Decapod crustacean assemblage from the middle Miocene (Badenian) of the Oslip sand pit, Austria (Eisenstadt-Sopron Basin)

Matúš Hyžný[1*] & Dominik Mihálik[2]

[1]Department of Geology and Paleontology, Faculty of Natural Sciences, Comenius University, Mlynská dolina, Ilkovičova 6, SK-842 15 Bratislava, Slovakia; e-mail: matus.hyzny@uniba.sk;
[2]Potvorice 80, SK-916 25 Potvorice, Slovakia
*corresponding author

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Abstract: From the sands of the Baden Group exposed in the Oslip sand pit (Eisenstadt-Sopron Basin; Burgenland, Austria), numerous isolated decapod crustacean claw elements were collected. The age of the material is indirectly assigned to the late Badenian (early Serravallian). The decapod assemblage consists of axiidean ghost shrimps (Callichiridae gen. et sp. indet.), paguroid hermit crabs (*Petrochirus priscus*), and brachyuran crabs (*Lucanthonisia eotvoesi*, *Calappa heberti*, *Maja* sp., *Parthenopoides tetenyensis*, *Actumnus telegdii*, *Liocarcinus rakosensis*, *Charybdis fragilis*, *Xantho moldavicus*). Taxonomically, the assemblage is close to the upper Badenian decapod assemblages from the Budapest area, Hungary. All studied decapod specimens are represented by isolated and often fragmentary cheliped elements. The assemblage is dominated by heavily calcified elements, notably of right dactyli (movable fingers) of *C. heberti* and remains of crusher claws of *L. rakosensis*. The lithology of the fossil-bearing settings and the fragmentary nature of decapod material suggests a near-shore, shallow marine environment with high hydrodynamic energy.

Key words: Decapoda; Axiidea; Paguroidea; Brachyura; Serravallian; taxonomy; palaeoenvironment

1. INTRODUCTION

Decapod crustaceans from the Miocene strata of Austria have been studied since the 19th century (Reuss, 1859, 1871; Bittner, 1877; Toula, 1904; Glaessner, 1924, 1928; Bachmayer, 1950, 1953, 1954, 1962; Bachmayer & Küpper, 1952; Bachmayer & Tollmann, 1953; Müller, 1984). Most of these occurrences relate to Badenian (Langhian–lower Serravallian) strata, which include various sediments from the onshore (marginal) to offshore (basinal) facies of the Central Paratethys Sea (Kováč et al., 2017a, 2017b).

Sands of the Badenian age exposed in the Oslip sand pit (located in Austrian part of the Eisenstadt-Sopron Basin) yielded numerous isolated decapod claw elements. Remains of crabs were already mentioned by Dullo (1983). Müller (1984: p. 47) mentioned presence of several crab taxa, based on a short visit ("a stay of an hour") of the locality. The aim of the present contribution is a re-evaluation of the decapod fossil record of the Oslip sand pit as resulted from further collecting in the last several decades.

2. GEOLOGICAL SETTINGS

The Eisenstadt-Sopron Basin is located in eastern Austria and covers also a part of Hungary. The lithologic and tectonic development of the Eisenstadt-Sopron Basin is closely linked with that of much larger Vienna Basin in the north. The sedimentary infill of the Eisenstadt-Sopron Basin attains the thickness of ca. 1,500 m and its sedimentation started in the early Miocene and ended in the late Miocene. Unfortunately, the lithostratigraphy of the Eisenstadt-Sopron Basin is not fully resolved, with various lithostratigraphic units having only informal names (Harzhauser, 2022).

The Oslip sand pit is located in east of the village of Oslip, Burgenland (Fig. 1A, GPS 47°49'28'' N, 16°38'10'' E). It is called "sand pit" because the sand facies prevail in the outcrop; however, also limestones are exposed here (Dullo, 1983; Häusler et al., 2015). Lithostratigraphically, the sands are broadly attributed to the Baden Group as defined by Harzhauser et al. (2020). Because the sands laterally change into limestones of the late Badenian age ("St. Margarethen Limestone" of the Rabensburg Formation sensu Harzhauser et al., 2020), the same age is assumed also for the fossil content of studied sands. Müller (1984) assigned the studied decapod remains questionably to the middle Badenian.

Details about the lithology of the exposure in the Oslip sand pit were given by Dullo (1983) and Häusler et al. (2015). A simplified section is shown in Fig. 1B. The studied material of isolated decapod cheliped fingers was collected from the sandy, ca. 1-m thick layer with the *Ophiomorpha* burrows (Müller, 1984: p. 47). The layer with decapods is overlain by corallinacean limestone.

3. MATERIAL AND METHODS

Studied decapod material consists exclusively of remains of two distalmost elements of chelipeds, i.e., propodus and dactylus. The prominent part of the propodus is termed manus, whereas its distalmost extension is a fixed finger. The movable finger (dactylus) is the distalmost cheliped element, which together with a fixed finger forms a claw. Dactyli and fixed fingers are commonly called fingers. Occlusal margin/surface of cheliped fingers can be entire (without armature) but often it is armed with teeth. In heterochelous taxa, each claw differs from the other in shape and/or size. Commonly, the crusher claw is the more robust one, while the cutter claw is the slenderer one. Terminology used for cheliped dentition follows Schäfer (1954) and Spiridonov et al. (2014).

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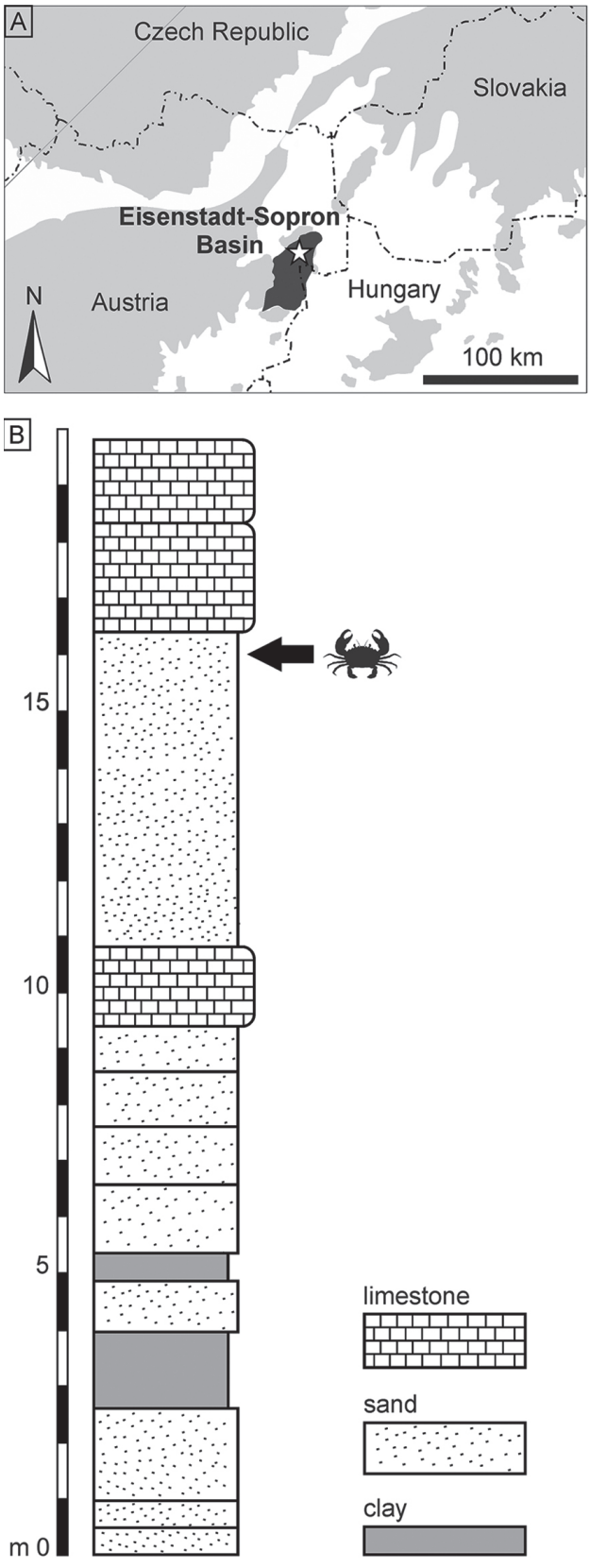

Fig. 1. Studied locality. **A,** Location of the Oslip sandpit (asterisk) within the Eisenstadt-Sopron Basin (in dark grey); white represents Neogene basins. **B,** Simplified lithostratigraphic section of the strata exposed in the Oslip sandpit (based on Dullo, 1983). Decapod specimens were collected from the upper part of the section (indicated by a crab icon).

Irrespective of decapod group and the way how the respective animals hold their claws, for the sake of uniformity, the orientation terms used in the material description follows a simple rule: the fixed finger is always considered to be a part of "lower margin" of the propodus. Consequently, the opposing margin is termed as "upper margin". Lateral surfaces are called as "inner lateral surface", which is closer to the body of the animal, and "outer lateral surface" opposing it.

Altogether 295 isolated cheliped elements were examined. Photographic documentation was done by the Nikon Coolpix P7800 camera. All specimens mentioned and figured in the systematic section are deposited in the Geological-Paleontological Department of the Natural History Museum Vienna, Austria (NHMW). The specimens used for quantitative evaluation of the decapod association from the Oslip sandpit include material from the NHMW and the private collection of Gerhard Wanzenböck.

The synonymy lists in the systematic section are abbreviated. For full synonymy lists a reference is made to Hyžný & Dulai (2021).

4. SYSTEMATIC PALAEONTOLOGY

Order Decapoda Latreille, 1802
Suborder Pleocyemata Burkenroad, 1963
Infraorder Axiidea de Saint Laurent, 1979
Family Callichiridae Manning & Felder, 1991

Callichiridae gen. et sp. indet.
Figures 2A–2C

Material: NHMW 2024/0155/0001, near-complete right dactylus (Fig. 2A); NHMW 2024/0155/0002, near-complete left dactylus (Fig. 2B); NHMW 2024/0155/0003, incomplete left fixed finger (Fig. 2C).

Description: Fixed finger slender, lower margin straight, tip blunt; occlusal margin armed with uniform serial teeth; outer and inner lateral surfaces with longitudinal row of round tubercles reaching midlength of fixed finger; lower margin with longitudinal row of setal pores. Lateral surfaces of dactylus smooth, with rows of setal pores close to upper and occlusal margins; occlusal margin entire, slightly undulated proximally.

Remarks: The material is identifiable as remains of major chelae of burrowing ghost shrimps (Hyžný & Klompmaker, 2015). Its fragmentary nature, however, precludes the assignment on the lower taxonomic level. The dentition and rows of tubercles on the fixed finger are similar to those in representatives of *Balsscallichirus* Sakai, 2011 and *Audacallichirus* Poore, Dworschak, Robles, Mantelatto & Felder, 2019. These genera are classified within the family Callichiridae. It is of note that the former genus has been reported also from the Miocene of Austria (Hyžný, 2016a). The studied dactyli are less distinctive, although similarly shaped fingers are present in various representatives of Callichiridae. The material from Oslip is therefore assigned to this family. It is possible that it belongs to more than one taxon (genus and/or species).

Infraorder Anomura MacLeay, 1838
Superfamily Paguroidea Latreille, 1802

Fig. 2. Callichiridae gen. et sp. indet. A, NHMW 2024/0155/0001, near-complete right dactylus in outer lateral (A1), inner lateral (A2), and occlusal (A3) views. B, NHMW 2024/0155/0002, near-complete left dactylus in outer lateral (B1), inner lateral (B2), and occlusal (B3) views. C, NHMW 2024/0155/0003, incomplete left fixed finger in outer lateral (C1), inner lateral (C2), and occlusal (C3) views.

Family Diogenidae Ortmann, 1892
Genus *Petrochirus* Stimpson, 1858

Type species. *Pagurus granulatus* Olivier, 1812 (= *Cancer diogenes* Linnaeus, 1758), by original designation.

***Petrochirus priscus* (Brocchi, 1883)**
Figures 3A–3C

1883 *Pagurus priscus* Brocchi, p. 7, pl. 5, fig. 9.
1928 *Petrochirus priscus* (Brocchi) – Glaessner, p. 173, text-fig. 2.
1929 *Pagurus priscus* Brocchi – Lőrenthey & Beurlen, p. 70, pl. 3, figs. 1–2.
1954 *Petrochirus* aff. *inequalis* Rathbun – Veiga Ferreira, p. 61, pl. 2, fig. 16.
1965 *Petrochirus* cf. *priscus* (Brocchi) – Veiga Ferreira, p. 142, pl. 2, figs. 7, 9, 11–12 [non pl. 2, fig. 8 = *Iphiculus eliasi* Hyžný & Gross, 2016].
1968 *Daira* sp. – Stancu & Andreescu, p. 466, pl. 7, fig. 84.
1984 *Petrochirus priscus* (Brocchi) – Müller, p. 59, pl. 19, fig. 5, pl. 20, figs. 1–5, pl. 21, figs. 1–3.
1998 *Petrochirus priscus* (Brocchi) – Müller, p. 12.
2017 *Petrochirus priscus* (Brocchi) – Díaz Medina et al., p. 179, fig. 7.
2021 *Petrochirus priscus* (Brocchi) – Hyžný & Dulai, p. 123, figs. 43.1–43.6.

Material: NHMW 2024/0155/0004, incomplete left dactylus (Fig. 3A); NHMW 2024/0155/0005, incomplete left fixed finger (Fig. 3B); NHMW 2024/0155/0006, near-complete right dactylus with attached serpulid worm tube (Fig. 3C).

Description: Fixed finger robust, lower margin convex, tip pointed and bent slightly upward; lateral surfaces and lower margin densely covered with round tubercles occlusal surface with two rows of small blunt teeth along edges with row of setal pores in between. Dactylus robust, tip blunt; lateral surfaces and upper margin densely covered with round tubercles, sometimes forming scale-like texture; occlusal surface with large molariform teeth proximally, teeth smaller distally.

Remarks: Although the isolated claws from Oslip are incomplete, they fully correspond to the morphological characteristics of *Petrochirus priscus* as presented in detail by Müller (1984) and Hyžný & Dulai (2021). The robustness of the fingers, cuticular surfaces covered with dense tuberculation and characteristic dentition on occlusal margins allow assignment to the respective species.

Petrochirus priscus is a well-known species reported from numerous locations, including lower Miocene (Burdigalian) and middle Miocene (Helvetian) of Portugal (Veiga Ferreira, 1954, 1965); middle Miocene (Badenian) of Austria (Glaessner, 1928; Müller, 1984, 1998; herein), Hungary (Brocchi, 1883; Lőrenthey & Beurlen, 1929; Müller, 1984; Hyžný & Dulai, 2021), Romania (Stancu & Andreescu, 1968), and Slovakia (Müller, 1984); upper Miocene (lower Tortonian) of Spain (Díaz-Medina et al., 2017); upper Miocene (Messinian) of Malta (Glaessner, 1933); and Miocene of Morocco (Glaessner, 1928; Müller, 1984).

Infraorder Brachyura Linnaeus, 1758
Section Dromiacea De Haan, 1833
Superfamily Dromioidea De Haan, 1833
Family Dromiidae De Haan, 1833
Subfamily Basinotopinae Karasawa, Schweitzer & Feldmann, 2011
Genus *Lucanthonisia* Van Bakel, Artal, Fraaije & Jagt, 2009

Type species. *Lucanthonisia praemium* Van Bakel, Artal, Fraaije & Jagt, 2009, by original designation.

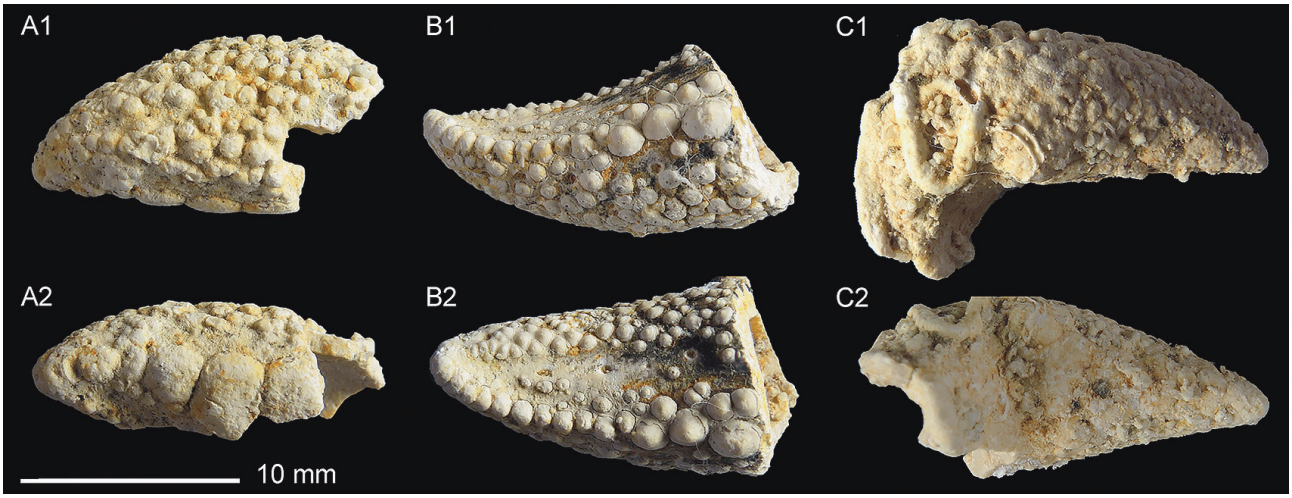

Fig. 3. *Petrochirus priscus* **(Brocchi, 1883). A, NHMW 2024/0155/0004, incomplete left dactylus in outer lateral (A1) and occlusal (A2) views. B, NHMW 2024/0155/0005, incomplete left fixed finger in outer lateral (B1) and occlusal (B2) views. C, NHMW 2024/0155/0005, near-complete right dactylus with attached serpulid worm tube in outer lateral (C1) and occlusal (C2) views.**

***Lucanthonisia eotvoesi* (Müller, 1975)**
Figures 4A–4H

1975 *Dromilites eotvoesi* – Müller, p. 508 [in Hungarian], 512 [in French], pl. 1, fig. 5, pl. 2, figs. 1, 4.
1976 *Dromilites eotvoesi* Müller – Müller, p. 150, pl. 2, figs. 1, 2.
1984 *Dromia eotvoesi* (Müller) – Müller, p. 63, pl. 29, figs. 8–9, pl. 30, figs. 1–7.
2009 *Lucanthonisia eotvoesi* (Müller) – Van Bakel et al., p. 49.
2021 *Lucanthonisia eotvoesi* (Müller) – Hyžný & Dulai, p. 137, figs. 48.1–48.11

Material: NHMW 2024/0155/0007, right dactylus (Fig. 4A); NHMW 2024/0155/0008, right dactylus (Fig. 4B); NHMW 2024/0155/0009, left dactylus (Fig. 4C); NHMW 2024/0155/0010, left dactylus (Fig. 4D); NHMW 2024/0155/0011, left dactylus (Fig. 4E); NHMW 2024/0155/0012, right dactylus (Fig. 4F); NHMW 2024/0155/0013, left fixed finger (Fig. 4G); NHMW 2024/0155/0014, left fixed finger (Fig. 4H).

Description: Fixed finger relatively short, bent inwards, lower margin slightly convex; outer lateral surface smooth, with large setal pores along teeth of occlusal margin; occlusal margin armed with several teeth, two proximal small round teeth followed by three serial teeth with middle tooth being highest, two distalmost teeth pointed and forming spoon-shaped tip. Dactylus strongly curved, highest proximally, upper margin distinctly convex; lateral surfaces smooth, outer lateral surface with large setal pores along occlusal margin; occlusal surface armed with several teeth, proximalmost round tooth being largest, followed by three or four smaller teeth, tip pointed.

Remarks: The species was originally described based on the isolated (and incomplete) carapaces (Müller, 1975, 1976). Later, claws were also described and figured by Müller (1984). Isolated cheliped fingers from Oslip match those from the Badenian of the Budapest area (Müller, 1984, pl. 30, figs. 4, 5; Hyžný & Dulai, 2021, figs. 48.8, 48.10, 48.11). It is of note that the overall morphology of dactylus of *Lucanthonisia eotvoesi* as presented herein is close to dynomenids, especially to selected species of *Dynomene* and *Hirsutodynomene* (McLay, 1999, 2001; McLay & Ng, 2005); for these taxa, down-curved dactyli resulting into gaping fingers are typical. The major difference is in the nature of fingertips which are generally spoon-shaped in both families, but in dynomenids the tips often are broadened, while in dromiids the teeth of dactylus and the fixed finger interlock distally.

Lucanthonisia eotvoesi has been reported from the middle Miocene (Badenian) of Austria (herein), Hungary (Müller, 1984; Hyžný & Dulai, 2021), and Poland (Müller, 1996).

Section Eubrachyura de Saint Laurent, 1980
Superfamily Calappoidea De Haan, 1833
Family Calappidae De Haan, 1833
Genus *Calappa* Weber, 1795

Type species. *Cancer granulatus* Linnaeus, 1758, subsequent designation by Latreille, 1810.

***Calappa heberti* Brocchi, 1883**
Figures 5A–5O

1883 *Calappa Heberti* – Brocchi, p. 2, pl. 4, fig. 3.
1929 *Calappa heberti* Brocchi – Lőrenthey & Beurlen, p. 130, pl. 6, figs. 2, 9–12.
1962 *Calappa* cf. *heberti* Brocchi spec. 1 – Bachmayer, p. 40, pl. 1, figs. 1–4.
1984 *Calappa heberti* Brocchi – Müller, p. 67, pl. 37, figs. 1–7, pl. 38, figs. 1–6.
1984 *Calappa* cf. *praelata* Lőrenthey in Lőrenthey & Beurlen – Müller, pl. 35, figs. 3–6.
(pars) 1998 *Calappa praelata* Lőrenthey in Lőrenthey & Beurlen – Müller, p. 22.
2016b *Calappa heberti* Brocchi – Hyžný, fig. 10G.
2021 *Calappa heberti* Brocchi – Hyžný & Dulai, p. 150, fig. 54.1–54.6, 55.1–55.11.

Material: NHMW 2024/0155/0015, incomplete right dactylus (Fig. 5A); NHMW 2024/0155/0016, right dactylus (Fig. 5B); NHMW 2024/0155/0017, right dactylus (Fig. 5C); NHMW 2018/0184/0001, incomplete right dactylus (Fig. 5D); NHMW 2024/0155/0018, incomplete right dactylus (Fig. 5E); NHMW 2024/0155/0019, right dactylus

Fig. 4. *Lucanthonisia eotvoesi* **(Müller, 1975). A,** NHMW 2024/0155/0007, right dactylus in outer lateral (A1), inner lateral (A2), upper (A3), and occlusal (A4) views. **B,** NHMW 2024/0155/0008, right dactylus in outer lateral (B1), inner lateral (B2), and occlusal (B3) views. **C,** NHMW 2024/0155/0009, left dactylus in outer lateral (C1), inner lateral (C2), and occlusal (C3) views. **D,** NHMW 2024/0155/0010, left dactylus in outer lateral (D1) and inner lateral (D2) views. **E,** NHMW 2024/0155/0011, left dactylus in outer lateral (E1) and inner lateral (E2) views. **F,** NHMW 2024/0155/0012, right dactylus in outer lateral (F1) and inner lateral (F2) views. **G,** NHMW 2024/0155/0013, left fixed finger in outer lateral (G1), inner lateral (G2), and occlusal (G3) views. **H,** NHMW 2024/0155/0014, left fixed finger in outer lateral (H1), inner lateral (H2), and occlusal (H3) views.

(Fig. 5F); NHMW 2018/0184/0002, incomplete right dactylus (Fig. 5G); NHMW 2018/0184/0008, right dactylus (Fig. 5H); NHMW 2018/0184/0010, incomplete right dactylus (Fig. 5I); NHMW 2024/0155/0020, left dactylus (Fig. 5J); NHMW 2024/0155/0021, left dactylus (Fig. 5K); NHMW 2024/0155/0022, incomplete right dactylus (Fig. 5L); NHMW 2024/0155/0023, right fixed finger (Fig. 5M); NHMW 2018/0184/0024, right fixed finger (Fig. 5N); NHMW 2018/0184/0025, left fixed finger (Fig. 5O). 22 incomplete right dactyli: NHMW 2018/0184/0003–0007, NHMW 2018/0184/0009, NHMW 2018/0184/0011–0023, NHMW 2018/0184/0059, NHMW 2018/0184/0060, NHMW 2018/0184/0063.

Description: Right fixed finger very short; outer lateral surface tuberculate, with double row of densely packed tubercles along lower margin; lower margin slightly concave near tip, tip

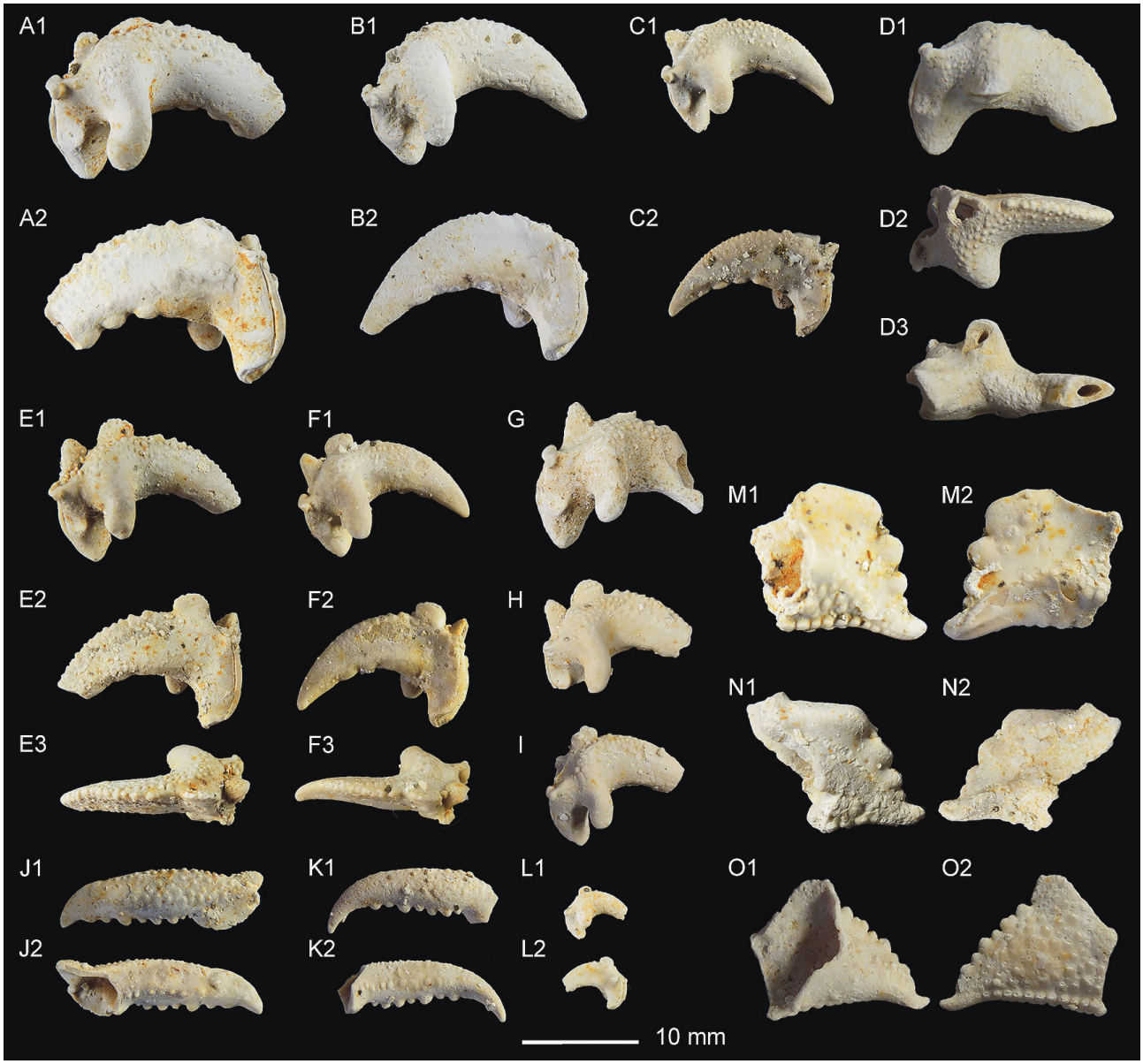

Fig. 5. *Calappa heberti* **Brocchi, 1883. A,** NHMW 2024/0155/0015, incomplete right dactylus in outer lateral (A1) and inner lateral (A2) views. **B,** NHMW 2024/0155/0016, right dactylus in outer lateral (B1) and inner lateral (B2) views. **C,** NHMW 2024/0155/0017, right dactylus in outer lateral (C1) and inner lateral (C2) views. **D,** NHMW 2018/0184/0001, incomplete right dactylus in outer lateral (D1), upper (D2), and occlusal (D3) views. **E,** NHMW 2024/0155/0018, incomplete right dactylus in outer lateral (E1), inner lateral (E2), and upper (E3) views. **F,** NHMW 2024/0155/0019, right dactylus in outer lateral (F1), inner lateral (F2), and upper (F3) views. **G,** NHMW 2018/0184/0002, incomplete right dactylus in outer lateral view. **H,** NHMW 2018/0184/0008, right dactylus in outer lateral view. **I,** NHMW 2018/0184/0010, incomplete right dactylus in outer lateral view. **J,** NHMW 2024/0155/0020, left dactylus in outer lateral (J1) and inner lateral (J2) views. **K,** NHMW 2024/0155/0021, left dactylus in outer lateral (K1) and inner lateral (K2) views. **L,** NHMW 2024/0155/0022, incomplete right dactylus in outer lateral (L1) and inner lateral (L2) views. **M,** NHMW 2024/0155/0023, right fixed finger in outer lateral (M1) and inner lateral (M2) views. **N,** NHMW 2018/0184/0024, right fixed finger in outer lateral (N1) and inner lateral (N2) views. **O,** NHMW 2018/0184/0025, left fixed finger in inner lateral (O1) and outer lateral (O2) views.

blunt and bent slightly upward; occlusal surface with five or six teeth, proximalmost tooth largest and molariform. Right dactylus strongly arcuate, laterally compressed; upper margin convex, with lobe directed distally and row of large tubercles; inner lateral surface smooth, with scattered tubercles proximally; outer lateral surface tuberculate, most tubercles positioned close to upper margin proximally; outer lateral surface with crushing (knobstick) tooth proximally near occlusal surface and fitting onto molariform tooth on opposite fixed finger; occlusal surface with four blunt teeth. Left fixed finger short, triangular in outline; inner lateral surface with scattered tubercles; outer lateral surface with densely packed scale-like tubercles and double row of scale-like tubercles along lower margin; lower margin slightly concave; tip blunt, slightly bent upward; occlusal margin with up to seven blunt teeth of uniform size. Left dactylus near-straight, tip bent downward; upper margin and outer lateral surface densely tuberculate; inner lateral surface with longitudinal row of tubercles; occlusal margin with up to ten blunt teeth of subequal size.

Remarks: Isolated right dactyli of *Calappa* are very distinctive and can be identified also from fragmentary material. However, the identification on the species level can be difficult if the material is not complete enough. In the Badenian strata of the Paratethys, two distinct species are identified, *Calappa heberti* and *Calappa praelata* (Müller, 1984; Hyžný, 2016b). They can be easily differentiated from each other as far as dorsal carapace features are concerned (Müller, 1984; Hyžný & Dulai, 2021); however, isolated dactyli are more difficult to evaluate, especially when the proximal lobe on the upper margin is not preserved. Müller (1984) assigned the *Calappa* material from *Oslip* to *C. praelata*, largely based on the assumption that the sands exposed at Oslip are of the middle Badenian age (Müller, 1984: p. 75) and the observation that *C. heberti* is confined to upper Badenian strata only (Müller, 1984: p. 67). The *Calappa* material studied herein consists of numerous right dactyli (some of which are complete), exhibiting a proximal lobe on the upper margin directed distally, the character considered of taxonomic importance for the assignment to *C. heberti* (Müller, 1984; Hyžný & Dulai, 2021). Therefore, all specimens attributable to *Calappa* originating from the sands of Oslip are assigned to *C. heberti*.

Calappa heberti is common in middle Miocene (Badenian) strata of numerous locations, including Austria (Bachmayer, 1962; herein), Hungary (Müller, 1984; Hyžný & Dulai, 2021), and Slovakia (Bachmayer, 1962; Hyžný, 2016b).

Superfamily Majoidea Samouelle, 1819
Family Majidae Samouelle, 1819
Subfamily Majinae Samouelle, 1819
Genus *Maja* Lamarck, 1801

Type species. *Cancer squinado* Herbst, 1788, subsequent designation by ICZN plenary powers [Opinion 511].

***Maja* sp.**
Figures 6A–6B

Material: NHMW 2024/0155/0024, left dactylus fingertip (Fig. 6A); NHMW 2024/0155/0025, right dactylus (proximal part) with serpulid worm tube (Fig. 6B).

Description: Dactylus fingertip smooth on all surfaces, with several large setal pores on outer and inner lateral surfaces; occlusal margin with large crest-like tooth proximally followed by sharp edge along entire occlusal margin; tip slightly bent downward.

Remarks: The assignment to the genus *Maja* is based on comparison with extant species as discussed and depicted by Ng & Richer de Forges (2015). Due to fragmentary nature of the material, its assignment on the species level is not possible.

The only known species of *Maja* from Badenian strata of the Paratethys is *Maja biaensis* Lőrenthey in Lőrenthey & Beurlen, 1929, well-known from a number of occurrences (Müller, 1984; Hyžný, 2016b; Hyžný & Dulai, 2021). It is possible that the fragmentary material from Oslip also belong to this species.

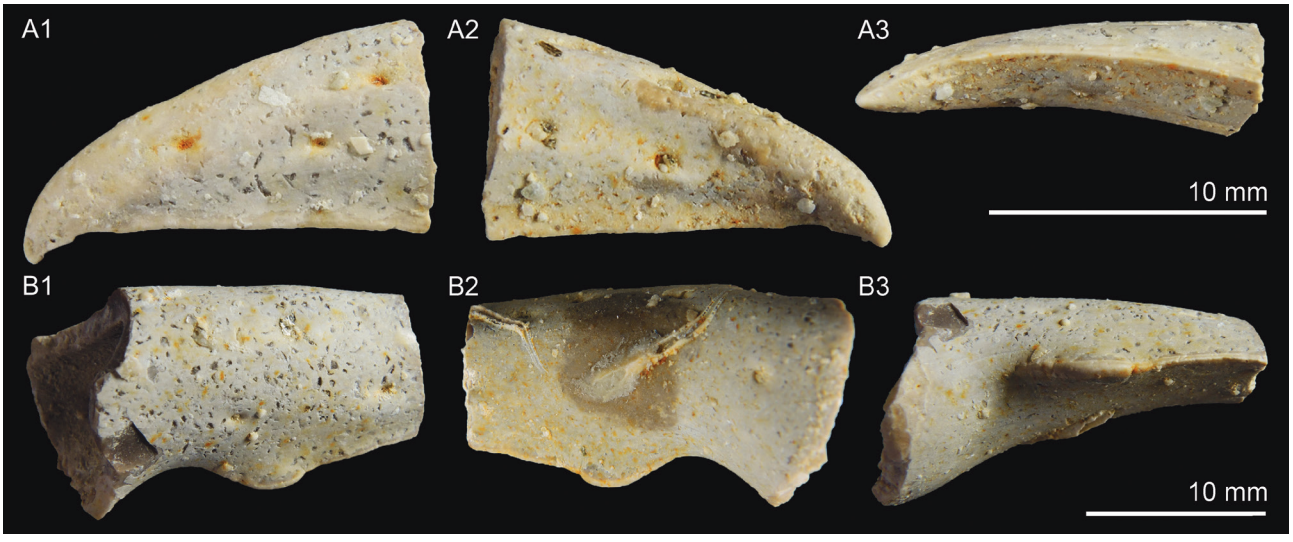

Fig- 6. *Maja* **sp. A, NHMW 2024/0155/0024, left dactylus fingertip in outer lateral (A1), inner lateral (A2), and occlusal (A3) views. B, NHMW 2024/0155/0025, right dactylus (proximal part) in outer lateral (B1), inner lateral (B2), and occlusal (B3) views. Note the presence of a serpulid worm tube.**

Superfamily Parthenopoidea MacLeay, 1838
Family Parthenopidae MacLeay, 1838
Subfamily Parthenopinae MacLeay, 1838
Genus *Parthenopoides* Miers, 1879

Type species. *Lambrus massena* Roux, 1830 [in Roux, 1828––1830], by original designation.

***Parthenopoides tetenyensis* (Müller, 1984)**
Figures 7A–7C

1901 *Andorina elegans*? – Lőrenthey, pl. 1, fig. 2.
(pars) 1929 *Andorina elegans* Lőrenthey – Lőrenthey & Beurlen, p. 139, pl. 8, fig. 3 [pl. 8, fig. 2].
1978 *Parthenope* sp. nov.? – Müller, pl. 11, fig. 3, pl. 12, fig. 3.
1984 *Parthenope tetenyensis* – Müller, p. 74, pl. 55, figs. 1–7, pl. 56, figs. 1–7.
(?) 1993 *Parthenope* cf. *tetenyensis* Müller – Müller, p. 13, fig. 6A–B.
2021 *Parthenopoides tetenyensis* (Müller) – Hyžný & Dulai, p. 188, figs. 71.1–71.15.

Material: NHMW 2018/0184/0053, right fixed finger (Fig. 7C); NHMW 2018/0184/0065, right fixed finger (Fig. 7B); NHMW 2018/0184/0071, left fixed finger (Fig. 7A).

Description: Right fixed finger extremely short, broad proximally; lateral surfaces smooth; occlusal surface with large molariform tooth proximally followed with two blunt teeth distally. Left fixed finger laterally compressed; occlusal margin with several teeth; tip not preserved.

Remarks: The material from Oslip is rather fragmentary, nevertheless, its assignment to *Parthenopoides tetenyensis* seems secure. Already Müller (1984) noted the presence of this species at Oslip; in fact, one of the paratypes of this taxon comes from the respective locality. Extremely short fixed finger of the crusher claw with broad molariform tooth (Fig. 7C) is quite characteristic for the species (Hyžný & Dulai, 2021: p. 188).

Parthenopoides tetenyensis is known from the middle Miocene (Badenian) of Austria (Müller, 1984; herein) and Hungary (Müller, 1984; Hyžný & Dulai, 2021); possibly also from the middle Miocene (Langhian) of Spain, Catalonia (Müller, 1993).

Superfamily Pilumnoidea Samouelle, 1819
Family Pilumnidae Samouelle, 1819
Subfamily Pilumninae Samouelle, 1819
Genus *Actumnus* Dana, 1851

Type species. *Actumnus tomentosus* Dana, 1852, subsequent designation by Rathbun, 1922.

***Actumnus telegdii* (Müller, 1974)**
Figures 8A–8D

1974 *Pilumnus telegdii* – Müller, p. 281 [in Hungarian], p. 284 [in French], pl. 2, figs. 7–8.
1978 *Actumnus telegdii* (Müller) – Müller, p. 274 [in Hungarian], p. 282 [in French], pl. 22, figs. 1–3.
1984 *Actumnus telegdii* (Müller) – Müller, p. 94, pl. 89, figs. 1–5, pl. 90, figs. 1–5.
(?) 1984 *Actumnus* n.? sp. – Müller, p. 94, pl. 90, figs. 6–7.
1996 *Actumnus telegdii* (Müller) – Müller, p. 12.
2021 *Actumnus telegdii* (Müller) – Hyžný & Dulai, p. 194, fig. 74.1–74.13.

Material: NHMW 2024/0155/0026, right dactylus (Fig. 8A); NHMW 2024/0155/0027, right dactylus (Fig. 8B); NHMW 2024/0155/0028, right dactylus (Fig. 8C); NHMW 2024/0155/0029, incomplete right propodus with associated dactylus (Fig. 8D).

Description: Upper margin and outer lateral surface of right manus strongly tuberculate; right fixed finger short with large molariform tooth proximally, followed with two blunt teeth, tip slightly bent upward. Right dactylus robust, slightly curved, bent

Fig. 7. *Parthenopoides tetenyensis* **(Müller, 1984). A, NHMW 2018/0184/0071, left fixed finger in inner lateral (A1) and occlusal (A2) views. B, NHMW 2018/0184/0065, right fixed finger in outer lateral (B1) and occlusal (B2) views. C, NHMW 2018/0184/0053, right fixed finger in occlusal (C1) and outer lateral (C2) views.**

inward; upper margin convex, with group of round tubercles proximally; lateral surfaces smooth; occlusal margin with four or five blunt teeth, tip blunt.

Remarks: Isolated cheliped fingers of *Actumnus telegdii* are morphologically very close to much more widespread *Pilumnus mediterraneus* (Lőrenthey, 1897). The latter species, however, is less tuberculate and tubercles are more spine-like, whereas they are round in *A. telegdii* (Müller, 1984; Hyžný & Dulai, 2021).

Actumnus telegdii has been reported from the middle Miocene (Badenian) of Austria (herein), Hungary (Müller, 1984; Hyžný & Dulai, 2021), and Poland (Müller, 1996).

Superfamily Portunoidea Rafinesque, 1815
Family Polybiidae Ortmann, 1893
Genus *Liocarcinus* Stimpson, 1871

Type species. *Portunus holsatus* Fabricius, 1798, by original designation.

***Liocarcinus rakosensis* (Lőrenthey in Lőrenthey & Beurlen, 1929)**

Figures 9A–9I

(pars) 1929 *Portunus rákosensis* – Lőrenthey in Lőrenthey & Beurlen, p. 171, pl. 13, fig. 1 [incorrect reconstruction], pl. 12, figs. 20–21 [= *Charybdis fragilis* (Müller, 1978)], pl. 12, figs. 22–23 [= *Glypturus munieri* (Brocchi, 1883)].

(?) 1968 *Portunus rakosensis* Lőrenthey in Lőrenthey & Beurlen – Stancu & Andreescu, p. 466.

1974 *Macropipus rakosensis* (Lőrenthey in Lőrenthey & Beurlen) – Müller, p. 280, pl. 3, figs. 2–6.

(pars) 1984a *Liocarcinus rakosensis* (Lőrenthey in Lőrenthey & Beurlen) – Müller, p. 83, pl. 69, figs. 2, 5, 6 [pl. 69, figs. 3, 4 = *Liocarcinus praearcuatus* Müller, 1996], pl. 70, figs. 1–8.

(?) 2004 *Liocarcinus* cfr. *L. rakosensis* (Lőrenthey in Lőrenthey & Beurlen) – Garassino et al., p. 269, fig. 11.

2018 *Liocarcinus rakosensis* (Lőrenthey in Lőrenthey & Beurlen) – Górka, p. 524, text-fig. 5.4, 5.5.

Fig. 8. *Actumnus telegdii* **(Müller, 1974). A, NHMW 2024/0155/0026, right dactylus in outer lateral (A1), inner lateral (A2), upper (A3), and occlusal (A4) views. B, NHMW 2024/0155/0027, right dactylus in outer lateral (B1), inner lateral (B2), upper (B3), and occlusal (B4) views. C, NHMW 2024/0155/0028, right dactylus in outer lateral (C1), inner lateral (C2), upper (C3), and occlusal (C4) views. D, NHMW 2024/0155/0029, incomplete right propodus with associated dactylus in outer lateral (D1) and inner lateral (D2) views.**

2021 *Liocarcinus rakosensis* (Lőrenthey in Lőrenthey & Beurlen) – Hyžný & Dulai, p. 205, figs. 80.1–80.11.

Material: NHMW 2024/0155/0030, right dactylus (Fig. 9A); NHMW 2024/0155/0031, left dactylus (Fig. 9B); NHMW 2024/0155/0032, right dactylus (Fig. 9C); NHMW 2024/0155/0033, right dactylus (Fig. 9D); NHMW 2024/0155/0034, left dactylus (Fig. 9E); NHMW 2024/0155/0035, right fixed finger (Fig. 9F); NHMW 2024/0155/0036, isolated right fixed finger (Fig. 9G); NHMW 2024/0155/0037, left fixed finger (Fig. 9H); NHMW 2018/0184/0066, right incomplete propodus with associated dactylus (Fig. 9I). 9 right dactyli: NHMW 2018/0184/0042–0048, NHMW 2024/0156/0005, NHMW 2024/0156/0007; three left dactyli: NHMW 2018/0184/0049, NHMW 2018/0184/0050, NHMW 2024/0156/0008; four right fixed

Fig- 9. *Liocarcinus rakosensis* **(Lőrenthey in Lőrenthey & Beurlen, 1929). A,** NHMW 2024/0155/0030, right dactylus in outer lateral (A1), inner lateral (A2), and occlusal (A3) views. **B,** NHMW 2024/0155/0031, left dactylus in outer lateral (B1) and inner lateral (B2) views. **C,** NHMW 2024/0155/0032, right dactylus in outer lateral (C1) and inner lateral (C2) views. **D,** NHMW 2024/0155/0033, right dactylus in outer lateral (D1) and inner lateral (D2) views. **E,** NHMW 2024/0155/0034, left dactylus in outer lateral (E1) and inner lateral (E2) views. **F,** NHMW 2024/0155/0035, right fixed finger in outer lateral (F1), inner lateral (F2), and occlusal (F3) views. **G,** NHMW 2024/0155/0036, isolated right fixed finger in outer lateral (G1), inner lateral (G2), and occlusal (G3) views. **H,** NHMW 2024/0155/0037, left fixed finger in outer lateral (H1), inner lateral (H2), and occlusal (H3) views. **I,** NHMW 2018/0184/0066, right incomplete propodus with associated dactylus in outer lateral (I1) and inner lateral (I2) views.

fingers: NHMW 2018/0184/0051, NHMW 2018/0184/0052, NMHW 2018/0184/0054, NHMW 2024/0156/0006.

Description: Fixed finger with two longitudinal ridges on each lateral surface; longitudinal ridges scabrous or finely tuberculate proximally; occlusal surface of crusher claw with two transversely positioned blunt teeth followed by large molariform tooth subdivided into three parts by Y-shaped groove, distal portion of occlusal margin with up to seven serial conical teeth, tip bent slightly upward; occlusal surface of cutter claw with bilobed or trilobed serial conical teeth, tip not bent upward. Dactylus with distinct longitudinal ridges and deep furrows in between on each lateral surface, upper margin with single longitudinal ridge; ridges scabrous or finely tuberculate proximally (crusher claw) or along entire length (cutter claw); occlusal surface of crusher claw with large proximal knobstick tooth positioned laterally, followed with up to ten blunt round teeth of two sizes, tip slightly bent downward, blunt; occlusal surface of cutter claw with bilobed or trilobed serial conical teeth, tip straight.

Remarks: Because of characteristic longitudinal ridges, the genus *Liocarcinus* is easily recognizable. Three species have been identified in the Badenian strata of the Central Paratethys, with *L. rakosensis* being the most widespread (Hyžný & Dulai, 2021).

Liocarcinus rakosensis is known from numerous occurrences, including the middle Miocene (Badenian) of Austria (herein), Hungary (Müller, 1984; Hyžný & Dulai, 2021), and Ukraine (Górka, 2018). The occurrences from the middle Miocene (upper Badenian) of Romania (Stancu & Andreescu, 1968) and upper Miocene (Messinian) of Italy (Garassino et al., 2004) probably also belong to this species.

Family Portunidae Rafinesque, 1815
Subfamily Thalamitinae Paulson, 1875
Genus *Charybdis* De Haan, 1833 [in De Haan, 1833–1850]

Type species. *Cancer sexdentatus* Herbst, 1783, subsequent designation by Glaessner, 1929.

***Charybdis fragilis* (Müller, 1978)**
Figures 10A–10F

1883 *Portunus* sp. – Brocchi, p. 2, pl. 5, fig. 4b.
(pars) 1929 *Portunus rakosensis* – Lőrenthey in Lőrenthey & Beurlen, pl. 12, figs. 20, 21, pl. 15, fig. 4.
1975 *Charybdis*? sp. – Müller, p. 510, pl. 3, fig. 3.
1978 *Thalamita fragilis* – Müller, p. 281 [in Hungarian], p. 289 [in French], pl. 17, figs. 1–4.
1984 *Thalamita fragilis Müller* – Müller, p. 81, pl. 65, figs. 1–2, 4–5.
2014 *Charybis fragilis* (Müller) – Collins, p. 42, pl. 3, figs. 4, 6–8, 10.
2021 *Charybis fragilis* (Müller) – Hyžný & Dulai, p. 220, figs. 86.1–86.11.

Material: NHMW 2024/0155/0038, right fixed finger (Fig. 10A); NHMW 2024/0155/0039, left dactylus (Fig. 10B); NHMW 2024/0155/0040, left fixed finger (Fig. 10C); NHMW 2024/0155/0041, left fixed finger (Fig. 10D); NHMW 2018/0184/0026, right fixed finger (Fig. 10F); NHMW 2018/0184/0041, left fixed finger (Fig. 10E). 15 fragmentary fingers: NHMW 2018/0184/0027–0040, NHMW 2018/0184/0064.

Description: Cheliped fingers elongate, slender, with round cross-section; both lateral surfaces with two faint longitudinal furrows; lower margin of fixed finger and upper margin of dactylus subparallel to each other; occlusal surface of crusher fixed finger with several molariform teeth proximally, followed with serial blunt teeth; occlusal surfaces of cutter fingers with trilobed serial conical teeth interspersed with singular smaller teeth.

Remarks: Because of relative uniformity of the cheliped dentition, it is often difficult to differentiate remains of fixed fingers and dactyli from each other. Unfortunately, no complete finger has been collected from sands of Oslip. Nevertheless, the morphology of these remains is quite typical for the species (Müller, 1984; Hyžný & Dulai, 2021).

Charybdis fragilis has been reported from the middle Miocene (Badenian) of Austria (Collins, 2014; herein) and Hungary (Müller, 1984; Hyžný & Dulai, 2021).

Superfamily Xanthoidea MacLeay, 1838
Family Xanthidae MacLeay, 1838
Subfamily Xanthinae MacLeay, 1838
Genus *Xantho* Leach, 1814 [in Leach 1813–1815]

Type species. *Cancer hydrophilus* Herbst, 1790 (= *Cancer incisus* Leach, 1814 [in Leach 1813–1815]), by monotypy.

***Xantho moldavicus* (Yanakevich, 1977)**
Figures 11

(pars) 1928 *Titanocarcinus vulgaris* n. sp. – Glaessner, pp. 185, 189, pl. 3, fig. 11.
1953 *Titanocarcinus vulgaris* Glaessner – Bachmayer, p. 254, pl. 4, figs. 1–5, pl. 5, figs. 1–2.
1977 *Medaeus moldavicus* – Yanakevich, p. 80, pl. 10, fig. 4.
1979a *Xantho* cf. *vulgaris* (Glaessner) – Förster, pp. 100–101, figs. 14, 15, pl. 3, figs. 1–3, pl. 4, figs. 1–4.
1979b *Xantho* cf. *vulgaris* (Glaessner) – Förster, pp. 263–264, fig. 11, pl. 3, fig. 4.
1984 *Xantho moldavicus* (Yanakevich) – Müller, p. 92, pl. 85, figs. 5–8, pl. 86, figs. 1–5, pl. 87, fig. 1.
(?) 1988 *Xantho* cf. *moldavicus* (Yanakevich) – Saint Martin & Müller, p. 254.
(?) 1993 *Xantho* aff. *moldavicus* (Yanakevich) – Müller, p. 20, figs. 10A, B.
1996 *Xantho moldavicus* (Yanakevich) – Müller, p. 11, pl. 2, fig. 6.
1998 *Xantho moldavicus* (Yanakevich) – Müller, p. 34.
2006 *Xantho moldavicus* (Yanakevich) – Radwański et al., p. 96, pl. 2, figs. 5, 6.
2010 *Xantho moldavicus* (Yanakevich) – Gatt & De Angeli, p. 1339, text-fig. 8G–K.

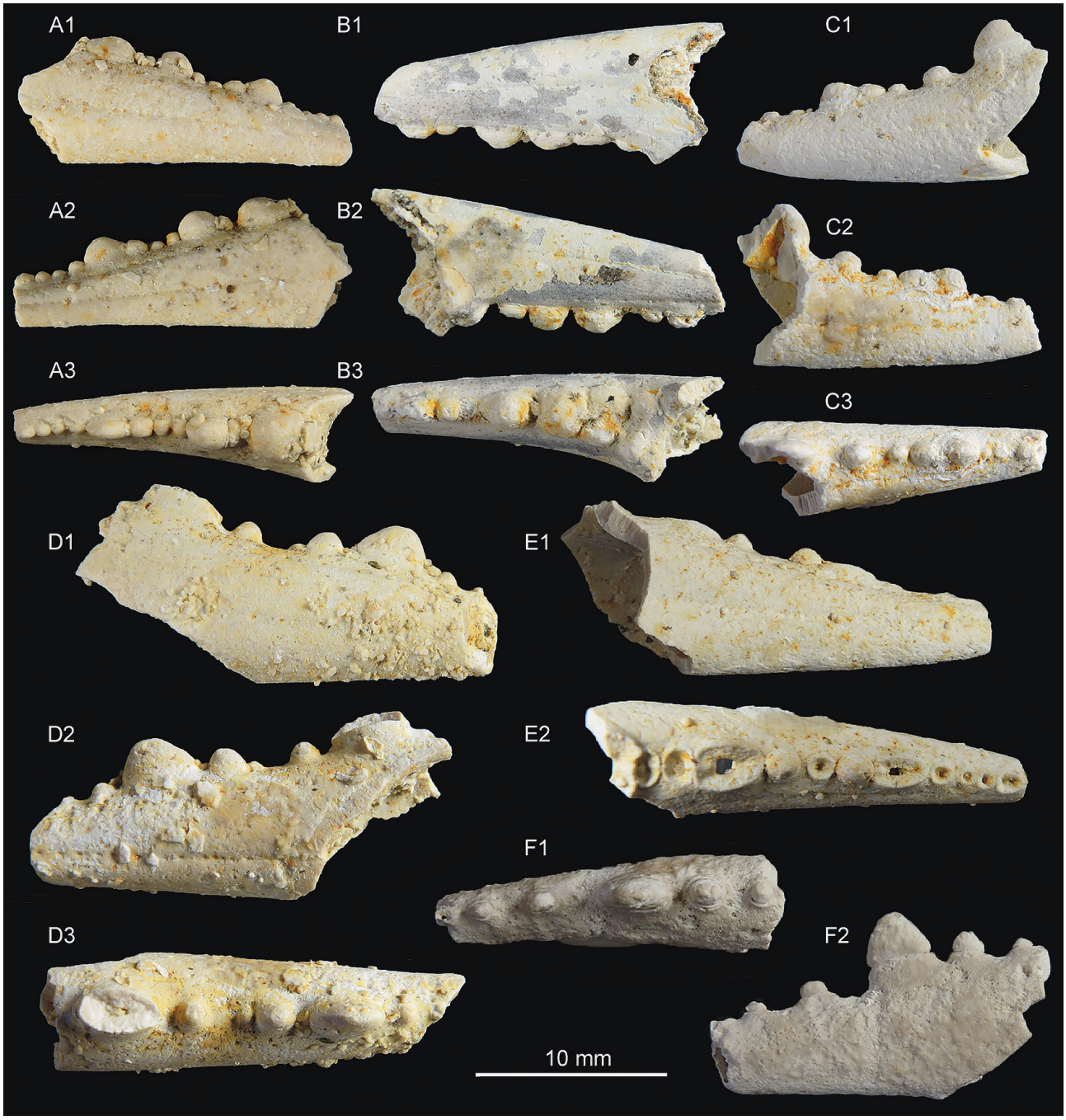

Fig. 10. *Charybdis fragilis* **(Müller, 1978). A, NHMW 2024/0155/0038, right fixed finger in outer lateral (A1), inner lateral (A2), and occlusal (A3) views. B, NHMW 2024/0155/0039, left dactylus in outer lateral (B1), inner lateral (B2), and occlusal (B3) views. C, NHMW 2024/0155/0040, left fixed finger in outer lateral (C1), inner lateral (C2), and occlusal (C3) views. D, NHMW 2024/0155/0041, left fixed finger in outer lateral (D1), inner lateral (D2), and occlusal (D3) views. E, NHMW 2018/0184/0026, right fixed finger in outer lateral (E1) and occlusal (E2) views. F, NHMW 2018/0184/0041, left fixed finger in occlusal (F1) and outer lateral (F2) views.**

2014 *Xantho moldavicus* (Yanakevich) – Hyžný et al., p. 226, pl. 1, fig. 6.

2014 *Xantho moldavicus* (Yanakevich) – Collins, p. 43, pl. 4, figs. 9, 10, 12.

2018 *Xantho moldavicus* (Yanakevich) – Górka, p. 528, text-fig. 8.1–8.4.

(?) 2019 *Xantho* cf. *moldavicus* (Yanakevich) – Ossó & Gagnaison, p. 378, fig. 5F–I.

Material: NHMW 2024/0155/0042, incomplete left propodus (Fig. 11A); NHMW 2024/0155/0043, incomplete left propodus (Fig. 11B); NHMW 2024/0155/0044, right dactylus (Fig. 11C); NHMW 2024/0155/0045, right dactylus (Fig. 11D); NHMW 2024/0155/0046, left fixed finger (Fig. 11E). Two right fixed fingers: NHMW 2018/0184/0055, NHMW 2018/0184/0056; left propodus: NHMW 2018/0184/0057; right dactylus: NHMW 2018/0184/0058.

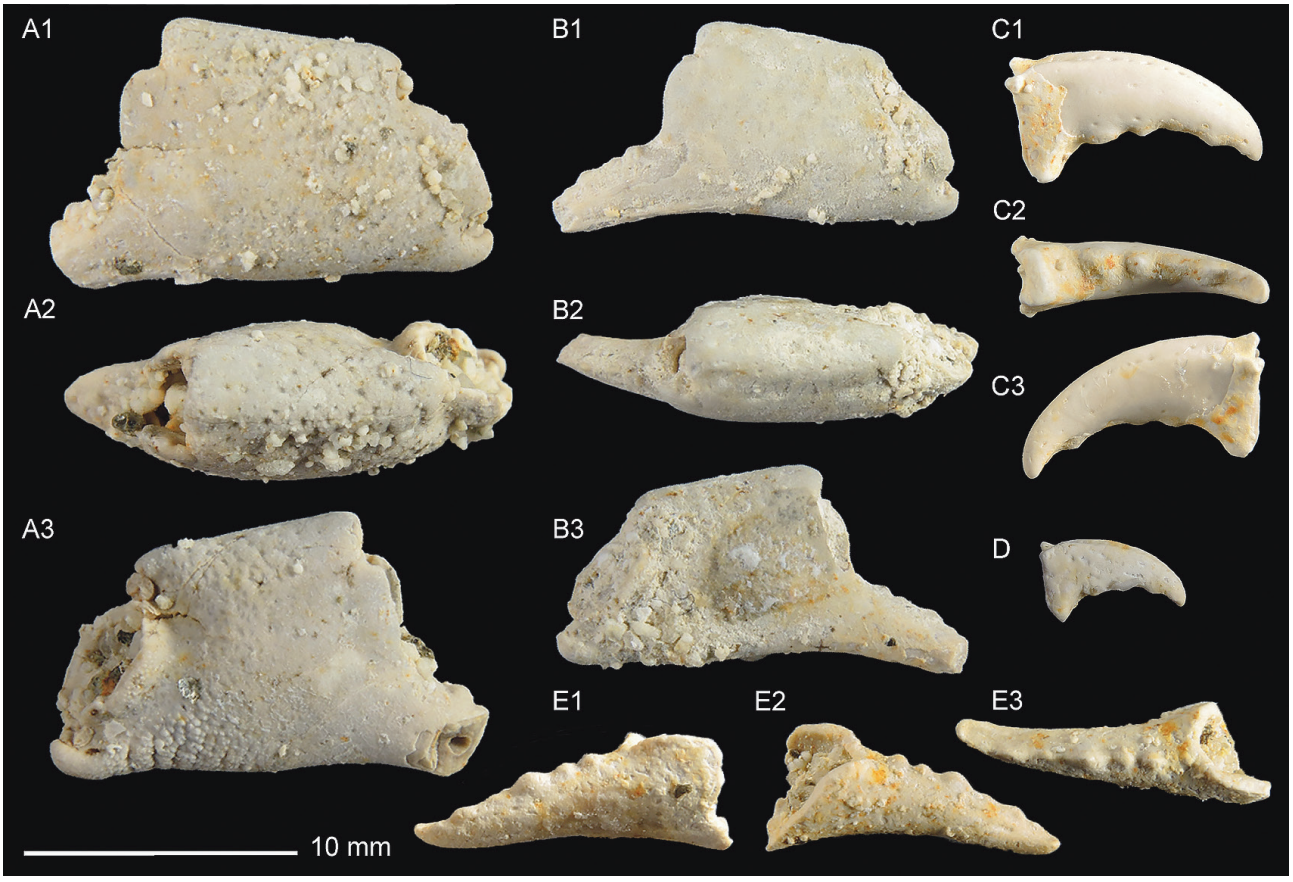

Fig. 11. *Xantho moldavicus* **(Yanakevich, 1977). A, NHMW 2024/0155/0042, incomplete left propodus in outer lateral (A1), upper (A2), and inner lateral (A3) views. B, NHMW 2024/0155/0043, incomplete left propodus in outer lateral (B1), upper (B2), and inner lateral (B3) views. C, NHMW 2024/0155/0044, right dactylus in outer lateral (C1), occlusal (C2), and inner lateral (C3) views. D, NHMW 2024/0155/0045, right dactylus in outer lateral view. E, NHMW 2024/0155/0046, left fixed finger in outer lateral (E1), inner lateral (E2), and occlusal (E3) views.**

Description: Manus subtrapezoidal in outline, highest distally, lower margin slightly concave at base of fixed finger. Fixed finger outer lateral surface with two longitudinal furrows, lower one running onto manus; fixed finger occlusal surface with several conical teeth, tip spoon-shaped, bent slightly upward. Dactylus upper margin arched, outer lateral surface with row of setal pores along occlusal margin; upper margin with two longitudinal furrows; occlusal surface with four to five subequal blunt teeth, tip distinctly spoon-shaped, slightly bent downward.

Remarks: Müller (1984, p. 93) called this species "the most puzzling crab of the Paratethys". Because of rather wide range of observed morphotypes, he assumed that it may be a compound taxon and not a single species. A careful re-evaluation of all occurrences of alleged *Xantho moldavicus* using a uniform taxonomic approach is needed to resolve this issue.

Xantho moldavicus is known from numerous occurrences, including the middle Miocene (Badenian) of Austria (Bachmayer, 1953; Müller, 1998; Collins, 2014; herein), Hungary (Müller, 1984; Hyžný & Dulai, 2021), Moldova (Yanakevich, 1977), Poland (Förster, 1979a, 1979b; Müller, 1996), and Ukraine (Radwański et al., 2006; Górka, 2018), and the upper Miocene (Messinian) of Malta (Gatt & De Angeli, 2010). Possible occurrences include the middle Miocene (Langhian-Serravallian) of Spain (Müller, 1993) and France (Ossó & Gagnaison, 2019), and the upper Miocene (Messinian) of Algeria (Saint Martin & Müller, 1988).

5. DISCUSSION

The Badenian decapod assemblage from the sands of the Oslip sand pit consists of 10 identified taxa with eight of them being classified to the species level. Taxonomically, the assemblage is close to upper Badenian decapod assemblages from the Budapest area, Hungary, namely to those of Keresztúri út (MEG), Örs vezér tere (MOH), and Gyakorló út (MGY), as characterized by Müller (1984) and Hyžný & Dulai (2021). It is of note that none of these three assemblages contains all taxa recognized in Oslip: in the assemblage from Keresztúri út (MEG), *Maja* and *Xantho* are missing; in the assemblage from Örs vezér tere (MOH), *Petrochirus* and *Parthenopoides* are missing; and in the assemblage from Gyakorló út (MGY), *Petrochirus* and *Xantho* are missing (based on data from Hyžný & Dulai, 2021). The assemblage from Oslip is dominated by *Calappa heberti* (43.4 %) and *Liocarcinus rakosensis* (22.4 %); other taxa contributed with 10 or less per cent (Fig. 12).

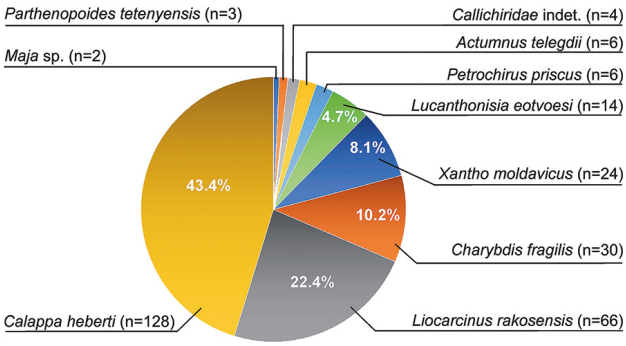

Fig. 12. Taxonomic composition and abundance of the Badenian decapod association from the Oslip sand pit. The pie chart represents raw data, i.e., all examined elements were included and no correction addressing differential preservation potential of right and left claws in heterochelous taxa was applied.

All studied decapod specimens are represented by isolated and often fragmentary cheliped elements, mostly dactyli (movable fingers) or broken fixed fingers. No remains of carapace have been identified. The assemblage is dominated by heavily calcified elements. From 125 isolated dactyli of *Calappa heberti*, the vast majority (115) are from right claws. Crabs of this genus exhibit directional asymmetry (Palmer, 2012) in the morphology (and function) of claws: right dactyli are robust, heavily calcified and possess a large crushing tooth. All these aspects promote preservation of right dactyli, whereas slenderer left dactyli are prone to physical disintegration. As for the second most common crab at Oslip, *Liocarcinus rakosensis*, from 65 elements exhibiting features of heterochely up to 50 elements represent the more robust crusher morphotype, whereas only 15 belong to the slenderer cutter morphotype. In many specimens, fingertips are broken. Additionally, in *Charybdis fragilis*, some isolated and/or broken fingers do not preserve the dentition. This is due to change in calcification concentration at the base of serial conical teeth and subsequent breakdown at the point of the concentration change (Mutel et al., 2008).

The preservation of decapod material suggests the environment with high hydrodynamic energy; all fragile exoskeleton elements were broken, and only heavily calcified parts were preserved. Previously published sedimentological analysis suggests a near-shore environment (Dullo, 1983). Similarly, Keresztúri út (MEG), Örs vezér tere (MOH), and Gyakorló út (MGY), i.e, the localities in the Budapest area with similar decapod assemblages, were interpreted as representing a near-shore environment and at all of them sandy facies was present. As for bathymetric preferences, the extant congeners of taxa identified at Oslip have been reported from intertidal/subtidal to shelf environments (Poore & Ahyong, 2023), with the narrowest preferences known in *Petrochirus* (depth of 1–160 m) and *Xantho* (0–100 m). In this respect, the presence of *Xantho* can be considered as an indicator of environment with the depth of less than 100 metres.

Serpulid worm tubes attached to fingers of *Petrochirus priscus* (Fig. 3C) and *Maja* sp. (Fig. 6B) document the presence of encrusting epibionts (e.g., Martin & Britayev, 1998; Waugh et al., 2004). It is difficult to state whether the epibionts encrusted living decapods (*syn vivo*) or the colonization of the respective claw fingers happened after death/moulting. Nevertheless, *syn vivo* encrustation appears more plausible. Although both encrusted claw elements are relatively robust (with the length exceeding 1 cm), representing a relatively stable substrate also when being detached from the rest of the crab body, the settlement of epibiont larvae would be prevented by high hydrodynamics (Pawlik & Butman, 1993).

The localities in the Budapest area yielded more decapod taxa than the Oslip sand pit; at Keresztúri út (MEG) 20 species were identified, at Örs vezér tere (MOH) 13 species were identified, and at Gyakorló út (MGY) as many as 21 species were identified (Hyžný & Dulai, 2021). The relatively low number of decapod taxa at Oslip is interpreted as a combination of the collection bias and the palaeoenvironment with higher hydrodynamic energy than that at the localities in the Budapest area, resulting into destruction of smaller and/or lightly calcified remains at Oslip. In this respect, it is of note that some decapod taxa identified at the localities in the Budapest area are known from the carapace material (Müller, 1984; Hyžný & Dulai, 2021), which is comparatively more fragile than cheliped fingers. Thus, the decapod association from Oslip is interpreted as being (at least partially) reworked and/or transported before final deposition because of a high-energy of the hydrodynamic regime.

6. CONCLUSIONS

Sands of the Baden Group, presumably of late Badenian age, exposed in the Oslip sand pit (Eisenstadt-Sopron Basin; Burgenland, Austria) yielded numerous isolated decapod claw elements, largely fingers. The material was collected from the sandy, ca. 1-m thick layer with the *Ophiomorpha* burrows.

Identified decapod taxa include axiidean ghost shrimps (Callichiridae gen. et sp. indet.), paguroid hermit crabs (*Petrochirus priscus*), and brachyuran crabs (*Lucanthonisia eotvoesi*, *Calappa heberti*, *Maja* sp., *Parthenopoides tetenyensis*, *Actumnus telegdii*, *Liocarcinus rakosensis*, *Charybdis fragilis*, *Xantho moldavicus*). Taxonomically, the assemblage is close to upper Badenian decapod assemblages from the Budapest area, Hungary.

All studied decapod specimens from the Oslip sand pit are represented by isolated and often fragmentary cheliped elements, mostly dactyli (movable fingers) or broken fixed fingers. The assemblage is dominated by heavily calcified elements, i.e., right dactyli of *C. heberti* and remains of crusher claws of *L. rakosensis*. No remains of carapace have been identified. The preservation of decapod material suggests an environment with high hydrodynamic energy; all fragile exoskeleton elements were broken, and only heavily calcified parts were preserved. The association is interpreted as being reworked and/or transported before final deposition.

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