Sea bass fish *Morone* sp. (Teleostei) from the north Bohemian Palaeogene (Tertiary, Czech Republic)

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The taxonomic position of sea bass fishes of the family Moronidae from Upper Eocene (Palaeogene) diatomite deposits of Kučlín near Bílina, Czech Republic, is discussed. Although the fossil skeletons are incomplete, *Morone* sp. is characterised by skull elements, fin formula, caudal skeleton and specific ctenoid scales. The morphology of certain skull elements typifies the family. Data on moronid fishes from the northern Bohemian Palaeogene is reviewed. • Key words: fish, Teleostei, Perciformes, Moronidae, Czech Republic, Eocene, Priabonian.


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Fossil fishes are relatively common in the freshwater Palaeogene diatomite deposits of the Kučlín locality near Bílina (e.g., Fejfar & Kvaček 1993, Obrhelová 1987). The fish fauna from the Kučlín diatomites consists of *Cyclurus macrocephalus* Reuss, 1844, *Bilinia uraschista* (Reuss, 1844), *Thaumaturus furcatus* Reuss, 1844 and *Morone* sp. The systematics of these fishes has been discussed by many authors (e.g., Grande & Bemis 1998; Micklich 1990; Micklich & Böhme 1997; Obrhelová 1971, 1975, 1987). A taxonomic list of the fauna is summarized by Fejfar & Kvaček (1993). Information about the flora is reported in Bellon et al. (1998), Kvaček (2002) and Kvaček & Walter (2003).

The first skeletal evidence of the family Moronidae was found in Grube Messel, dated as Eocene, Lutetian Stage in Patterson (1993). Moronid skeletons and otoliths are also quite common in the Oligocene and Miocene deposits of central and western Europe; for a summary see Böhme & Ilg (2003).

Fishes of the family Moronidae (sea basses) are fast-moving marine fishes with anadromic migration habits, migrating into freshwater to spawn (Nelson 1994). Micklich & Böhme (1997) suggested a connection between the Kučlín Lake and the Eocene “North Sea” (see Fig. 15 in Micklich & Böhme, 1997). The presence of moronid fishes at the Kučlín locality was determined by Micklich (1990) and Micklich & Böhme (1997) based on the fragmentary material of the head, part of the body and ctenoid scales (National Museum Prague: Kuč30a, Kuč30b, Kuč80; Institut für Geophysik und Geologie der Universität Leipzig: MB Kuč.13 – today in the National Museum Prague as Pc2853; Naturhistorischem Museums Wien: 1864/XL/1961). New specimens will be described here with a review of the Bohemian material.

**Geological setting**

The studied material was collected from laminated diatomaceous deposits exposed at the Trupelnik Hill (355.8 m), northeast of Kučlín village. A description of the outcrop was given by Mrázek & Procházka (1953), summary was given by Kvaček (2002).

Tertiary sediments are a relict of the old Kučlín lake sedimentary area and lie upon Upper Cretaceous sediments. These volcanogenic deposits of the České středohoří Mountains were accumulated during the Late Eocene to Early Oligocene (Fejfar & Kvaček 1993). The lowermost part of the Palaeogene sediments is formed by pyroclastics continuing into marlstone (thickness about 15 m). The rest of the deposits are composed of various kinds of diatomite with volcanogenic admixture (Mrázek & Procházka 1953). This section belongs to the Ústí Formation, accumulated during the upper Priabonian - this is based on fossil flora evidence (Kvaček 2002). The top of the sedimentary body is covered by a basaltic sheet. A radiometric date obtained from the tephrite indicates 38.3 ± 0.9 My (Bellon et al. 1998). The diatomites accumulated in a high-productivity environment (Fejfar & Kvaček 1993).
The following fossil fish material from the Kučlín locality housed at the Department of Palaeontology, National Museum, Prague, has been evaluated in this study: Kuč30a – part of a head; Kuč30b – part of a head; Pc2850 – an almost complete fish without caudal fin; Pc2854 – anterior part of body with head; Pc2853 = IGGL MB Kuč.13 in Micklich & Böhme (1997) – posterior part of body; Kuč80 – scale. Z. Dvořák’s collection, Bílina Mine: DB – caudal part of body with caudal fin. Comparative recent material: Perciformes; Percidae; *Perca fluviatilis* Linnaeus, 1758; Europe. Perciformes; Moronidae; *Morone labrax* (Linnaeus, 1758); Atlantic.

### Material and methods

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Anatomical abbreviations: A – anal fin; a – articular; a. c. – articular condyle; a. p. – processus ascendens; c. m. – corpus maxillaries; c. pm. – corpus premaxillaris; c. q. – corpus quadrati; d – dentary; d. p. – processus dorsalis; D1 – first dorsal fin; D2 – second dorsal fin; f – frontal; f. l. p. – frontal lateral plate; f. s. – fossa sympletica; l. d. – lamina dorsalis; l. p. – lateral plate; l. v. – lamina ventralis; la – lacrimale; m – maxilla; o – operculum; p – preoperculum; p. p. – processus posterior; p. pm. – processus postmaxillaris; pa – palatinum; pm – premaxilla; q – quadrato; r. h. – ramus horizontalis; r. v. – ramus verticalis; s. p. – sulcus praeperculi; SL – estimated standard length.

### Systematic palaeontology

Family Moronidae *sensu* Johnson, 1984

Genus *Morone* Mitchill, 1814

*Type species.* – *Morone labrax* (Linnaeus, 1758), S Europe, Recent.

### Morone sp.

*Figures 1, 2A–C, 3A–D*

1851 *Perca lepidotata* Agassiz, 1844. – von Meyer, pp. 56, 57, pl. 12, fig. 1.

1971 *Bilinia uraschista* (Reuss, 1844). – Obrhelová, pl. 4, fig. 6.

1990 *Percidae indet. [non Bilinia Obrhelová, 1971].* – Micklich, p. 201, fig. 1.


1997 *Morone* sp. – Micklich & Böhme, p. 121, text-figs 4, 5.

*Description.* – The studied specimens have incomplete bodies, which are fusiform and shallow in lateral view. The estimated standard length rate on the basis of Pc2853 is about 30 cm (Micklich & Böhme 1997); 30 cm based on Pc2850; and 35 cm based on Pc2854. The maximum body depth is in front of the first dorsal fin. There are two poorly preserved dorsal fins on specimen Pc2850. Two spines and less than seven rays are preserved in the ventral fin. The anal fin on Pc2850 supports three spines. Measurements of the studied specimens and percentages of the estimated standard length are given in Table 1. Micklich (1990) determined certain cranial elements in Kuč30a and Kuč30b: frontal (fr), lacrimale (la), palatinum (pa), maxilla (mx), articular or more precisely angulo-articulare (an) and preoperculum (po).

Using the new specimens it was possible to distinguish the following skull elements (Figs 1, 2A, B): frontal (f), lacrimale (la), palatinum (pa), maxilla (m), dentary (d), articular (a), quadrato (q), preoperculum (p) and operculum (o).

**Frontal** (based on Pc2854, Kuč30a): a wide triangular bone with anteriad elongation and radial ornamentation; a wide frontal lateral plate (f. l. p.) with a clear convexly curved lateral margin; the sensory canal terminates in two anterior spurs.

**Premaxilla** (Fig. 3B; specimen Kuč30b; preservation without teeth): a wide corpus premaxillaris (c. pm.); a processus postmaxillaris (p. pm.) with a wide base.

**Maxilla** (Fig. 3D; specimens Kuč30a, Kuč30b): large ventral portion of corpus maxillaris (c. m.); articular head with narrow lateral plate (l. p.) and long processus dorsalis (d. p.).

**Dentary** (Kuč30b; badly preserved): a few rows of small teeth on the teeth patch.

**Articular** (Pc2854, Kuč30a; badly preserved): a triangular processus coronoides without curvature.

**Quadrate** (Fig. 3C; specimens Pc2850, Pc2854, Kuč30a): a wide corpus quadrati (c. q.); a large articular condyle (a. c.); the processus posterior (p. p.) is pointed and long; a distinct fossa sympletica (f. s.); the sulcus praeperculi (s. p.) does not extend the total length of the processus posterior (p. p.).

Figure 1. *Morone* sp., Pc2854: part of a head, left side. Eocene, Kučlín. Scale bar represents 10 mm.
Figure 2. *Morone* sp. • A – Kuč30b, part of the head. • B – Kuč30a, part of the head. • C – Museum no Pc2850, an almost complete fish without caudal fin; Left side. Scale bar represents 10 mm.
The caudal skeleton was described by Micklich & Böhme (1997). The operatorium was compared with recent representatives of family Moronidae [Morone labrax (Linnaeus, 1758)] and Percidae [Perca fluviatilis Linnaeus, 1758].

Comparing Morone labrax and Perca fluviatilis skull morphology and the studied fossil specimens:

The frontal has radial ornamentation and a wide f. l. p. (with a clear convexly curved lateral margin) in the fossils and in M. labrax and a narrow f. l. p. (with a concave curved lateral margin) in P. fluviatilis. The sensory canal terminates in two anterior projections in the fossils and M. labrax and in only one anterior projection (it clings to the midline of skull roof) in P. fluviatilis. The ratio of the frontal length to width is 3.8 to 1.6 in the fossil Kuč30a, 3.7 to 1.5 in M. labrax and 3 to 1 in P. fluviatilis. The M. labrax premaxilla (Fig. 4D) has a large corpus premaxillaris (c. pm.) and a wide processus postmaxillaris (p. pm.); P. fluviatilis has a triangular processus ascendens (a. p.) at the premaxilla (Fig. 4C). In M. labrax and the fossils the maxilla (Fig. 4A) has a straight lateral plate and a long processus dorsalis (d. p.) compared to P. fluviatilis where the maxilla has a portly articular head and a short spherical processus dorsalis (Fig. 4B). The ratio of corpus maxillaris width and length is 1.5 to 3.5 in the studied fossils, 0.9 to 2.7 in M. labrax, and 0.7 to 2.4 in P. fluviatilis. The quadrate (Fig. 4G) has a long processus postorali (p. p.) in M. labrax and a short one in P. fluviatilis. The ratio of the lengths of the preopercular ramus ventralis and the ramus horizontalis equals 3 to 2 in M. labrax and the fossils rather than 2 to 1 in P. fluviatilis. The lamina ventralis (l. v.) is very well developed in the studied specimens and M. labrax (Fig. 4E) and badly developed in P. fluviatilis (Fig. 4F). The operculum has two spines in the studied fossils and M. labrax but only one spine in P. fluviatilis. A comparison of fins and vertebral number of the studied fossil Morone sp. with the recent representatives Morone labrax and Perca fluviatilis is shown in Table 2.
Members of the extant Moronidae have certain diagnostic characters (e.g., Nelson 1994): two dorsal fins, D1VIII–X, D2 I, 10–13; A III, 9–12; an operculum with two spines; a lateral line extends almost to posterior margin of the caudal fin; there is an auxiliary row of lateral line scales on the caudal fin above and below the main row; seven branchiostegal rays; and 25 vertebrae. Characteristic recent moronid scales have: broad pentagonal ctenii with straight proximal ends and a straight median shaft (McCully 1961); truncated ctenial bases that are quadrangular and regular both in shape and arrangement; ctenii that are never needle-like (Coburn & Gaglione 1992).

Features in the fossils, such as the frontal sensory canal that terminates in two projections, the quadrate with a long processus posterior, the ratio of the lengths of the preopercular ramus verticalis and ramus horizonatlis being 3 to 2, the large lamina ventralis and the presence of bifurcate spines, an operculum with two spines, an anal fin with three rigid fin spines, and 25 vertebrae all suggest a possible affinity to the extant Morone. The scale morphology of the family Moronidae is also the same as the studied fossils (see also Micklich 1990 and Micklich & Böhme 1997).

**Table 1. Measurements of fossils (in mm).**

<table>
<thead>
<tr>
<th></th>
<th>Pc2850</th>
<th>Pc2854</th>
<th>Pc2853</th>
<th>Kuč Kuč 30b 30a DB</th>
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<tr>
<td>% of SL</td>
<td>% of SL</td>
<td>% of SL</td>
<td></td>
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<tr>
<td>estimated standard length</td>
<td>300</td>
<td>350</td>
<td>300</td>
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<tr>
<td>anal fin length</td>
<td>39</td>
<td>13</td>
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<td>-</td>
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<td>90</td>
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<td>caudal penducle depth</td>
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<td>-</td>
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<td>14.7</td>
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<td>eye diameter</td>
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<td>50.3</td>
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<td>postorbital length</td>
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<tr>
<td>preventral length</td>
<td>120</td>
<td>40</td>
<td>-</td>
<td>-</td>
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</table>
The fossils cannot be referred to either the family Centropomidae (one spine in the ventral fin only), Percichthyidae (the ctenoid scales with simple needle-like ctenii on the posterior field), or Serranidae (the operculum with three spines, the ventral fin with one spine only), according to Nelson (1994).

Conclusions

This paper presents important information on the entire moronid fishes known from North Bohemian Paleogene. The study is based on comparison of a series of fossils from Kučlín with recent representatives of the families Moronidae [Morone labrax Linnaeus, 1758] and Percidae [Perca fluviatilis Linnaeus, 1758]. The presence of the genus Morone is confirmed based on well preserved specimens. Detailed morphology of skull elements (frontal, premaxilla, maxilla, quadratic, preoperculum and operculum), estimated number of vertebrae, fin formula, caudal skeleton (Micklich & Böhme 1997) and scales (Micklich 1990 and Micklich & Böhme 1997), shows direct affinity to the family Moronidae, genus Morone.

There is no significant similarity between the recent genus Perca and the studied specimens. Consequently, the assignment to the species “Perca” lepidota is not acceptable. The proposed determination for the studied fossils is Morone sp. These conclusions confirm the study of Micklich & Böhme (1997).

From the palaeoecological point of the view, the ctenoid scales of Morone sp. without marked annuli suggest that a uniform climate without grand temperature fluctuations existed at the time of the diatomite deposition.

Acknowledgements

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Table 2. Comparison of fin and number of vertebrae of fossil Morone with the recent representatives Morone labrax and Perca fluviatilis (for data see Nelson 1994, Pospíšil 1998 and Froese & Pauly 2007).

<table>
<thead>
<tr>
<th>fossil Morone sp.</th>
<th>Morone labrax</th>
<th>Perca fluviatilis</th>
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</thead>
<tbody>
<tr>
<td>spines rays</td>
<td>spines rays</td>
<td>spines rays</td>
</tr>
<tr>
<td>first dorsal fin</td>
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<td>VIII–X</td>
</tr>
<tr>
<td>second dorsal fin</td>
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<td>XII–XVI</td>
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<tr>
<td>pectoral fin</td>
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<td>I</td>
</tr>
<tr>
<td>ventral fin</td>
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<td>I–III</td>
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<tr>
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<tr>
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<td>17</td>
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<tr>
<td>vertebrae</td>
<td>25</td>
<td>39–42</td>
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</table>

References


