUNA FROM THE COZA VALLEY (MARGINAL FOLDS NAPPE, EASTERN CARPATHIANS, ROMANIA)

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Abstract. The study of Oligocene fishes from the external sector of the Eastern Carpathians Flysch of Romania (Marginal Folds Nappe or Vrancea Nappe) started more than a century ago. During all this time the research was focused mainly on the Northern exposures of these deposits, while the southern areas remained almost neglected. The aim of this research is to report the occurrence of several Oligocene fishes discovered from a new outcrop. This new outcrop which brings to the surface a part of the Bituminous Marls Formation is found on Coza Valley (Vrancea District). This site could be considered an important landmark in the study of the fish fossils, due to the relative richness of the specimens. Seven genera and five related species were collected and assigned to the following taxa: *Keasius parvus* Leriche, 1908, *Sardinella sardinites* Heckel, 1850, *Glossanodon musceli* Paucă, 1929, *Palaeogadus* sp., *Aeoliscus* sp., *Oliganodon budensis* Heckel, 1856, *Anenchelum glarisianum* Blainville, 1818.

Keywords: fossil fishes, Oligocene, Marginal Folds Nappe, Vrancea half-window, Eastern Carpathians, Romania.

Rezumat. Lista comentată a faunei de pești oligoceni inferiori din Valea Coza (Pânza Cutelor Marginale, Carpații Orientali, România). Studiul peștilor oligoceni identificați în flișul extern al Carpaților Orientali din România (Pânza Cutelor Marginale = Pânza de Vrancea) are începuturi care depășesc un secol. În tot acest timp studiile s-au focalizat asupra sectoarelor nordice în care aceste depozite afloră, cele sudice fiind în mare parte neglijate. Scopul acestui studiu este de a semnală descoperirea unor pești oligoceni într-un afloriment identificat recent. Aflorimentul permite studiul unei părți a Formațiunii Marnelor Bituminoase în Valea Coza (Județul Vrancea) și poate fi considerat drept un reper important în studiul peștilor fosili datorită numeroaselor specimene identificate. Șapte genuri și cinci specii de pești au fost colectate și determinate: *Keasius parvus* Leriche, 1908, *Sardinella sardinites* Heckel, 1850, *Glossanodon musceli* Paucă, 1929, *Palaeogadus* sp., *Aeoliscus* sp., *Oliganodon budensis* Heckel, 1856, *Anenchelum glarisianum* Blainville, 1818.

Cuvinte cheie: pești fosili, Oligocen, Pânza Cutelor Marginale, Semifereastră Vrancei, Carpații Orientali, România.

INTRODUCTION

The presence of fish remains in the Oligocene formations of Romania has been known since 1883, when Leon C. Cosmovici collected the first fossils from the Cozla Mountain, Piatra Neamț area. In the following years he completed the systematic description of the discovered specimens. The results were published in a paper issued in Paris (COSMOVICI, 1886). In the next century, the research of the Oligocene-lowermost Miocene fish fauna from Eastern Carpathians thrived, as new outcrops were found (for details see CONSTANTIN, 1999).

In the following decades, other researchers added new and important contributions to this topic (e.g. SIMIONESCU, 1904; PAUCĂ, 1934; JONET, 1949; CIOBANU, 1977). CONSTANTIN (1999) published the first inventory of the Oligocene-lowermost Miocene fish fauna reported in Romania. BACIU (2001), in his PhD studies realized a detailed research on the fossil fish fauna from Piatra Neamț area, adding a new perspective on the studied exposures and to the importance of the fish fossils. GRĂDIANU (2010) studied the fish fauna from the Cenozoic flysch deposits (Tarcău and Marginal Folds nappes) exposed between Moldova and Suceava rivers (Suceava District).

ȘTEFAN (1988) was the first to attempt a study on fossil fishes from the Vrancea half-window (Marginal Folds Nappe). He described six species collected from the Lower Dysodilic Shales Formation from the Coza Valley. The specimens herein reported were collected from a new outcrop located on the same valley, more specifically on the southwestern side of the Coza Village, upstream on the river (Fig. 1). It is placed on a slope of the Coza Mountain, in the Eastern Carpathians (Romania, Vrancea District).



Figure 1. Satellite view of the Coza Valley; the outcrop is marked by a white rectangle (after maps.google.com, modified).

GEOLOGICAL SETTING

The Carpathian Orogen is the result of the gradual collision between the African and Eurasian plates. As a consequence, the Neo-Tethys Ocean vanished and the Paratethys Sea to the north and the Mediterranean Sea to the south began their evolutions (DERCOURT et al., 2000; BERRA & ANGIOLINI, 2014). According to SÂNDULESCU (1984) and BĂDESCU (2005) the eastern Moldavids, i.e. Tarcău, Marginal Folds [= External Unit – BÂNCILĂ (1958); Marginal Unit – DUMITRESCU (1952); Submarginal Unit – JOJA (1952); Marginal Folds Nappe – SÂNDULESCU (1984)] and Peri-Carpathian nappes were erected in Miocene. As the overlying Tarcău Nappe covers completely the Marginal Folds Nappe, in many sectors, this one can be observed in detail only in half-windows which occurred due to the river erosion (SÂNDULESCU, 1984). The studied fish-bearing outcrop belongs to this thrusting nappe, located in the half-window named Vrancea (Fig. 2).

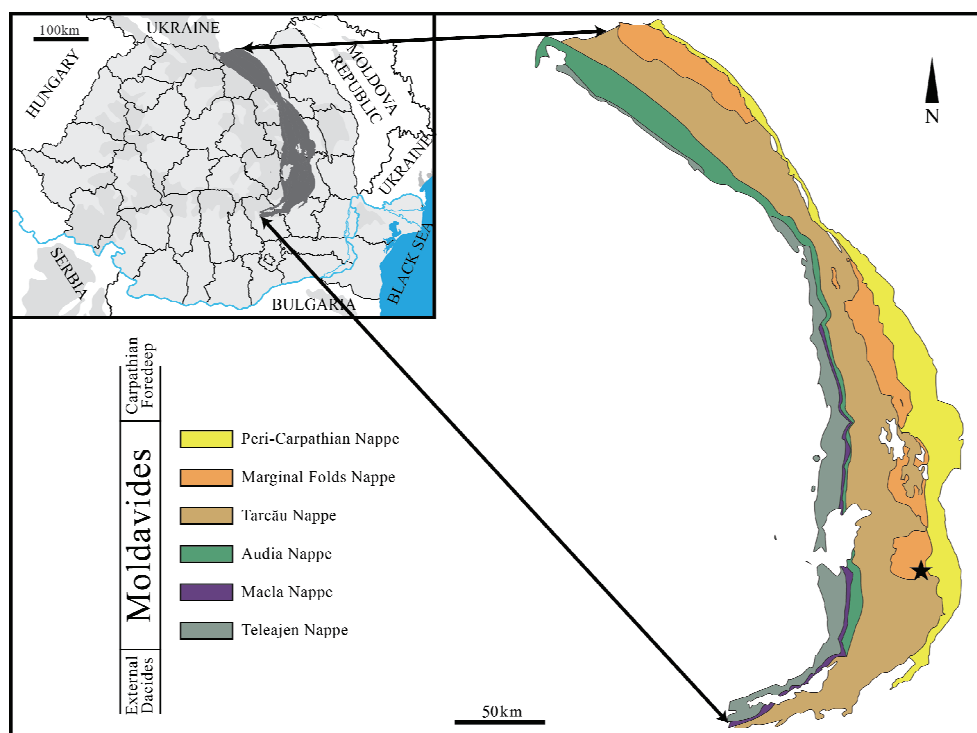


Figure 2. The Moldavides and the related nappes; location of the outcrop in the Vrancea half-window (based on SÂNDULESCU, 1984; BĂDESCU, 2005).

The Marginal Folds Nappe includes mainly deep sea sediments with anoxic tendencies, ideal for specific fossilizations (PAUCĂ, 1979). In this nappe, sedimentation started in the Early Cretaceous with the black schist, followed by Upper Cretaceous deposits. At a small scale in the Vrancea half-window, the Eocene sediments are part of the Coza anticlinoria, situated in the southern area of the Putna Valley. DUMITRESCU (1948) divided this anticlinorium into six distinct anticlines. The Oligocene sedimentary series (Fig. 3) starts with the menilitic lithofacies divided by ATANASIU (1943) in two "terms" (members): a lower one that is now named Lingurești Member (GRASU, 1988) and the upper one, the Compact Menilitic Member. The succession continues with the Bituminous Marls Formation, which DUMITRESCU (1952) and GRASU et al. (1988) described as an excellent cartographic marker for the Oligocene in the Tarcău and Vrancea nappes. It is well known that in several studies (CIOBANU 1977, GRASU et al. 1988, 2004), this unit is also called the 'Bituminous Brown Marls Formation', associated mostly with the marls from the northern region of the Tarcău and Vrancea nappes. The Lower Dysodilic Formation marks a series of episodic alternating regressions and transgressions, followed by a subsidence of the basin bottom that allowed a high stand sedimentation represented by the Kliwa lithofacies (ȘTEFĂNESCU et al., 2006). The Oligocene sedimentation is ending with the Upper Menilitic and Dysodilic Formation. BÂNCILĂ (1958) considered that the whole Oligocene comprises bituminous facies with rare flysch interbeddings, mostly to the top of this succession. Due to the erosion, the Miocene sedimentation is represented in the first stage particularly by clays associated with arenites, silts and rudites, and with olistoliths (IONESI & BOGATU, 1986).

The fossil fish specimens were collected between 2012 and 2014 by the senior author during several field campaigns. The outcrop is situated on the left bank of the Coza River, almost 3.5 km upstream from the Coza Village limits. Starting from this village towards the outcrop, Miocene and Oligocene deposits are visible. Even though there are complex folds and faults, Oligocene sediments can be easily distinguished due to their mineralization, composition and emplacement. Unlike the other Oligocene formations in the area, the Bituminous Marls Formation outcrop is not crossed by the stream as a transversal section, but is parallel with the stream, which is following the beds direction.

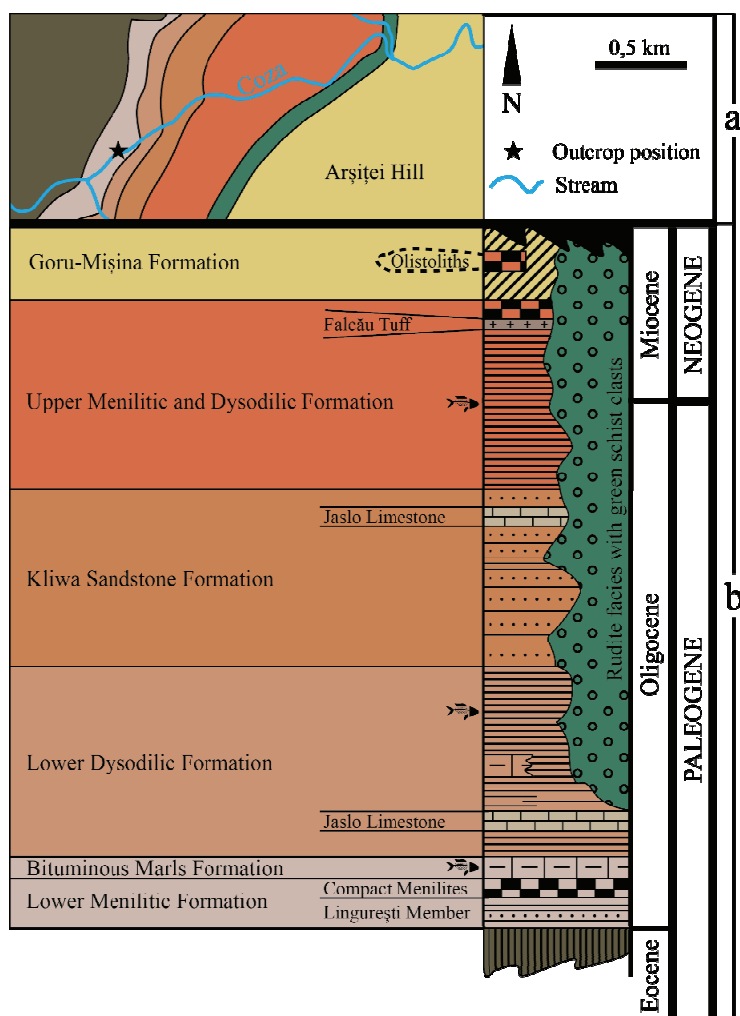


Figure 3. a. Simplified geological map of the studied area (based on DUMITRESCU, 1952),
b. lithostratigraphic column of the Oligocene deposits from the Marginal Folds Nappe (based on GRASU et al., 1988).

MATERIAL AND METHODS

Preparation: Most of the fishes were found articulated and isolated on the bedding surfaces, devoid of other associated fossils. Some of the specimens were found without excess of covering matrix. However, the specimens that needed sediment removal were prepared using various tools, such as needles and scalpels, a rotary rubbing tool was used in some cases (commercial Dremel™). The preparation was done under the magnification of a binocular stereo microscope (Carl Zeiss Jena). The fish fossils presented herein are inventoried in the collection of the Paleontology-Stratigraphy Museum from the “Babeș-Bolyai” University of Cluj Napoca (V547-V560, 23936).

SYSTEMATIC PALEONTOLOGY

Class **Chondrichthyes** Goodrich, 1909
Subclass **Elasmobranchii** Bonaparte, 1838
Order **Lamniformes** Berg, 1940
Family **Cetorhinidae** Gill, 1862
Genus **Keasius** Welton, 2013
Keasius parvus (Leriche, 1908)

Plate I - 1

1977 *Cetorhinus parvus* Leriche; CIOBANU, p. 43, pl. VI, fig. 1, 2, 3;
1991 *Cetorhinus parvus* Leriche; PHARISAT, p. 24, fig. 9;
2013 *Keasius parvus* (Leriche); WELTON, p. 39.

Material: one gill raker (V547).

Diagnosis: according to HOVESTADT & HOVESTADT EULER (2012) and WELTON (2013).

Description: The specimen is represented by a complete imprint that preserves two parts of the gill raker, the base and a medial part of the filament. The length of the filament starting from curvature of the base to its apex is 6.3 cm. The

filament base is strongly curved and has well-formed distal protuberance. Bight shape is rounded and has an intermediate width. Medial process length is longer than basal length. Mesial edge of medial process is rounded. Basal edge of the base is rounded and it forms with the mesial edge a sub-angular basal shape. The vascular foramina of attachment surface are present on the entire length of the mesial curvature of the gill raker base. Starting from these foramina, several fine parallel edges are visible on the entire length of the specimen.

Subdivision **Teleostei** *sensu* Patterson & Rosen, 1977

Order **Clupeiformes** *sensu* Grande, 1985

Family **Clupeidae** Cuvier, 1817

Genus **Sardinella** Valenciennes, 1847

Sardinella sardinites (Heckel, 1850)

Plate I – 2

1850 *Meletta sardinites* HECKEL, p. 227, pls 23, 24;

1934 *Clupea longimana* (HECKEL); PAUCĂ, p. 601, pl. I, figs 3a, 3b, pl. V, figs 2, 5;

1934 *Clupea sardinites* (HECKEL); PAUCĂ, p. 603, pl. I, fig. 1;

1980 *Sardinella sardinites* (HECKEL); DANIL'CHENKO, p. 9;

1985 *Sardinella sardinites* (HECKEL); GRANDE, P. 322;

1991 *Clupea sardinites* (HECKEL); PHARISAT, p. 27, figs 13, 14, 15;

2006 *Sardinella sardinites* (HECKEL); CARNEVALE et al., p. 686, figs 4.1, 4.2.

Material: three incomplete specimens (V551, V552, V553).

Diagnosis: according to DANIL'CHENKO (1980) and GRANDE (1985).

Description: Vertebrae: 43-46; D: 17-19; A: 17; P: 15-17; V: 9.

Body it is elongated and laterally compressed. The head is relatively large. The diameter of the orbit it is smaller than the preorbital distance. The vertebral column consists of 43-46 vertebrae. The dorsal fin it is inserted approximately in the middle of the body. Anal fin is located posteriorly on the body. Cycloid scales are visible.

Order **Argentiniformes** Johnson & Patterson, 1996

Family **Argentinidae** Bonaparte, 1846

Genus **Glossanodon** Guichenot, 1867

Glossanodon musceli (Pauca, 1929)

Plate I – 3, 6

1934 *Nemachilus musceli* Pauca, p. 598, pl. II, figs 1, 2;

1967 *Glossanodon musceli* (Pauca); JERZMAŃSKA, p. 200, text-figs 2, 4, 6, 8, 10, pl.I, figs 1, 2;

2011 *Glossanodon musceli* (Pauca); GREGOROVÁ, p. 8, pl. III, fig. 1.

Material: six incomplete specimens (V548, V549, V550, V553, V555, V559 and three unnumbered specimens).

Diagnosis: according to JERZMAŃSKA (1967).

Description: Vertebrae: 45-46; D: 11-12; A: 16-18; P: 17-18; V: 10-12.

Small sized fishes. The body is elongated and slender. The head is almost triangular in shape. The diameter of the orbit is relatively big. The premaxilla is elongated. No teeth on the premaxilla and dentary. The dorsal fin it is inserted approximately in the middle of the body. The anal fin it is placed posteriorly to the last ray of the dorsal fin.

Order **Gadiformes** *sensu* Endo, 2003

Family **Merlucciidae** Adams, 1864

Genus **Palaeogadus** von Rath, 1859

Palaeogadus sp.

Plate I – 4

Material: one specimen poorly preserved (V554).

Diagnosis: according to DANIL'CHENKO (1960) and JERZMAŃSKA (1968).

Description: Vertebrae: 42; DI: 9, DII: 31-32.

Body it is elongated and laterally compressed. The head it is large; morphology of the cranial region it is not visible because of the preservation state. The vertebral column contains 42 vertebrae; relatively long, robust and aciculated parapophyses are visible on the abdominal vertebrae but the preservation state does not allow us to establish the precise number. Two dorsal fins. The anal fin it is poorly preserved. The caudal peduncle is moderately deep.

Order **Gasterosteiformes** Gill, 1872

Family **Centriscidae** Rafinesque, 1826

Genus **Aeoliscus** Jordan & Starks, 1902

Aeoliscus sp.

Plate I – 5

Material: one poorly preserved specimen (V560).

Diagnosis: according to DANIL'CHENKO (1960).

Description: Wedge-shaped small fishes with elongated body. The length of the head is bigger than the body height. The snout is long and tubular. The body is almost totally covered with thin bony shields. Dorsal shields are extended down to the middle line of the body. There are 15 visible vertebrae. First dorsal spine it is long and pointed. Soft dorsal and anal fins are poorly preserved. Caudal fin it is small.

Order **Perciformes** Bleeker, 1859

Percoidei *incertae familiae*

Genus ***Oliganodon*** Bannikov, 2010

Oliganodon budensis (Heckel, 1856)

Plate I – 6

1856 *Smerdis budensis*, HECKEL, p. 264, pl. XI, fig. 16;

1960 *Serranus budensis* (HECKEL); DANIL'CHENKO, p. 101, fig. 21, pl. XXV, fig. 4;

1991 *Serranus budensis* (HECKEL); PHARISAT, p. 44, figs 32, 33;

2010 *Oliganodon budensis* (HECKEL); BANNIKOV, p. 86, pl. VII, figs 2, 3.

Material: one incomplete specimen (V555).

Diagnosis: according to BANNIKOV (2010).

Description: Vertebrae: 24; D: X+10; A: III+9; P: 16; V: I+5.

Body elongated, laterally compressed. Head length is bigger than body height. The orbits are large. The preopercle is serrated on the ventral and posterior margins. Two small spines are visible on the opercle. The vertebral column is composed from 24 vertebrae from which ten are abdominal. Dorsal fin is continuous. The anal fin insertion is located below the first dorsal soft rays. The caudal fin contains 17 principal rays.

Suborder **Scombroidei** Bleeker, 1859

Family **Trichiuridae** Rafinesque 1810

Genus ***Anenchelum*** Blainville, 1818

Anenchelum glarisianum Blainville, 1818

Plate I – 7, 8

1818 *Anenchelum glarisianum*, Blainville, p. 314;

1901 *Lepidopus glarisianus* (Blainville); WOODWARD, p. 477;

1977 *Lepidopus glarisianus* (Blainville); CIOBANU, p. 119, pl. XL, fig. 1;

1977 *Anenchelum glarisianum* Blainville; CIOBANU, p. 120, pl. XLI, figs 1, 2;

2011 *Anenchelum glarisianum* Blainville; GREGOROVÁ, p. 17, pl. VI, figs 1, 2.

Material: three incomplete specimens and one almost complete (V557, V558, V559, 23936).

Diagnosis: according to JERZMAŃSKA (1968).

Description: Body elongated and laterally compressed. Head is triangularly shaped; the length of the head it is bigger than the body depth. Two canine-like teeth followed by small conical teeth are present on the upper maxilla. The vertebrae are elongated; 116 vertebrae are visible on the specimen no. 23936. The dorsal fin is continuous almost on the total length of the body; 33-35 spines and are visible. The anal fin is poorly preserved. The pectoral fins are composed from about 12-13 soft rays each.

CONCLUDING REMARKS

In 2012, a new outcrop exposing the Bituminous Marls Formation of Early Oligocene (Rupelian) age, belonging to the Vrancea Nappe (Eastern Carpathians of Romania) was identified nearby to the Coza locality.

The fish fossil specimens discovered from this outcrop are referred to known taxa in this region, already reported from the same formation of the Piatra Neamț area as well as from several Early Oligocene deposits from the Central and Eastern Paratethys and include the following species: *Keasius parvus* (Leriche, 1908), *Sardinella sardinites* (Heckel, 1850), *Glossanodon musceli* (Pauca, 1929), *Palaeogadus* sp., *Aeoliscus* sp., *Oliganodon budensis* (Heckel, 1856), *Anenchelum glarisianum* Blainville, 1818.

Based on the interpolation method proposed by GAUDANT (1979) with the distribution of the actual taxa and the data indicated by COMPAGNO (2002) and NELSON (2006), the identified fish fossil assemblage probably indicate the following bathymetric distribution: *Keasius* and *Sardinella* – shallow waters, *Glossanodon*, *Anenchelum* and *Paleogadus* – bathypelagic waters, *Oliganodon* and *Aeoliscus* – continental shelf and coastal waters. Presently, no typical meso- and bathypelagic fish species were discovered in the Coza outcrop, although they are common in the Bituminous Marls Formation from the northern part of the Marginal Folds Nappe (Piatra Neamț area).

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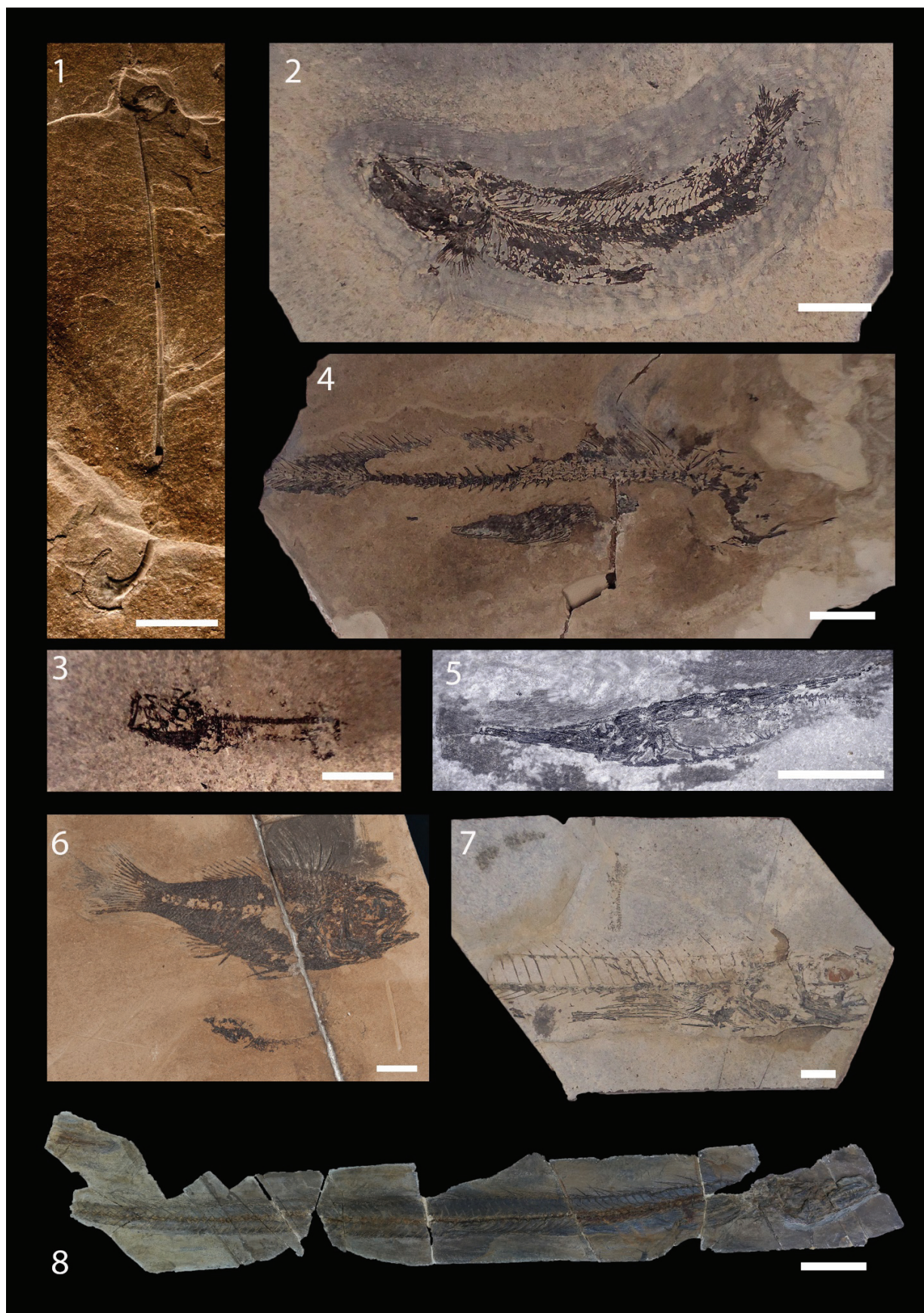


Plate I: 1 - *Keasius parvus* (V547), 2 - *Sardinella sardinites* (V551), 3 - *Glossanodon musceli* (V550), 4 - *Paleogadus* sp. (V554), 5 - *Aeoliscus* sp. (V560), 6 - *Oliganodon budensis* and *Glossanodon musceli* (V555), 7 - *Anenchelum glarisianum* and *Glossanodon musceli* (V559). Scale bar: 1 cm. 8 - *Anenchelum glarisianum* (23936). Scale bar: 10 cm.