

Synopsis of fossil fish fauna from the Hermanowa locality (Rupelian; Central Paratethys; Poland): current state of knowledge

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Abstract This publication represents the first comprehensive review of the currently known palaeoichthyological diversity of the Hermanowa locality (Poland). Specimens were collected from a single outcrop belonging to the single IPM zone (IPM2-T according to the presence of the index taxon *Trachinus minutus*). The assemblage is composed of two elasmobranch taxa and 22 taxa of teleosts. Overwhelming part of the assemblage is represented by teleosts; elasmobranchs are present in less than 0.5 %, with one new taxon for the Polish Carpathians (*Physogaleus latus*). The meso-pelagic and bathy-pelagic fishes are missing; dominant part of the assemblage is composed of the neritic taxa. Developmental stages of some taxa were recognized and relatively common throughout the whole section. The assemblage is briefly discussed.

Keywords Fish · Teleostei · Elasmobranchii · Paleogene · Oligocene · Paratethys

1 Introduction

Oligocene–Miocene fishes of the Polish Carpathians have been intensively studied since the second half of the twentieth century by Anna Jerzmańska and her coworkers (e.g., Jerzmańska 1960, 1967, 1968, 1974, 1979; Jerzmańska and Kotlarczyk 1975, 1976; Jerzmańska and Świdnicka 2003; Kotlarczyk et al. 2006; for a complete overview of the references, see the last publication). Rich localities, such as Jamna Dolna provided important documentations in extraordinary detail (in a quantitative and qualitative sense) of this fauna, which inhabited the Central Paratethys region during the Oligocene to Early Miocene. Over time, an enormous collection of fish specimens from the region was assembled (today housed in Wrocław University), which, together with sedimentary and lithostratigraphic data, also allow the elaboration of an ichthyostratigraphical concept for the area, i.e., IPM zones (Kotlarczyk and Jerzmańska 1976; Kotlarczyk et al. 2006). Although these fish faunas have been intensively studied for a long time, the whole region is still attractive for palaeoichthyological exploration today.

The Hermanowa locality is located in southeastern Poland, about 12 km south of the center of Rzeszów (Fig. 1). Kotlarczyk et al. (2006) mentioned two places with the name Hermanowa: Hermanowa and Hermanowa Kamieniec (the latter place with two exposures; according to the original publication abbreviated as HE, HK₁ and HK₂, respectively). Nevertheless, the Hermanowa locality (HE *sensu* Kotlarczyk et al. 2006) is synonymous with the place described herein. Kotlarczyk et al. (2006) also briefly sketched the taxonomic composition of the assemblage, but this was based on a limited number of specimens. The locality was more recently intensively sampled from 2005 to 2015, and this collection comprises several hundred fish remains.

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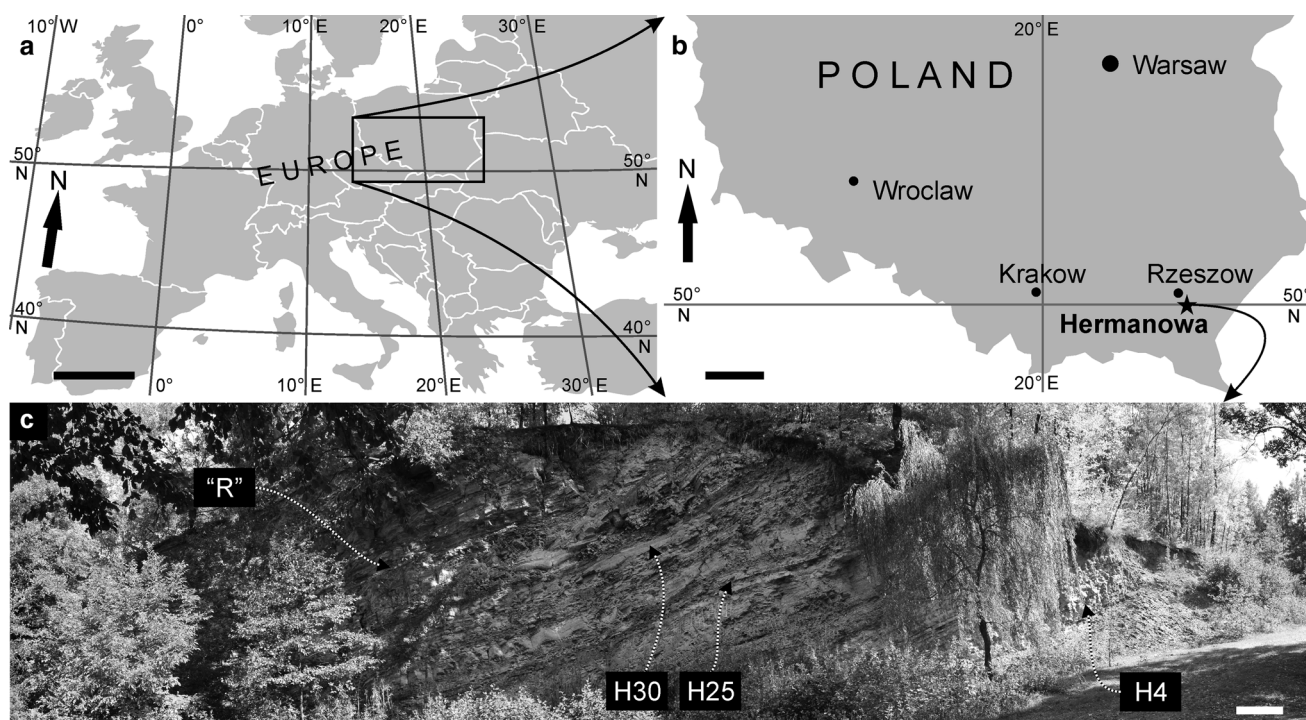


Fig. 1 Position of the Hermanowa locality; **a** within Europe (scale bar represents 500 km); **b** within Poland (scale bar represents 100 km); **c** outcrop of the locality with identification of selected important strata (scale bar represents 1 m; situation in the 2013 year)

The primary purpose of this paper is to provide an overview of the fish taxa of the Hermanowa locality, with an accompanying brief discussion of the fauna as a whole.

2 Material and locality

The material is housed at the University of Rzeszów (UR/KBS), Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Kraków (Pi-F), and the National Museum in Prague (NMP). The standard length (SL) abbreviation is used elsewhere in the text. Taxa synonymies are not included for all taxa due to space limitations (they may be found in the references). Photographs were taken with a Nikon D3100 camera, and a Canon EOS 1000D associated with a binocular Leica MZ6 stereomicroscope.

The material consists of natural moulds of skeletons in sediment (the original bone tissue was destroyed during the fossilization process); when bones are preserved (very rarely), these are limonitized. Soft tissue impressions (e.g., alimentary canal or body pigmentation) are rarely recognizable. Specimens were left unprepared, or were lightly prepared using small scalpels or needles.

2.1 Geological notes

The specimens were collected from a single outcrop (Fig. 2; GPS lat 49.934266; long 22.019500), located in the Hermanowa village. The presence of the index species *Trachinus minutus* (distributed in all parts of the profile) allows the assignment of the locality to the *Trachinus* event of the IPM2 zone (for the palaeoecologic interpretation of this event see Kotlarczyk et al. 2006). This biostratigraphic restriction allows the assignment of this section to the Rupelian age (Early Oligocene) and more precisely to the NP23 calcareous nannoplankton zone (see Kotlarczyk et al. 2006; fig. 33).

The fish fauna is well distributed in all parts of the profile, but seems to be more abundant in some sections (these are marked by a fish symbol in Fig. 2). Some taxa seem to be limited to only particular sections; this is mentioned in the descriptive part of the text where applicable. The upper part of the profile is less accessible for sampling.

The profile (Fig. 2) is based on the unpublished lithological description provided by Uchman to Kozdęba for her master thesis (although the description was not included in the thesis; Kozdęba 2008).

Figure 1 illustrates the stratigraphic correlation of the Rupelian stage across three sections. The left column shows the reference section with units H1 through H26. The middle column shows a section with units H27 through H32. The right column shows a section with units H33 through H38. Correlation lines connect equivalent units across the sections. Lithological symbols at the bottom indicate claystone, siltstone, and sandstone. Fish fossils are marked in several units.

Class Chondrichthyes GOODRICH, 1909
Subclass Elasmobranchii BONAPARTE, 1832
Order Lamniformes BERG, 1940
Family Cetorhinidae GILL, 1862
Genus *Keasius* WELTON, 2013
Keasius parvus (LERICHE, 1908)

The presence of this species in the locality is problematic. Lithology of the slabs is atypical for the locality, and

has not been observed directly in the profile (specimens were found in the rubble under the profile wall).

Order Carcharhiniformes COMPAGNO, 1973

Family Carcharhinidae JORDAN & EVERMANN, 1896

Genus *Physogaleus* CAPETTA, 1980

Physogaleus latus (STORMS, 1894)

Figure 3a, b

Synonymy Refer to Ciobanu (2002).

Material examined Pi-F/MP/10/1483/08 (counterpart Pi-F/MP/11/1483/08).

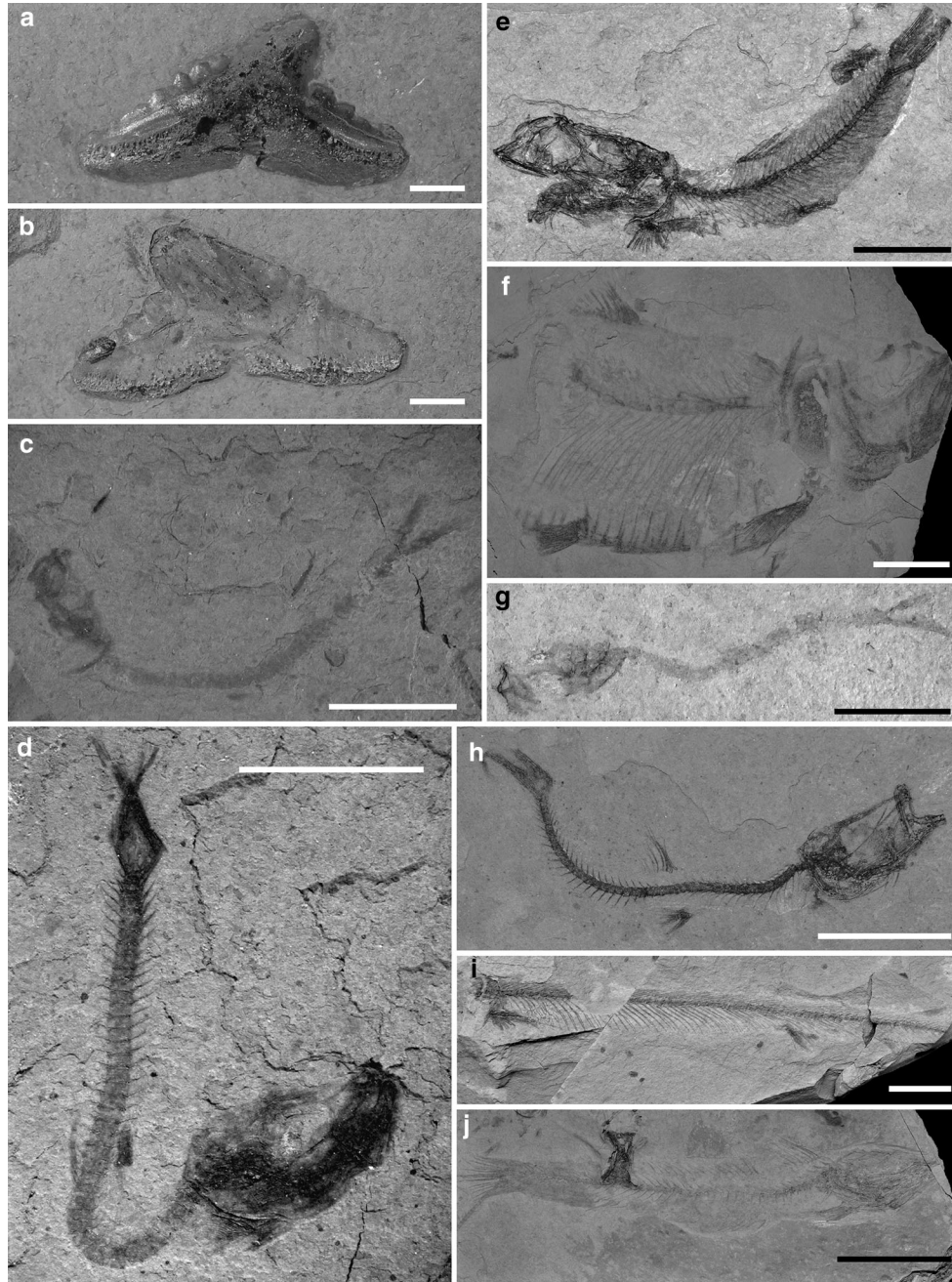


Fig. 3 Selected fish taxa of the Hermanowa locality; **a, b** *Physogaleus latus* (STORMS, 1894); **a** specimen Pi-F/MP/10/1483/08 (scale bar represents 2 mm); **b** counterpart specimen Pi-F/MP/11/1483/08 (scale bar represents 2 mm); **c, d, e** *Sardinella* cf. *S. sardinites* (HECKEL, 1850); **c** larval specimen UR/KBS/540 (scale bar represents 5 mm); **d** sub-adult specimen UR/KBS/546 (scale bar represents 5 mm); **e** adult specimen UR/KBS/130 (scale bar represents 10 mm);

f Clupeidae gen. et sp. indet., specimen Pi-F/MP/171/1648/15 (scale bar represents 10 mm); **g, h** “*Glossanodon*” *musceli* (PAUCĂ, 1929); **g** larval specimen UR/KBS/470 (scale bar represents 5 mm); **h** sub-adult specimen UR/KBS/615 (scale bar represents 10 mm); **i** *Holosteus* sp., specimen UR/KBS/151a (scale bar represents 10 mm); **j** *Palaeogadus* sp., specimen Pi-F/MP/16/1572/10 (scale bar represents 20 mm)

Description The single specimen (an upper lateral tooth) shows a wide root, with well-developed nutritive groove; short apex, inclined distally; tip not exposed; four wide cusplets in the distal heel; mesial cutting edge; crown tongue developed in transition from crown to root, ventrally bordered by vertical ridges; root in lingual view bears well developed lingual protuberance; basal edge of root bears numerous foramina.

Remarks The specimen was discovered in the lower part of the section. The occurrence of the species was recorded from the Early Oligocene of Belgium (Leriche 1910; Bor 1980), Paris Basin (Leriche 1910), Hungary (Weiler 1938), France (Pharisat 1991, 1998; Pharisat and Micklich 1998), Germany (Micklich and Parin 1996; Pharisat and Micklich 1998), and Romania (Ciobanu 2002). This species has a temporal distribution through the Early Miocene (for details see Cappetta 2012).

Division Teleostei *sensu* PATTERSON & ROSEN, 1977

Order Clupeiformes BLEEKER, 1859

Family Clupeidae BONAPARTE, 1831

Genus *Sardinella* VALENCIENNES, 1847

Sardinella cf. *S. sardinites* (HECKEL, 1850)

Figure 3c–e

Synonymy Synonymy of *S. sardinites* refer to Přikryl (2013).

Material examined 144 specimens—UR/KBŠ/ 1–4, 8, 13, 17, 25, 68, 77, 79–82, 84–88, 91, 93, 94, 96, 101, 102, 104, 105, 109, 111, 113, 114, 117–119, 124–126, 129–132, 134–136, 140, 149, 153, 154, 160, 163, 179, 189–192, 260, 261, 281, 282, 288, 289, 300, 311, 322, 326–328, 330, 342, 347, 359, 361, 364, 368, 372, 375, 384, 390, 407, 413, 418, 421, 424, 425, 427, 429, 439, 440, 446, 454, 457, 461, 466, 482, 485, 486, 488, 490, 494, 499, 501, 502, 531, 540, 543, 545, 546, 551, 561, 614, 617, 620, 625, Pi-F/MP/30, 40/1485/08, Pi-F/MP/1, 8, 11, 17, 19, 20, 26/1591/11, Pi-F/MP/2, 3/1592/11, Pi-F/MP/4, 7, 10, 11, 14/1510/08, Pi-F/MP/8, 10/1539/08, Pi-F/MP/31, 55, 67, 98, 99, 101, 102, 104, 128, 132, 134/1598/11 (some of them with counterparts).

Description Small fish with laterally compressed body. Head triangular; head length slightly less than three times in standard length. Mouth terminal, dorsally oriented. Lower jaw joint in front of anterior-most margin of orbit. Two supramaxillae. Orbit large, with parasphenoid exposed in ventral part. Prootic bulla seems to be larger than pterotic bulla. Opercle smooth, with no obvious ornamentation. Vertebral column consists of 42–45 preural vertebrae (but some specimens show fewer, about 40); about 21 pairs of ribs; three series of intermuscular bones. Dorsal fin located in middle of body, composed of 15–17 (in some specimens possibly 19) fin rays. Nine or ten supraneural bones are recognizable. First dorsal fin

pterygiophore is forked. The anal fin is shifted posteriorly and consists of 18 fin rays; the last two shifted to a more posterior position. Pectoral fin consists of 16–19 rays. Pelvic fins start at level of posterior part of dorsal fin, and consist of eight or nine rays. The series of abdominal scutes is developed anteriorly and posteriorly to the pelvic fin. Caudal fin deeply forked. Body covered by cycloid scales.

Remarks Clupeids from the Polish Carpathians were traditionally classified as *Clupea sardinites* (Jerzmańska 1968; Szymczyk 1978), but Daniltshenko (1980) and later also Grande (1985) suggested transferring this species to the genus *Sardinella*. The species has a large geographic distribution (for details see Grande 1985; and Carnevale et al. 2006) with a stratigraphic range from the Oligocene to the Middle Miocene. Despite the great need for a complete revision of many fossil clupeids, we retain the traditional classification scheme, but due to our specimens showing somewhat greater variability (especially in numbers of vertebrae) than specimens described by Jerzmańska (1968), specimens are classified as *Sardinella* cf. *S. sardinites*. The species is one of the most commonly found in different ontogenetic stages at the locality, including poorly ossified larvae, juveniles and (sub-) adults. The specimens are distributed throughout the section.

Family Clupeidae BONAPARTE, 1831

Genus and species indeterminate

Figure 3f

Material examined Pi-F/MP/171/1648/15 (part and counterpart).

Description A single incomplete specimen (with estimated SL about 150 mm) shows important differences the clupeid taxon described above, such as the lower jaw joint situated under the center of the orbit (or slightly posteriorly); the opercle bears well-developed postero-ventral striations; pelvic fin with seven or eight rays; pelvic fins start at the level of the anterior portion of the dorsal fin; abdominal scutes are more strongly developed. It is similar to the previous form in the number of pectoral fin rays (around 16), and cycloid scales.

Remarks Although this specimen is far from complete, it is definitely a different clupeid taxon than *Sardinella* cf. *S. sardinites* (described above), with possible affinities to several clupeids, including the genus *Alosa* (the taxon was mentioned from the Polish Carpathians under a younger synonym *Pomolobus* by Jerzmańska 1968). For a definitive taxonomic placement, better preserved specimens are needed.

Order Osmeriformes *sensu* NOLF & DOCKERY, 1990

Family Argentinidae BONAPARTE, 1846

Genus *Glossanodon* GUICHENOT, 1867

“*Glossanodon*” *musceli* (PAUČĀ, 1929)

Figure 3 g, h

Synonymy Refer to Přikryl (2013).

Material examined More than three hundred specimens (not listed completely herein)—e.g., UR/KBŠ/9, 11, 12, 14–16, 20–24, 40–55, 73 and many others (some of them with counterparts).

Description Small, slightly elongated fish. Head tear drop-shaped in lateral view, with terminal mouth; lower jaw joint at level of anterior margin of orbit; maxilla slightly bent with flattened posterior projection rounded antero-ventrally; preopercle with rami of approximately same length and two short ridges at angle of bone. About seven branchiostegal rays. Posttemporal articulates with supracleithrum in a 90° angle. Supracleithrum aligned vertically with cleithrum. Vertebral column consists of 45–47 vertebrae (abdominal vertebrae 24–26; caudal vertebrae 20–22) with 23 or 24 pairs of ribs. Intermuscular bones seem to be present. Left and right neural spines of anterior part of vertebral column apparently not fused in midline. Dorsal fin composed of 10–12 rays, located approximately mid-body. Anal fin shifted posteriorly (starts about four vertebrae posterior to first caudal vertebra), composed of 13 (or slightly more) rays. Pectoral fins in fairly ventral position, composed of 16 to 18 fin rays. Pelvic fins midway between pectoral and anal fins, just under origin of dorsal fin (or slightly anteriorly). Pelvic fins composed of eight to ten rays. Caudal fin deeply forked, composed of 10 + 9 principal rays.

Remarks The specimens are fairly abundant and represent different ontogenetic stages, almost throughout the stratigraphic section of the locality. The species is well distributed in Oligocene localities of the Central and Eastern Paratethys (Paučā 1929, 1934; Daniltshenko 1960; Jerzmańska 1967; Prokofiev 2005b; Gregorová 2011), but missing at the coeval localities of the Rhine valley (Pharisat 1991; Micklich and Parin 1996; Micklich 1998; Pharisat and Micklich 1998), Alpine foredeep (Wettstein 1886; von Rath 1859) and Iran (Arambourg 1967; the locality is of greater stratigraphic range now, see Afsari et al. 2014). The morphology and osteology of this species was described by Paučā (1929, 1934), Daniltshenko (1960), Jerzmańska (1967), and newly revised also by Prokofiev (2005b), who suggested the erection of a new genus *Austromallotus* to accommodate a part of the fossil material. We did not observe features considered diagnostic by Prokofiev (2005b) for the genus *Austromallotus* in our specimens, and thus retain the traditional classification to the genus *Glossanodon*.

Order Aulopiformes ROSEN, 1973

Family Paralepididae BONAPARTE, 1832

Subfamily Holosteinae PROKOFIEV, 2005

Genus *Holosteus* AGASSIZ, 1839

Holosteus sp.

Figure 3i

Material examined Three specimens—UR/KBŠ/251, 252, and probably also 265 (some of them with counterparts).

Description None of the specimens are complete (head, caudal portion and some fins are missing), but the remains belong to an elongate fish with numerous vertebrae (more than 70 preserved vertebrae, precise number unknown). Around 45 ribs; two series of intermuscular bones recognizable. Dorsal and anal fins shifted posteriorly; predorsal length greater than preanal length. Dorsal fin consists of more than 15 rays. Anal fin not preserved completely, but preserved rays suggest presence of more rays than found in dorsal fin. Pectoral fin shifted ventrally, composed of more than 15 rays. Pelvic fin has wide base; precise number of fin rays is not clear.

Remarks The specimens are restricted to the layers “H33” and “R”. The overall appearance of the specimens suggest an affinity to the family Paralepididae, and they can be placed in the Holosteinae subfamily on the basis of a greater predorsal than preanal distance (other features used by Prokofiev 2005a for defining this subfamily are not preserved). The subfamily comprises one single genus, with one early Eocene species from Monte Bolca (Carnevale et al. 2014) and probably one Oligocene species [Prokofiev 2005a; although some specimens from the Romanian Carpathians were classified in a separate species *H. fieniensis* by Constantin (2001), their separate taxonomic status should be verified].

Order Gadiformes *sensu* ENDO, 2003

Family Moridae GOODE & BEAN, 1896

Genus *Eophycis* JERZMAŃSKA, 1968

Eophycis jammensis JERZMAŃSKA, 1968

1968 *Eophycis jammensis* n. sp.—Jerzmańska: 413, text-fig. 8, pl. III, fig. 3.

2015 *Eophycis jammensis* JERZMAŃSKA, 1968—Přikryl: 626, figs. 1–10.

Material examined 45 specimens—UR/KBŠ/95, 97, 180, 183, 185, 201, 202, 204, 205, 207, 208, 213, 270, 271, 276, 285–287, 293–296, 302, 303, 308, 309, 312, 318, 414, 419, 471, 510, 511, 523, 530, 554, Pi-F/MP/23/1572/10, Pi-F/MP/4, 7, 9, 11–13/1592/11, NMP Tv 1002, 1003 (some of them with counterparts).

Remarks The species was morphologically described in detail by Přikryl (2015a). It should be noted that part of the undescribed uncatalogued material also studied (superficially similar to *E. jammensis*) suggests the probable presence of another form, provisionally classified as Gadiformes indet., that differs from *E. jammensis* in vertebral and fin ray formulas, and arrangement of fins.

Nevertheless, until better preserved and more numerous specimens are collected, we are not able to clarify the relationships of these two taxa.

Family Merlucciidae GILL, 1884

Genus *Palaeogadus* VON RATH, 1859

Palaeogadus sp.

Figure 3j

Material examined Nine specimens—UR/KBS/6, 29, 577, 578, Pi-F/MP/16/1572/10, Pi-F/MP/25, 26/1598/11, Pi-F/MP/12, 16/1591/11 (some of them with counterparts).

Description Slightly laterally compressed fish with moderately elongate body. Head triangular, with terminal mouth; lower jaw joint at level of posterior margin of orbit; premaxilla and dentary with well-developed teeth. Vertebral column composed of 44–45 vertebrae (23 abdominal; 21–22 caudal). Neural spines of anterior abdominal vertebrae enlarged; neural spine of first vertebra not fused with occipital part of skull. Abdominal vertebrae bear well-developed triangular parapophyses (wider anteriorly, tapered posteriorly); posterior margin of each parapophysis straight, anterior margin slightly sigmoidal to convex (shape trapezoidal in some cases); neighboring parapophyses not in contact with each other. Ribs relatively short. Epicentrals present. At least one supraneural seems to be present, just in front of first dorsal fin. First dorsal fin short, composed of 11 rays supported by 10 pterygiophores. Supraneural bone, and first and second pterygiophores housed between first and second neural spine. Second dorsal fin shifted very slightly posteriorly, composed of 28–30 rays. Anal fin starts at approximately same level as second dorsal fin, elongate and composed of 33–35 rays. About 16 anterior pterygiophores of anal fin in front of first haemal spine. Caudal fin rounded. X and Y accessory bones not present. Pectoral fin composed of 14 rays. Pelvic fins positioned anteriorly under pectoral girdle, composed of five rays. Body covered by cycloid scales.

Remarks The specimens approximately fit the characters of *Palaeogadus simionescui*, including the morphology of the parapophyses. Due to the currently unexplained variability of some features, and the need for revision of the *Palaeogadus* group, we classify our specimens as *Palaeogadus* sp.

Order Beloniformes BERG, 1937

Family Hemiramphidae GILL, 1859

Genus and species indeterminate

Figure 4a

Material examined Two specimens—UR/KBS/298 (part and counterpart); Pi-F/MP/54/1485/08.

Description Incomplete fragments of two individuals with head and anterior part of body (the following

description is related to better preserved specimen UR/KBS/298). Head tear drop-shaped. Frontals wide, roughly rectangular. Upper jaw shortened, lower jaw prolonged (although not preserved completely – rostrum is broken off). Lower jaw joint at level of anterior half of orbit. Orbit oval, with parasphenoid running through middle. Preopercle is “L” shaped, with horizontal limb slightly longer than vertical limb. 21 vertebrae preserved, in anterior part with ribs, but preservation is not perfect. Slightly elongated pectoral fins preserved in position perpendicular to body axis, composed of seven fin rays.

Remarks The specimens are incomplete, but general features of the body shape and elongated jaw allow us to classify the specimen to the order Beloniformes. Jerzmańska (1968) described beloniform fish from the Polish Carpathians, and classified them in the genus *Hemiramphus*, with a new species *H. jerzyi* (Jerzmańska 1985). Later, the species was transferred to the genus *Hyporhamphus* (see Bannikov 2010).

Order Gasterosteiformes *sensu* PIETSCH, 1978

Family Syngnathidae BONAPARTE, 1832

Genus and species indeterminate

Material examined Six specimens—UR/KBS/584, 588–590, Pi-F/MP/1/1510/08, Pi-F/MP/1/1593/11 (all of them with counterparts).

Description Specimens are small individuals, one is a sub-adult. Head length is about one tenth of standard length. Snout length is around half of head length. Abdominal part of body is slightly more than half of standard length. Ventrally exposed opercle shows radially arranged series of ridges. Scutes arranged in less than 40 rings. No spines recognizable on surface of scutes. No fins preserved except caudal fin. Caudal fin preserves less than 10 rays.

Remarks Syngnathids were described from different parts of the Paratethys region and classified in several taxa, with the most common representative being *Syngnathus incompletus* originally described from Romania (Cosmovici 1887). The more diverse Oligocene syngnathid assemblage was described from the Frauenweiler locality (Rhine valley; Micklich and Parin 1996) with three genera. The specimens are still under more detailed study and therefore classified within open nomenclature.

Subfamily Eogastrophinae JERZMAŃSKA, 1968 (Hipposyngnathinae *sensu* FRITZSCHE, 1980)

Genus *Hipposyngnathus* DANILTSHENKO, 1960

Hipposyngnathus neriticus JERZMAŃSKA, 1968

1968 *Hipposyngnathus neriticus* n. sp.—Jerzmańska: 437, text-figs. 15A, 16, pl. VII, figs. 2, 3a.

2011 *Hipposyngnathus neriticus* JERZMAŃSKA, 1968—Přikryl et al.: 561, figs. 2–4.

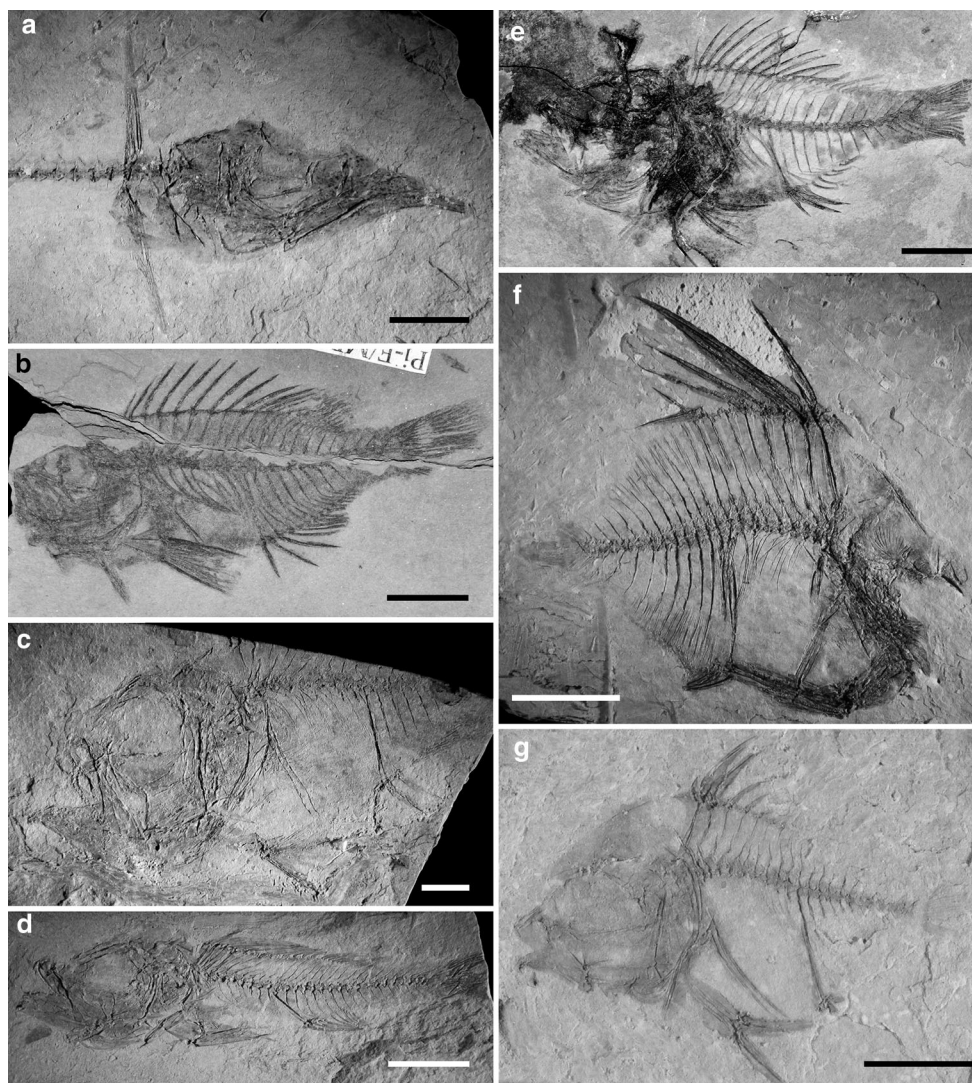


Fig. 4 Selected fish taxa of the Hermanowa locality; **a** Hemiramphidae gen. et sp. indet., specimen UR/KBS/298a (scale bar represents 5 mm); **b, c** *Priacanthus longispinus* LEDNEV, 1914; **b** specimen Pi-F/MP/19a/1510/08 (scale bar represents 10 mm); **c** specimen UR/KBS/572 (scale bar represents 2 mm); **d** *Repropca sabai* (PAUCĂ, 1929), specimen UR/KBS/236a (scale bar represents 5 mm); **e** *Oliganodon*

budensis (HECKEL, 1856), specimen Pi-F/MP/18/1592/11 (scale bar represents 10 mm); **f** *Capros rhenanus* (WEILER, 1920), specimen Pi-F/MP/5a/1592/11 (scale bar represents 5 mm); **g** *Capros* cf. *C. caprosoides* (COSMOVICI, 1887), specimen UR/KBS/278a (scale bar represents 3 mm)

Material examined Five specimens—UR/KBS/585–587, Pi-F/MP/4, 5/1572/10 (some of them with counterparts).

Remarks The species was morphologically described in detail by Přikryl et al. (2011). The specimens are distributed in the lowermost part of the profile (H5 layer).

Family Centriscidae RAFINESQUE, 1810

Genus and species indeterminate

Material examined Four specimens—UR/KBS/200, 203, Pi-F/MP/8/1592/11, Pi-F/MP/172/1648/15 (some of them with counterparts).

Description Small specimens, incomplete, greatly shortened body, with elongated snout. Radially ornamented

opercle; well-developed dorsal and ventral scutes. No fins recognizable.

Remarks The overall appearance of the specimens allow us to classify them as centriscids, but the specimens are still under more detailed study, and therefore are not classified more precisely (for details and review of up to date literature see Parin and Micklich 1996).

Order Perciformes BLEEKER, 1859

Family Priacanthidae GILL, 1872

Genus *Priacanthus* OKEN, 1817

Priacanthus longispinus LEDNEV, 1914

Figure 4b, c

Synonymy Refer to Bannikov (2010).

Material examined Two specimens—UR/KBS/572, Pi-F/MP/19/1510/08 (both of them with counterpart).

Description Fish with relatively deep body; maximum body depth about one third standard length, similar to head length. Head approximately as deep as long, with large eye. Lower jaw joint at level of center of orbit. Preopercle bears serrations posteriorly; ventral margin with long spine developed at angle of bone. Opercle bears two spines at postero-dorsal margin of bone. Vertebral column composed of ten abdominal and 13 caudal vertebrae. Ribs developed on seven precaudal vertebrae. Epipleurals present. Single dorsal fin composed of 10 spines and 11 rays. No supraneurals observed. Anal fin composed of three spines, and 10 or 11 rays. Pectoral fins relatively short, with wide base, about 15 fin rays. Pectoral girdle has robust cleithrum, with spine developed at postero-dorsal margin. Single postcleithrum. Pelvic fins under pectoral fins, composed of one spine and five soft rays. Caudal fin and supporting skeleton not preserved in any studied specimens. Surface of body covered by modified cycloid scales (spinoid scales according to Roberts 1993), with spines at posterior margin. Lateral line position not clear.

Remarks Oligocene priacanthids are well known from many localities in all parts of the Paratethys realm (more than three species were described, traditionally classified in the genus *Priacanthus* or *Pristigenys*). These localities include sites in the Alpine foredeep (Wettstein 1886), Rhine valley (Pharisat 1991; Micklich and Parin 1996; Pharisat and Micklich 1998), Carpathians (Kotlarczyk et al. 2006) and Caucasus (Daniltschenko 1960; Bannikov 2010; Prokofiev 2013). It is probable that some of the poorly preserved specimens from the Hermanowa locality (classified as a *Percoidei* indet.) also belong to priacanthids.

Family Repropcidae BANNIKOV, 1991

Genus *Repropca* BANNIKOV, 1991

Repropca sabbai (PAUCĂ, 1929)

Figure 4d

1929 *Properca sabbai* n. sp.—PAUCĂ: 117.

1934 *Properca sabbai* PAUCĂ—PAUCĂ: 624, pl. III, fig. 5.

1968 *Properca sabbai* PAUCĂ, 1929—Jerzmańska: 446, text-fig. 18, pl. VI, fig. 2.

1991 *Properca sabbai* PAUCA 1929—Pharisat: 41, figs. 30, 31.

Material examined UR/KBS/236 (part and counterpart).

Description: Small fish (ca. 25 mm SL) with spindle-shaped body. Head length less than one-third of SL; orbit diameter about one third of head length; preorbital part of head bigger than postorbital part. Head triangular, with terminal mouth and lower jaw joint at level of center of orbit. Teeth recognizable on premaxilla and dentary. Preopercle bears six

spines at ventral margin of bone, posterior spine is the largest and oriented posteriorly. Eight or nine branchiostegal rays observed. Vertebral column consists of 11 or 12 abdominal and 18 caudal vertebrae. Caudal skeleton not preserved sufficiently. Eight pairs of ribs; epipleurals recognizable. Single dorsal fin starts just behind head, contains 12 spines (first spine very short, third spine longest) and 13 soft rays. Two supraneurals. Anal fin consists of three spines and seven soft rays. Pectoral fins start at ventro-lateral flank of body, closely behind head. Fin consists of 14 relatively short rays. Cleithrum robust, dorsally oriented spine in postero-dorsal margin. Pelvic fins ventral to pectoral fins, composed of one spine (strongly elongated) and probably five soft rays. Surface of body covered by small cycloid scales.

Remarks The repropcids were described from localities in the Romanian and Polish Carpathians (Paucă 1929, 1934; Jerzmańska 1968, respectively), Rhine valley (Pharisat 1991; Micklich and Parin 1996; Micklich 1998; Pharisat and Micklich 1998), and Caucasus (Bannikov 1991, 2010; Prokofiev 2013).

Family Carangidae RAFINESQUE, 1815

Genus and species indeterminate

Material examined Single specimen—UR/KBS/571 (part and counterpart).

Description Only one, severely fragmented (and poorly preserved) specimen that lacks skull and posterior-most part of body (estimated SL is about 100 mm). Body relatively deep, with eight preserved abdominal and 11–12 preserved caudal vertebrae. Anal fin has long base, first pterygiophore (with anteriorly enlarged ventral portion) bears two short bulky spines, and 22 rays. Dorsal fin composed of seven or eight preserved spines, and 22 rays.

Remarks The specimen is classified within Carangidae, but a more precise classification is still under study.

Percoidei incertae familiae

Genus *Oliganodon* BANNIKOV, 2010

Oliganodon budensis (HECKEL, 1856)

Figure 4e

Synonymy Refer to Bannikov (2010).

Material examined 36 specimens—UR/KBS/ 45, 122, 237, 242, 243, 253, 254, 258, 259, 263, 266, 267, 273, 310, 313, 314, 321, 355, 367, 397, 400, 403, 404, 428, 458, 517, 548, 574, 593, 594, Pi-F/MP/18/1592/11, Pi-F/MP/20/1510/08, Pi-F/MP/21/1510/08, Pi-F/MP/15/1592/11, Pi-F/MP/19/1592/11, Pi-F/MP/10/1591/11 (some of them with counterparts).

Description Small to medium sized fish. Premaxilla and dentary bear teeth. Teeth around premaxillary symphysis slightly enlarged. Lower jaw joint at level of posterior margin of orbit. Preopercle bears fine serrations at postero-

ventral margin of bone. Opercle has two spines at postero-dorsal corner of bone. Vertebral column composed of 24 vertebrae (10 abdominal and 14 caudal). Abdominal vertebrae bear ribs and epipleurals. Three supraneurals present. Dorsal fin composed of 10 spines and 10 rays. Anal fin composed of three spines and eight (in several cases nine) rays. Pectoral fins composed of 16–17 rays; posterior tips of longest rays can reach level of origin of anal fin. Pelvic fins have one spine and five rays, positioned anteriorly at level of pectoral fins. Body covered by ctenoid scales, some scales in head region (especially in smaller individuals) seem to be cycloid.

Remarks This percoid is common in many Paratethys localities (for review of the principal literature, see Bannikov 2010: 86), and the material should be revised as a whole for a more detailed understanding of this taxon. Specimen Pi-F/MP/19/1592/11 is also tentatively assigned to this species, as it fits the characteristics well, with the notable deviation of 15 caudal vertebrae.

Family Ammodytidae BONAPARTE, 1846

Genus and species indeterminate

Material examined Four specimens—UR/KBS/245–249 (some of them with counterparts).

Description Specimens not well preserved, but short head with terminal mouth observable (lower jaw slightly protruding past upper jaw); small eye; elongate body; pelvic fins absent; vertebral column composed of about 60 vertebrae; caudal fin deeply forked.

Remarks The specimens are limited to the “R” section of the profile. The specimens are classified within the family Ammodytidae, but better preserved specimens are needed for a more precise determination. Only one species, *Ammodytes antipai*, was described from the Oligocene of the Paratethys area of the Carpathians (Paučá 1929, 1934; Jerzmańska 1968), and Caucasus (Daniltschenko 1960; Bannikov 2010).

Family Trachinidae RISSO, 1826

Genus *Trachinus* LINNAEUS, 1758

Trachinus minutus (JONET, 1958)

Synonymy Refer to Přikryl (2009).

Material examined 45 specimens—UR/KBS/115, 121, 186, 206, 279, 280, 291, 292, 299, 307, 319, 320, 358, 476, 477, 478, 480, 564–570, 611, Pi-F/MP/45/1485/08, Pi-F/MP/5, 9/1510/08, Pi-F/MP/4, 6–12, 14, 17–22/1572/10, Pi-F/MP/60/1598/11, NMP Tv 1001 (some of them with counterpart).

Remarks The species was described in the detail by Přikryl (2015b).

Family Caproidae LOWE, 1843

Genus *Capros* LACEPÈDE, 1802

Capros rhenanus (WEILER, 1920)

Figure 4f

Synonymy Refer to Baciú et al. (2005).

Material examined Two specimens—Pi-F/MP/5/1592/11 (part and counterpart; the following description is related with this specimen), UR/KBS/269 (less complete, but clearly belonging to the same species).

Description Small fish with convex dorsal and ventral body margins. Body depth less than one half of SL. Suspensorium, visceral part of cranium and parts of some fins missing. Supraoccipital crest well developed, with thickened anterior and concave posterior margin. Skull roof bones ornamented by radially arranged ridges. Supraoccipital crest reaches anteriorly past level of posterior-most orbit. No supraneurals. Base of spiny dorsal fin approximately same length as base of soft rayed dorsal fin. Vertebral column consists of 23 vertebrae (10 + 13). Ribs present at third to tenth abdominal vertebrae. First dorsal fin not completely preserved: one spine associated with the first pterygiophore (therefore the first one and supernumerary), was lost, the longest spine (on the second pterygiophore) is therefore the third one, and another five spines are recognizable. Spine associated with sixth pterygiophore not preserved. Total count of spines in dorsal fin therefore should be nine. Soft rays not preserved, but number of pterygiophores suggests that about 16 or 17 were present. Seventh interneural space vacant (in the sense of Birdsong et al. 1980). Anal fin bears three spines (first is longest); soft rays not sufficiently preserved, but it is possible to estimate about 18 soft rays (on the basis of their pterygiophores). Caudal skeleton and fin not preserved sufficiently to provide usable information.

Remarks Fossil caproids (including all up to date literature), their systematics, relationship and record were fully revised by Baciú et al. (2005), with one interesting new addition to the Polish fauna published recently by Bienkowska-Wasiluk and Bonde (2015).

Capros cf. *C. caprosoides* (COSMOVICI, 1887)

Figure 4g

Synonymy Synonymy of *C. caprosoides* refer to Baciú et al. (2005).

Material examined Single specimen—UR/KBS/278 (part and counterpart).

Description Small, almost completely preserved deep-bodied fish. Head length slightly less than half of SL. Mouth terminal; jaw joint at level of anterior portion of orbit. Orbit large; preorbital distance smaller than orbit. Supraoccipital crest starts above posterior portion of orbit. Skull roof ornamented by small tubercles. Preopercle bears fine spines at ventral margin of bone; size of spines increases at angle of preopercle. Strong spine-like postcleithrum. Vertebral

column composed of 22 vertebrae (10 + 12). Thin ribs recognizable only in posterior part of abdominal cavity. Dorsal fin preserves only spinous part, with nine spines (first is shortest and in supernumerary association with first pterygiophore; second and third spines approximately the same length, but second one is more robust; other spines decrease in length posteriorly). Pterygiophores accommodated one by one in interneural spaces (in the sense of Birdsong et al. 1980), with exception of seventh interneural space that is vacant. Anal fin incompletely preserved, only bases of three spines recognizable. Pectoral fins not recognizable. Pelvic fins shifted anteriorly, but only proximal parts of spines are preserved. Caudal fin insufficiently preserved, but 13 caudal fin rays recognizable.

Remarks The general description, anatomy and meristic features fit relatively well with those of *Capros caprosoides* (for details see Baciu et al. 2005), but some features seem to be slightly different (second and third dorsal spines are approximately same long, while third dorsal spine should be longest in *C. caprosoides*) or are not completely preserved (uncertainty in numbers of the soft rays in unpaired and paired fins). The specimen is thus classified as *Capros* cf. *C. caprosoides*.

Family Scombridae RAFINESQUE, 1815

Genus and species indeterminate

Material examined Two specimens—UR/KBS/277, 612 (both of them with counterpart).

Description Both specimens consist of incomplete fragments (following description is related to specimen UR/KBS/277). Postcranial section without caudal fin show three preserved abdominal and 17 caudal vertebrae (16th vertebra is shortened). Rib attached at parapophysis of last abdominal vertebra. Preserved dorsal fin shows one spine, 11 rays, four finlets; anal fin with one spine, 11 rays, four finlets. Body covered by small cycloid scales.

Remarks The specimen is classified within Scombridae, but a more precise classification is still under study.

Family Trichiuridae RAFINESQUE, 1810

Genus *Anenchelum* BLAINVILLE, 1818

Anenchelum sp.

Material examined 62 specimens—UR/KBS/45, 52, 100, 106, 107, 194–196, 198, 225–227, 233, 234, 306, 329, 331, 334, 351, 362, 365, 366, 398, 402, 406, 415, 416, 430, 431, 441–443, 459, 460, 462, 463, 473–475, 504, 508, 515, 521, 552, 573, 609, 621, Pi-F/MP/15, 18, 21/1591/11, Pi-F/MP/1, 14/1592/11, Pi-F/MP/2/1593/11, Pi-F/MP/69, 72, 74, 75, 81, 96, 105, 108, 109, /1598/11 (some of them with counterpart).

Description Severely fragmented material (especially in bigger specimens) does not allow a complete description of this strongly elongated fish. Head tapered anteriorly, with

terminal mouth; lower jaw joint at level of anterior portion of orbit. The surface of anterior-most part of dentary bears strong dermal sculpturing. Premaxilla and dentary bear teeth (there are two types of teeth recognizable in the premaxilla; character of teeth in the dentary is not clear). Seven branchiostegal rays. Vertebral column not complete in any specimen; 39 vertebrae present in abdominal part. Dorsal fin starts just behind head, number of spines and rays not known. Interstitial pterygiophores visible in some specimens. Pectoral fins elongate. Pelvic fins reduced to flattened spines. Other details not visible.

Remarks Along with bigger specimens, some presumed to be larvae and juveniles specimens were discovered. Trichiurids are commonly found in the Paratethys region, and are classified within several species (for details see Bannikov 2010), with the most common species being *A. glarisianum* in the Central Paratethys (for more information see new morphological study by Gregorová 2010).

Family Propercarinidae BANNIKOV, 1995

Genus *Propercarina* PAUCĂ, 1929

Propercarina problematica PŘIKRYL, BANNIKOV, GRĂDIANU, KANIA & KRZEMIŃSKI, 2014

Synonymy Refer to Přikryl et al. (2014).

Material examined Single specimen—Pi-F/MP/170/1626/14 (part and counterpart).

Remarks The species was described in detail by Přikryl et al. (2014). The specimen was collected in the “R” section of the outcrop.

Order Pleuronectiformes BLEEKER, 1859

Genus and species indeterminate

Material examined Single specimen—Pi-F/MP/15/1572/10 (part and counterpart).

Remarks This poorly preserved specimen is classified as a flatfish due to its overall appearance. The specimen is currently under closer study.

4 Discussion

The above descriptions of about seven hundred specimens cover a good representative sample of the fish fauna of the Hermanowa locality (an additional more than one hundred catalogued specimens have not yet been classified more precisely). Although the locality also provided abundant lepidological (i.e., scales) and ichnological (coprolites and rare bioturbation) material, along with scarce remains of swimming crabs (*Portunus* sp.) and sea turtles (*Glarichelys* sp.), these specimens were not taken into account herein.

Composition of the assemblage shows several interesting features (Table 1; Fig. 5).

Table 1 Representatives of the fish fauna at the Hermanowa locality (and their percentage)

Taxa	Number of specimens	%
<i>Keasius parvus</i>	2	0.29
<i>Physogaleus latus</i>	1	0.14
Clupeidae	145	20.86
<i>"Glossanodon" musceli</i>	315	45.32
<i>Holosteus</i> sp.	3	0.43
<i>Eophycis jamnensis</i>	45	6.47
<i>Palaeogadus</i> sp.	9	1.29
Hemirampidae gen. et sp. indet.	2	0.29
Syngnathidae gen. et sp. indet.	6	0.86
<i>Hipposyngnathus neriticus</i>	5	0.72
Centriscidae gen. et sp. indet.	4	0.58
<i>Priacanthus longispinus</i>	2	0.29
<i>Repropca sabbai</i>	1	0.14
Carangidae gen. et sp. indet.	1	0.14
<i>Oliganodon budensis</i>	36	5.18
Ammodytidae gen. et sp. indet.	4	0.58
<i>Trachinus minutus</i>	45	6.47
<i>Capros rhenanus</i>	2	0.29
<i>Capros</i> cf. <i>caprosoides</i>	1	0.14
Scombridae gen. et sp. indet.	2	0.29
<i>Anenchelum</i> sp.	62	8.92
<i>Propercarina problematica</i>	1	0.14
Pleuronectiformes gen. et sp. indet.	1	0.14
Total	695	100

Although elasmobranchs are not present in large numbers (fewer than 0.5 %), the material shows there was a greater diversity of sharks in the Polish Carpathians than was previously assumed, with the newly recognized presence of *Physogaleus latus*. This species was described from several localities of the Paratethys realm, but was initially recognized in Oligocene sediments of the region (the species was not mentioned by Kotlarzyk et al. 2006, nor by Bieńkowska-Wasiluk and Radwański 2009). The remainder (i.e., overwhelming part) of the assemblage is represented by teleosts. Also notable is the presence of two clearly different forms of caproids in the single locality.

Typical meso- to bathy-pelagic fishes (such as gonostomatids and/or myctophids) are missing, and the dominant part of the assemblage is composed of the neritic argentinid *"Glossanodon" musceli* (about 45 %) and clupeids (about 20 %). Other taxa are significantly underrepresented; more than 5 % representation was noted only in the trichiurid *Anenchelum* (about 9 %), the morid *Eophycis jamnensis* (about 6.5 %), and the perciforms *Trachinus minutus* (about 6.5 %), and *Oliganodon budensis* (about 6.5 %). Acanthopterygians (as a whole) represent slightly more than 25 %, but are very diverse, with more than 16

recognized taxa. Other groups are present in significantly smaller numbers.

Therefore, the locality is similar (in primary qualitative features) to Jamna Dolna D-G, Leszczawa (Jerzmańska 1968: table 8), Rogi (Kotlarzyk et al. 2006), and Rudawka Rymanowska (Bieńkowska-Wasiluk 2010), and in addition to the Polish Carpathians, a similar assemblage was described from the Bystré locality in the Central Paleogen of Slovakia (Gregorová et al. 2012). Surprisingly, the presence of some taxa, such as centriscids and *Priacanthus longispinus* suggests also an affinity to other IPM zones (such as IPM 1, 4, 4A, 6; for details see Kotlarzyk et al. 2006); nevertheless, these deviations are hard to interpret at the present time (many authors consider IPM zonation to be tentative).

An interesting question is the estimation of the original palaeobathymetry of the locality. As was mentioned above, the greatest part of the assemblage is composed by neritic fishes. Furthermore, practically all of the specimens (with the exception of specimens of *Anenchelum*) are individuals of small size (max-SL barely 10 cm), which are supposedly easily influenced by water currents. Thus, it is difficult to estimate the original bathyal conditions, but the absence of gonostomatids and myctophids (commonly found in many non-IPM2 localities of the Polish Carpathians; see Kotlarzyk et al. 2006) does not suggest the area was originally a typical deep-water environment.

Furthermore, light-colored fine-grain sediments have exceptional preservation allowing the recognition of early developmental stages of some taxa. Non-adult specimens of different taxa (together with *Trachinus* and *Hipposyngnathus* specimens) are relatively common throughout the whole section, but are most common in the lower part of the "H5" layer (that is probably equivalent of the layer "E" *sensu* Kotlarzyk et al. 2006, p 39). This ontogenetically immature assemblage is outstandingly preserved due to specific taphonomic conditions (although difficult to specify more precisely at the moment), probably related to a hypo- to anoxic regime close to the bottom. The non-adult specimens provide data on the ontogenetic variability of taxa under consideration, and evaluation of the true importance of selected features (such as in *Eophycis jamnensis* and *Trachinus minutus*; see Přikryl 2015a, b, respectively) and the locality such supplies new information regarding the non-adult fish-fauna of the Paratethys (previously studied properly only by very few authors, such as e.g., Świdnicki 1988; or Micklich et al. 2009).

The other very productive part of the section is the so called "R layers", with trachinids, *Palaeogadus*, *"Glossanodon"*, ammodytids and *Propercarina*. This section is also atypical for the profile in having significantly more diatomaceous sediment. It is difficult to definitively classify these layers as related to mass mortality (although

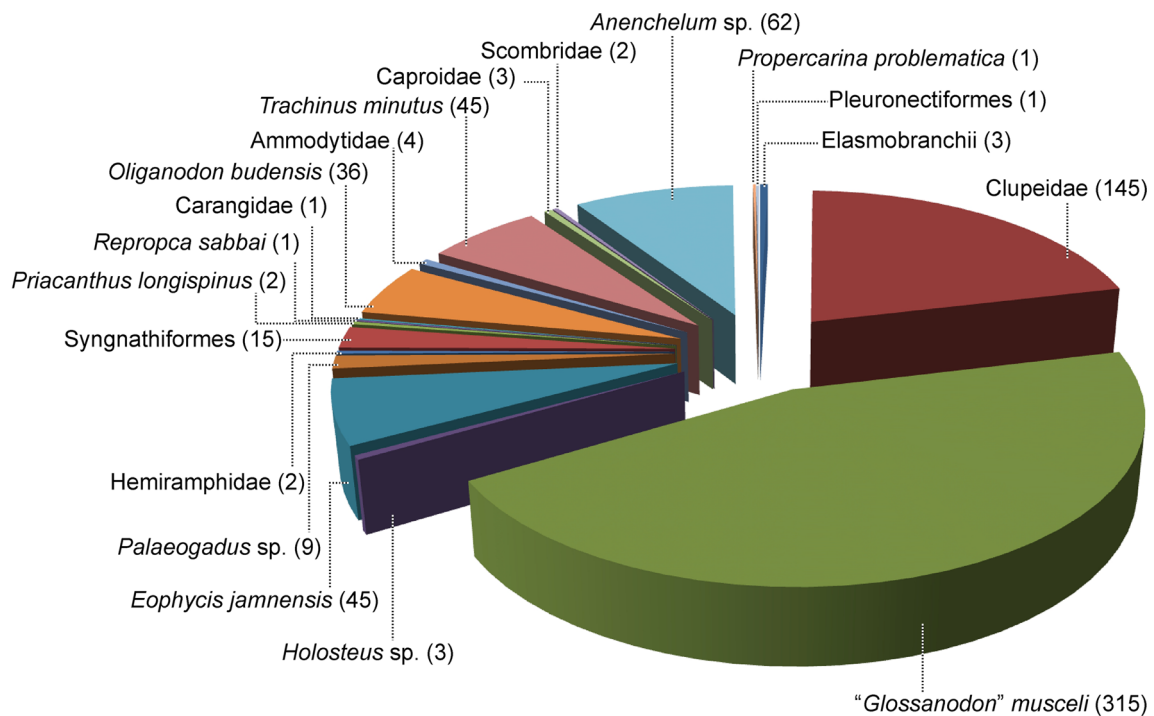


Fig. 5 Representation of the fish fauna of the Hermanowa locality

fossils in this section of the outcrop are more numerous than in other parts), but probably they may be related, as are other parts of the profile, to an insufficiently ventilated (oxygenated) environment, as was generally mentioned by Báldi (1980).

5 Conclusion

The collection of fossil fish from the Hermanowa locality (Rupelian) provides following data:

1. The assemblage is composed of two elasmobranch taxa (*Keasius parvus*, *Physogaleus latus*) and 22 taxa of teleosts (*Sardinella* cf. *S. sardinites*, Clupeidae gen. et sp. indet., "*Glossanodon*" *musceli*, *Holosteus* sp., *Eophycis jamnensis*, *Palaeogadus* sp., Hemiramphidae gen. et sp. indet., Syngnathidae gen. et sp. indet., *Hipposyngnathus neriticus*, Centriscidae gen. et sp. indet., *Priacanthus longispinus*, *Reppoca sabbai*, Carangidae gen. et sp. indet., *Oliganodon budensis*, Ammodytidae gen. et sp. indet., *Trachinus minutus*, *Capros rhenanus*, *Capros* cf. *C. caprosoides*, Scombridae gen. et sp. indet., *Anenchelium* sp., *Propercarina problematica*, and Pleuronectiformes gen. et sp. indet.).
2. *Physogaleus latus* is recognized for the first time in the Polish Carpathians.

3. Typical meso- and bathy-pelagic fish taxa are missing and the dominant part of the assemblage is composed of the neritic fishes with very diverse acanthopterygians.
4. It is difficult to estimate the original bathyal conditions of the locality.
5. Light-colored fine-grain sediments have exceptional preservation allowing the recognition of early developmental stages of some taxa, most common in the lower part of the "H5" layer.

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