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Contributions to the knowledge of the Muricidae (Neogastropoda) fauna in the Middle Miocene Central Paratethys

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Abstract – Seven new Muricidae species are described from the Middle Miocene Central Paratethys from Hungarian and Romanian localities: *Murexsul sztanoae* n. sp., *Attiliosa juhaszi* n. sp., *Pazinotus martonszaboi* n. sp., *Gracilipurpura*? *evae* n. sp., *Coralliophila subscarrosa* n. sp., *Galeropsis badenica* n. sp., and *Acanthais*? *sutii* n. sp. The Muricidae fauna of the locality Buda Hill North, Márkháza (Cserhát Hills, N Hungary) is briefly presented. Extended palaeogeographical distributions of several muricid genera are reported from the Middle Miocene Pannonian Basin. Genera *Attiliosa*, *Acanthais*, and *Galeropsis* are recorded for the first time in the Paratethys. With 65 figures.

Key words – Badenian, Făget Basin, Gastropoda, Muricidae, Pannonian Basin

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INTRODUCTION

The aim of this paper is to describe seven new Middle Miocene muricid species from the Central Paratethys: *Attiliosa juhaszi* n. sp., *Gracilipurpura*? *evae* n. sp., *Coralliophila subscarrosa* n. sp., *Galeropsis badenica* n. sp., and *Acanthais*? *sutii* n. sp. from Letkés (Börzsöny Mts), *Pazinotus martonszaboi* n. sp. from Tekeres (Mecsek Mts) and Letkés, and *Murexsul sztanoae* n. sp. from Lăpugiu de Sus (Făget Basin, Romania). The achievement is based on newly collected gastropod assemblages, and the revision of the fossil gastropod collection in the Hungarian National Museum Public Collection Centre – Hungarian Natural History Museum, Budapest (HNHM). Five Badenian localities are mentioned in this paper.

1. Letkés. It is a well-known Middle Miocene fossiliferous site between the River Ipoly and the western part of the Börzsöny Mts (N Hungary) (Fig. 1). The study locality is situated about 400 m eastward from the village on the western slope of the Bagoly Hill (N 47.888319°, E 18.784647°). The locality is characterized

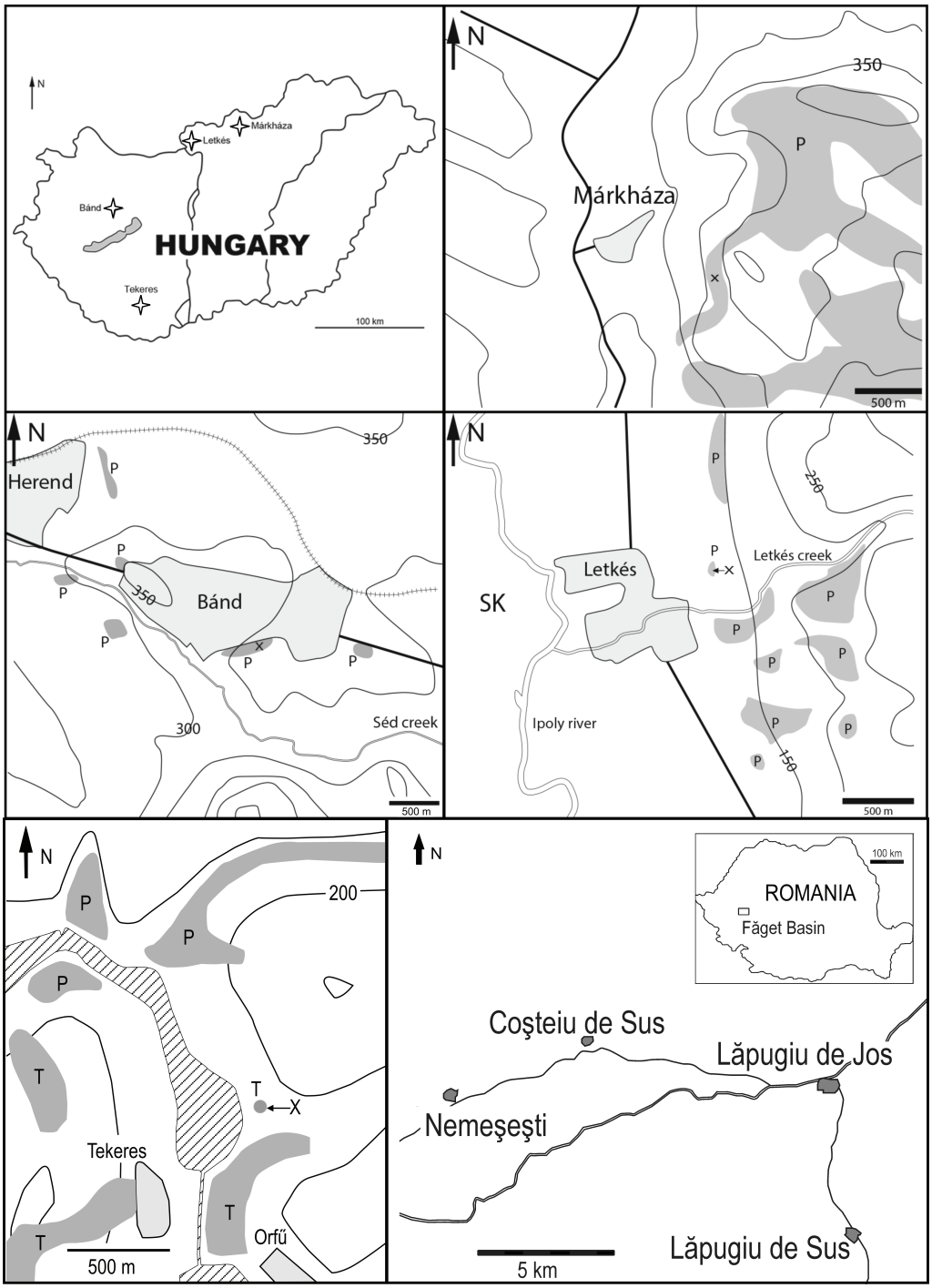


Fig. 1. The study sites and localities mentioned in the text. P – Pécsszabolcs Member (Lower–Middle Badenian) of the Lajta Limestone Formation, T – Tekeres Schlier Formation (uppermost Lower–Middle Badenian), X – fossiliferous locality

by resedimented beds without well-visible layers. The beds consist of fossil-rich limonitic marly sand with andesite rock fragments, andesitic tuff, and eroded colonial coral blocks – the sediments represent the Badenian Pécsszabolcs Member of the Lajta Limestone Formation (Selmeczi *et al*. 2023: 84). The macrofauna is characterized by fossils of mainly rocky intertidal, inner to middle neritic, and coral reef communities containing colonial and solitary corals, serpulids, fragmentary echinoid and decapod remains, bivalves, gastropods, scaphopods, polyplacophores, brachiopods, bryozoans, and rarely fish teeth. From the gastropod assemblage the muricids were dealt with by Csepreghy-Meznerics (1956), Kovács (2018, 2019, 2020), and Kovács *et al.* (2018) describing 54 species. We present herein a few newly collected specimens of rare species and six new taxa from the locality.

2. Bánd. It is located in the Herend Sub-basin (Bakony Mts, W Hungary). The study gastropod material came from artificial trenches of Locality 28, which was described by Kókay (1966) at 250 m southeast of the village church (N 47.1210878°, E 17.7867708°). The deposits are characterized by mollusc and coral-bearing grey clay and yellowish clayey sand of approximately 2 m thickness; these shallow marine sediments belong to the Pécsszabolcs Member. The colonial coral, brachiopod, polyplacophoran, gastropod, and bivalve assemblages indicate intertidal to infralittoral patch reef palaeoenvironments. Muricids from the site were treated by Kókay (1966) and Kovács (2020). We illustrate herein two *Muricopsis cristata* specimens and a new occurrence in the assemblage of the Herend Sub-basin (Bánd, and the Halastó locality of Herend): *Ocinebrina boeckhi* (Hoernes et Auinger, 1885).

3. Tekeres. It is a Middle Miocene fossiliferous site in the NW Mecsek Mts (SW Hungary). The geology and stratigraphy of the Orfű-Tekeres area were dealt with by Sebe *et al.* (2015), the lower–middle Badenian deposits belong to the Tekeres Slír Member of the Badeni Formation (Selmeczi *et al.* 2023: 79). The study outcrop is located 100 m east of Lake Herman Ottó at the south-western slope of the Kopasz Hill (N 46.174498°, E 18.130638°), it was recently discussed in detail by Szabó *et al.* (2022). Clayey sand of 180 cm thickness was excavated by artificial trenches; the deposit represents a typical offshore palaeoenvironment but also contains fossils from coastal and shallow-water habitats transported by tempestites into offshore settings. The macrofauna is very rich in invertebrate and vertebrate fossils; the material studied herein was collected by Márton Szabó (HNHM). From the gastropod assemblage the Muricidae fauna was investigated by Kovács (2020) describing five species: *Bolinus submuticus* (Grateloup, 1845), *Dermomurex scalaroides* (Blainville, 1826), *Hirtotyphis horridus* (Brocchi, 1814), *Siphonochelus fistulosus* (Brocchi, 1814), and *Pteropurpura friedbergi* (Cossmann et Peyrot, 1924). This small material is completed herein with two species: *Flexopteron goniostoma* (Hörnes, 1853) and *Pazinotus martonszaboi* n. sp.

4. Márkháza. Around Márkháza (Cserhát Hills, N Hungary) the Middle Miocene fossiliferous beds are characterized by clay, clayey sand, tuffaceous sandstone, limestone, and andesite conglomerate, the sediments represent the Pécsszabolcs Member. The study locality (Buda Hill North) was discovered by one of us (Z. Vicián). It is located in a trench of the northern part of the Buda Hill (south of Márkháza) and consists of several spots of hard greenish clay among andesite blocks in which reworked, 10–50 cm thick fossil-rich sand layers occur (as the research is in progress, the coordinates are not public). The characteristic fossils are gastropods and colonial corals, while bivalves are extremely rare; the assemblage represents a shallow-water palaeoenvironment. The mollusc fauna of the Cserhát Hills were presented by Csepreghy-Meznerics (1954) who described seven muricids mainly from the area of Sámsonháza, later two muricid species were studied by Vicián *et al.* (2017). The Muricidae fauna of the Márkháza, Buda Hill North locality is rather small, 12 species are recorded in this paper: *Hexaplex austriacus* (Tournouër, 1875), *Muricopsis cristata* (Brocchi, 1814), *Pygmaepterys transsylvanicus* (Hoernes et Auinger, 1885), *Ocinebrina credneri* (Hoernes et Auinger, 1885), *O. kojumdgievae* (Bałuk, 1995) (Vicián *et al.* 2017, pl. 2, figs 11–12), *Janssenia echinulata* (Pusch, 1837), *J. spinosa* (Kojumdgieva, 1960), *Cathymorula exilis* (Hörnes, 1852), *Morula austriaca* (Hoernes et Auinger, 1882), *Coralliophila burdigalensis* Tournouër, 1874, *C. gracilispira* Boettger, 1906 (Vicián *et al.* 2017, pl. 2, figs 20–21), and *Leptoconchus jaegeri* Rolle, 1863 (see Figs 40–41, 53–65). The shells are characterized by poor to moderate preservation.

5. Lăpugiu de Sus (Făget Basin, Romania). It is among the most famous Middle Miocene fossiliferous sites in the Central Paratethys, located between the Pannonian and the Transylvanian basins. The fossil-rich layers are characterized by tuffites, clays, and silts (Lower Badenian Dej Formation; Szakács *et al.* 2012), the deposits represent nearshore to offshore palaeoenvironments. Macro and micro invertebrate fossils have been dealt with for almost 200 years, muricid assemblages were described by Hoernes & Auinger (1882, 1885), Boettger (1902–1906), Popa *et al.* (2015), and Kovács (2019). The material from Lăpugiu de Sus studied herein is housed in the Hungarian National Museum Public Collection Centre – Hungarian Natural History Museum, Budapest.

MATERIAL AND METHOD

The specimens investigated in this paper are stored in the palaeontological collection of the Hungarian National Museum Public Collection Centre – Hungarian Natural History Museum, Budapest (HNHM), and in the private collections of the authors. Taxonomy and description terminology are based on

papers by Landau *et al.* (2013, 2019), Merle *at al.* (2011, 2022), and Russini *et al.* (2023).

Abbreviations: SL = shell length; SW = shell width; P = primary cord; IP = infrasutural primary cord; ADP = adapical primary cord of the siphonal canal; MP = median primary cord of the siphonal canal; ABP – abapical primary cord of the siphonal canal; s = secondary cord; adis = adapical secondary cord of the infrasutural ramp; abis = abapical secondary cord of the infrasutural ramp; ads = adapical secondary cord of the siphonal canal; D = denticle.

SYSTEMATIC PALAEONTOLOGY

Clade Neogastropoda Wenz, 1938
Superfamily Muricoidea Rafinesque, 1815
Family Muricidae Rafinesque, 1815
Subfamily Muricinae Rafinesque, 1815
Genus *Flexopteron* Shuto, 1969

Flexopteron goniostoma (Hörnes, 1853)
(Figs 2–3)

2011 *Paziella* (*Flexopteron*) *goniostoma* Partsch in Hörnes – Merle *et al.*, p. 522, pl. 139, figs 1–2.
2018 *Paziella* (*Flexopteron*) *goniostoma* Partsch in Hörnes – Kovács *et al.*, p. 116, figs 3I–J.
2019 *Paziella* (*Flexopteron*) *goniostoma* Hörnes – Kovács, p. 118, figs 19–20.
non 2023 *Flexopteron* cf. *goniostoma* (Partsch in Hörnes) – Lozouet, p. 18, pl. 15, figs 1–3.

Material – 2 specimens (Tekeres).

Remarks – In the Pannonian Basin the species was recorded by Kovács *et al.* (2018) from the muricid assemblage of Letkés, Bagoly Hill. New field works have recently yielded two *Flexopteron goniostoma* specimens at Tekeres, they were collected by Márton Szabó (HNHM). The preservation of the illustrated specimen is relatively fine. As the circolittoral–upper bathyal gastropods in the clayey sand deposits of the locality are characterized by generally well-preserved shells (as opposed to the poor preservation of the nearshore assemblages), the good state of the shell indicates offshore palaeoenvironment for the species. The fragmentary *Flexopteron* specimen in Lozouet (2023: 18, pl. 15, figs 1–3) from the Chattian of France is characterized by a multispiral protoconch (as opposed to 1½ on *Paziella goniostoma*) and very weakly developed spiral sculpture on spire whorls – it represents another (probably new) species.

Distribution – Middle Miocene. Badenian: Central Paratethys (Austria, Bulgaria, Czechia, Hungary, and Romania).

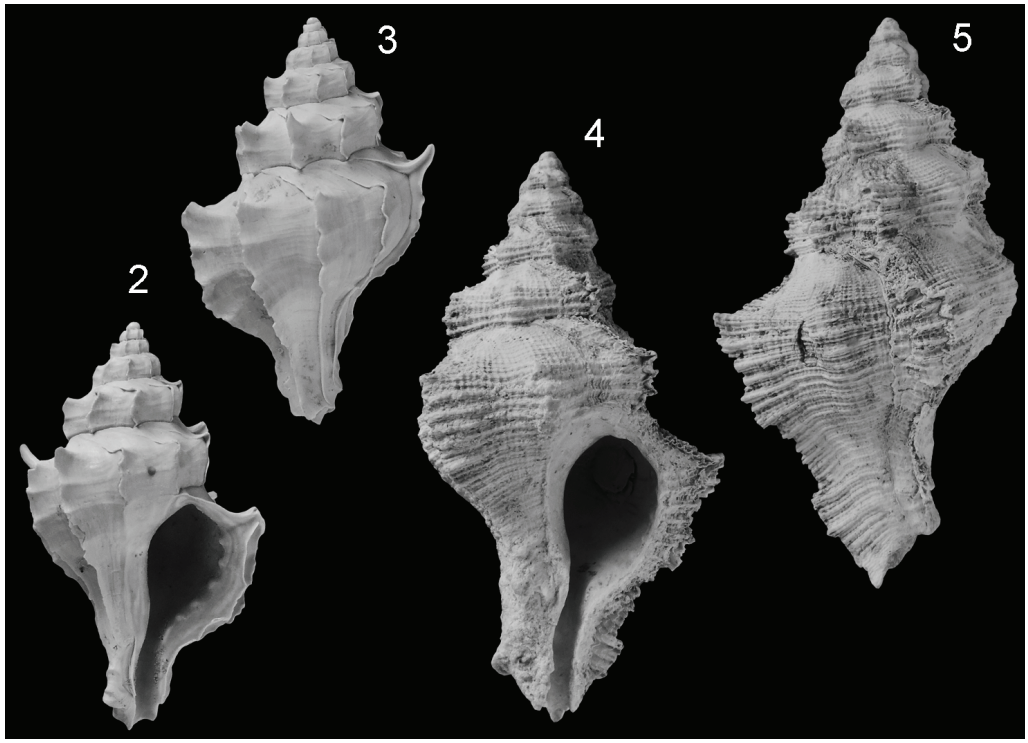
Genus *Pterynotus* Swainson, 1833

Pterynotus granuliferus (Grateloup, 1833) (Figs 4–5)

1995 *Purpura* (*Tritonalia*) *granulifera* (Grateloup) – Bałuk, p. 227, pl. 24, figs 1–2.
2011 *Pterynotus* (s.s.) *granuliferus* (Grateloup) – Merle *et al.*, p. 416, pl. 86, figs 1–3.
2013 *Pterynotus granuliferus* (Grateloup) – Landau *et al.*, p. 148, pl. 21, figs 12–13 (*cum syn.*).
2018 *Pterynotus granuliferus* (Grateloup) – Kovács *et al.*, p. 114, figs 3E–F.
2023 *Pterynotus granuliferus* (Grateloup) – Lozouet, pl. 17, figs 13–15.

Material – 9 specimens (Letkés).

Remarks – The species is characterized by medium-sized, trivaricate shell bearing scabrous spiral cords with small P1–P5 spines at their intersections with the well-developed varices. The fine spiral threads and the fine growth lines form a reticulate pattern on the infrasutural ramp. *Pterynotus granuliferus* is widespread in the Miocene of Europe but is extremely rare in the Pannonian Basin, it is known only in the Badenian Letkés assemblage. The NE Atlantic specimens are characterized by less angular whorls.



Figs 2–3. *Flexopteron goniostoma* (Hörnes), SL 20.2, SW 12 (2.5×), Tekeres, apertural and abapertural views. – **Figs 4–5.** *Pterynotus granuliferus* (Grateloup), SL 46, SW 24.6 (1.5×), Letkés, apertural and abapertural views

Distribution – Early–Middle Miocene. Burdigalian–Langhian: NE Atlantic (France). Badenian: Central Paratethys (Austria, Bulgaria, Hungary, Poland, and Romania), Serravallian: Proto-Mediterranean Sea (Turkey). Late Miocene. Tortonian: Proto-Mediterranean Sea (Italy).

Subfamily Muricopsinae Radwin et D'Attilio, 1971
Genus *Muricopsis* Bucquoy et Dautzenberg, 1882

Muricopsis cristata (Brocchi, 1814)
(Figs 6–13, 53–56)

1966 *Muricopsis cristatus* Brocchi – Kókay, pl. 7, fig. 20.
2018 *Muricopsis cristata* (Brocchi) – Kovács *et al*., p. 118, figs 5E–F.
2022 *Muricopsis cristata* (Brocchi) – Merle *et al*., pp. 63, 176, text-figs 16, 27, pls 4–6.
2022 *Muricopsis* cf. *cristata* (Brocchi) – Merle *et al*., p. 174, pl. 3, fig. 8.

Material – 17 specimens (Letkés), 4 specimens (Márkháza), 320 specimens (Bánd), 35 specimens (Făget Basin, Romania: Coşteiu de Sus, Lăpugiu de Sus – HNHM collection, see Kovács 2019: 122).

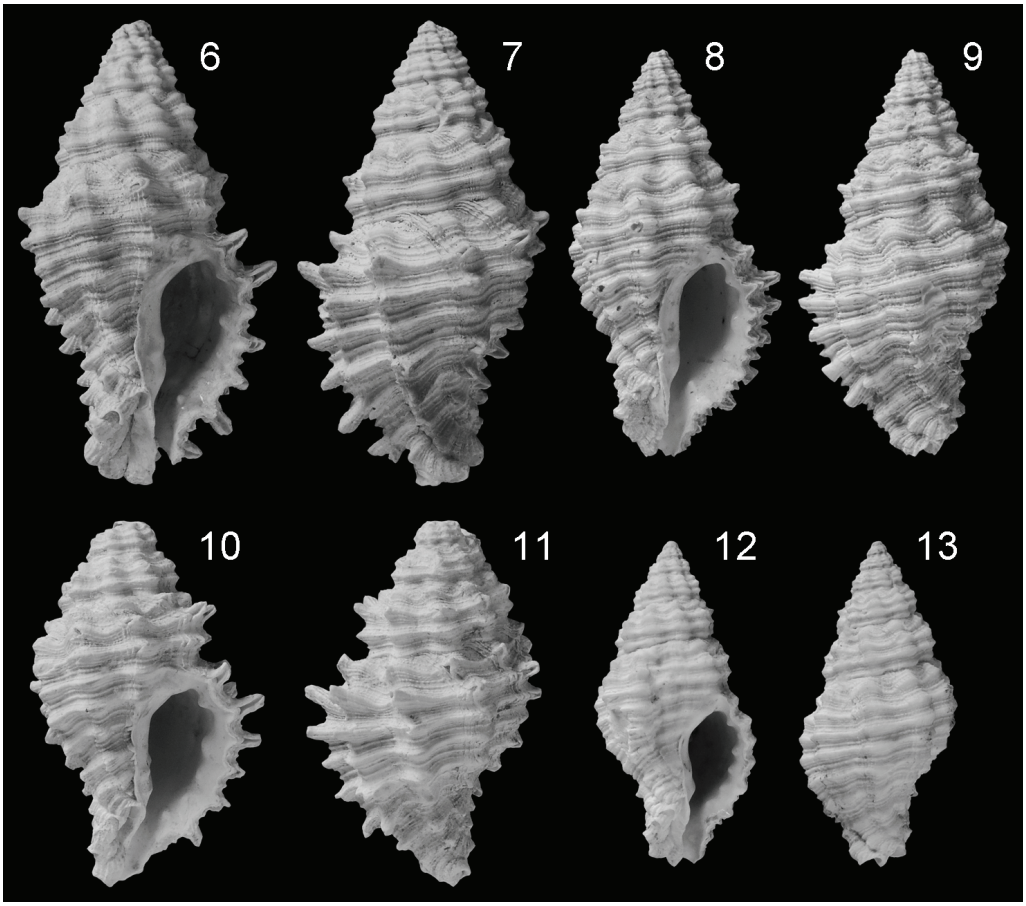
Remarks – The Miocene–Recent *Muricopsis cristata* displays a remarkable morphological variability: beside "variations" at least 14 species were synonymized by Merle *et al*. (2022). In the previous literature two subspecies or morphotypes were used for fossil specimens: *Muricopsis cristata cristata* (Brocchi) for broader and strongly spiny shells and *M. cristata inermis* (Philippi, 1836) for more slender and smooth shells (Landau *et al*. 2007, 2013). In the Central Paratethys both morphs are common in the fossil record, and numerous transitional forms were also illustrated (for literature see Landau *et al*. 2007: 42). We represent herein a few specimens from the Pannonian and the Făget basins to demonstrate the moderate variability of the species in different Badenian assemblages. *Muricopsis cristata* had a Middle Miocene Paratethyan origin, in the Late Miocene the species appeared in the Proto-Mediterranean Sea, and then it became widespread during the Pliocene in the Mediterranean and the NW Atlantic regions.

Miocene distribution – Badenian: Central Paratethys (Austria, Bulgaria, Czechia, Hungary, Poland, Romania, and Ukraine). Tortonian–Messinian: Proto-Mediterranean Sea (Italy).

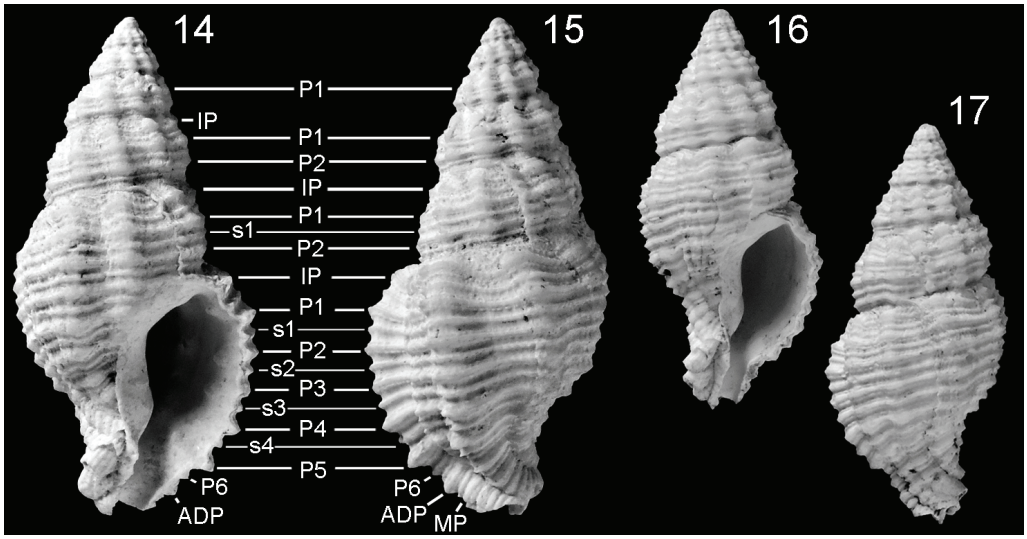
Muricopsis emus (De Gregorio, 1885)
(Figs 14–17)

1853 *Murex cristatus* – Hörnes, p. 243, pl. 25, fig. 6 (*non* Brocchi, 1814).
1885 *Murex cristatus* Brocchi var. *emus* De Gregorio – De Gregorio, p. 256 (new name for *Murex cristatus* in Hörnes 1853, pl. 25, fig. 6).
2018 *Muricopsis* (s.s.) *dujardini* – Kovács *et al*., p. 118, figs 5G–H (*non* Peyrot, 1938).

Remarks – As *Muricopsis emus* has not been discussed in the literature since its introduction, a detailed description is given herein on the basis of the study material: Subfusiform shell with paucispiral protoconch of approx. 1½ rounded whorls. Teleoconch of 6 slightly rounded whorls, suture impressed. Last whorl rounded, constricted at base. Aperture ovate, anal canal well-developed, outer lip somewhat flaring, thickened by varix, 5 weak denticles (ID, D1–D4) within, from which ID and D1 strongest. Last whorl of the specimen in Figs 14–15 also bears denticles below the protovarix. Parietal and columellar callus slightly extended, delimited. Columella bearing two weakly developed folds. Spiral sculpture of moderately developed primary and secondary cords, IP, abis, P1–P2, s1–s2 on spire whorls, adis, IP, abis, P1–P6, s1–s6, ADP, ads, MP on last



Figs 6–13. *Muricopsis cristata* (Brocchi). – **Figs 6–7.** SL 28.5, SW 15.7 (2×), Lăpugiu de Sus, apertural and abapertural views. – **Figs 8–9.** SL 25.3, SW 13.5 (2×), Bánd, apertural and abapertural views. – **Figs 10–11.** SL 22.6, SW 15 (2×), Bánd, apertural and abapertural views. – **Figs 12–13.** SL 20, SW 9.6 (2×), Letkés, apertural and abapertural views



Figs 14–17. *Muricopsis emus* (De Gregorio). – **Figs 14–15.** SL 20.1, SW 10 (3×), apertural and abapertural views. – **Figs 16–17.** SL 16.3, SW 7.8 (3×), apertural and abapertural views. Locality: Letkés, Bagoly Hill

whorl. Secondaries and both sides of primaries finely scabrous. Axial sculpture of rounded ribs and varices (last whorl: 4 ribs, 2 varices), small spines at intersections on varices.

The study material was assigned to *Muricopsis dujardini* Peyrot, 1938 by Kovács *et al.* (2018). This species was reinvestigated by Merle *et al.* (2022), and the illustrations made it obvious that the Letkés specimens are distinguishable from Peyrot's taxon by their more slender spire, weaker sculpture and less developed denticles. The Hungarian material was synonymized under *Muricopsis landaui* Merle by Merle *et al.* (2022: 63), the type specimen (l.c., pl. 3, fig. 7), however, differs from the specimens figured herein by its biconic shell, lower spire, almost flattened spire whorls, narrower aperture, stronger denticles, and deeper pseudoumbilicus. The specimens from Letkés are much closer to *Muricopsis emus* that was introduced by De Gregorio (1885: 256) for the *Murex cristatus* specimen illustrated in Hörnes (1853, pl. 25, fig. 6; holotype: NHMW 1846/0037/0220, Naturhistorisches Museum, Wien) from the Miocene Vienna Basin which remarkably differs from Brocchi's species in morphology. Although the holotype of *Muricopsis emus* is larger (SL: 31.6 mm, SW: 15.2 mm), the study material agrees with it in morphology. Slight variability of the species can be traced: the study specimens have somewhat more slender shell and less rounded whorls bearing fewer axial ribs than the holotype.

Genus *Murexsul* Iredale, 1915

Murexsul sztanoae n. sp.
(Figs 18–21)

ZooBank registration – zoobank.org:act:2B711C65-B72A-4467-A413-1D30EB793FAC

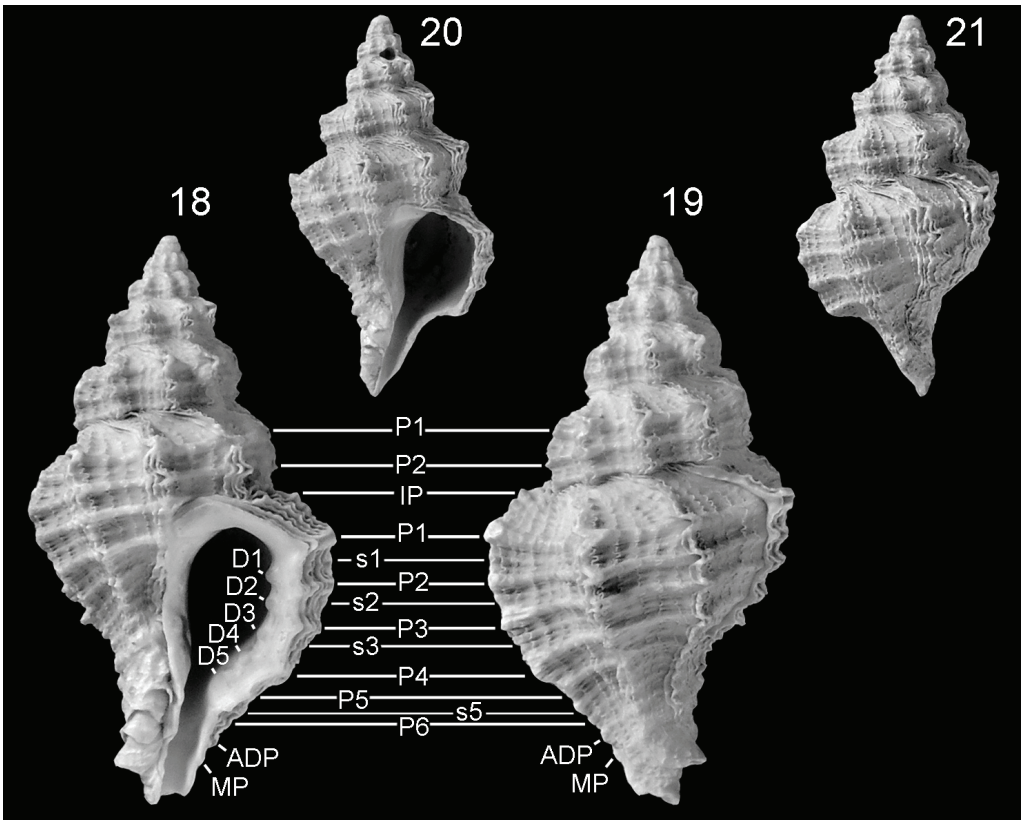
Holotype – HNHM M.60.10556., SL 19 mm, SW 9.9 mm (Figs 18–19).

Paratype – HNHM M.60.7957., SL 13.5 mm, SW 7.3 mm (Figs 20–21).

Type strata and locality – Lower Badenian (Middle Miocene) clayey silt (Dej Formation), Lăpugiu de Sus (Făget Basin, Romania).

Derivation of name – In honour of Orsolya Sztanó, Hungarian geologist (Eötvös Loránd University, Budapest).

Diagnosis – *Murexsul* species with biconical shell, gradate spire, paucispiral protoconch, five teleoconch whorls, last whorl shouldered, slightly rounded below, aperture ovate, outer lip thickened by varix, denticulate within, folded



Figs 18–21. *Murexsul sztanoae* n. sp. – **Figs 18–19.** Holotype, SL 19, SW 9.9 (3.5×), apertural and abapertural views. – **Figs 20–21.** Paratype, SL 13.5, SW 7.3 (3.5×), apertural and abapertural views. Locality: Lăpugiu de Sus (Romania)

columella, open siphonal canal, sculpture of primary and secondary spiral cords, axial varices, open spines at intersections.

Description – Biconical shell with gradate spire, protoconch of 1½ smooth, rounded whorls, teleoconch of 5 shouldered whorls. Last whorl 73.7% of total length of the teleoconch, with sloping infrasutural ramp, shouldered, slightly rounded below, constricted at base. Ovate aperture, outer lip thickened by varix, 5 strong denticles (D1–D5) within, D1 and D2 strongest, ID absent. Parietal and columellar callus somewhat extended, sharply delimited, two basal folds on columella, siphonal canal open, slightly dorsally recurved. Scabrous shell surface, spiral sculpture of strong primary and finer secondary cords. First teleoconch whorl: appearance of P1–P2; third and fourth whorls: P1–P3, last whorl: IP and fine threads on infrasutural ramp, strong P1–P5, weakly developed P6 and ADP, MP and ABP, s1–s5. Axial sculpture of 8 varices on penultimate and 7 varices on last whorls, small, open spines at intersections on varices, P1 spine strongest.

Remarks – The material was erroneously recorded by Kovács (2019: 122) as *Muricopsis moravica* (Hoernes et Auinger, 1885). Later we could study photos of the type specimens of *Murex* (*Muricidea*) *moravicus* by courtesy of Mathias Harzhauser (NHM, Vienna). *Murexsul sztanoae* n. sp. is really similar in overall morphology and absence of ID but is distinguished by its more slender spire, much finer spiral cords and narrower axial ribs, weaker denticles, lack of pseudoumbilicus, and less scabrous surface by more widely spaced growth lines. The Late Oligocene *Murexsul elatospira* (Cossmann et Peyrot, 1924) differs by its elongated, gradate spire and longer siphonal canal (Merle *et al*. 2022, pl. 23, figs 2–3; Lozouet 2023, pl. 28, figs 15–20); the Late Oligocene–Early Miocene *M. rostralis* (Grateloup, 1847) is characterized by broader shell, stronger spiral sculpture with more projected spines, bearing more developed columellar folds and denticles (ID is present) (Merle *et al*. 2022, pl. 23, figs 7–8, pl. 24, figs 1–3; Lozouet 2023, pl. 28, figs 1–3, 6–8), and the Late Miocene–Early Pliocene *M. alternicosta* (Michelotti, 1841) is distinguishable by broader shell with lower spire, larger foliaceous varices, and stronger denticles (Merle *et al*. 2022, pl. 24, figs 4–7).

Genus *Attiliosa* Emerson, 1968

Attiliosa juhaszi n. sp.
(Figs 22–28)

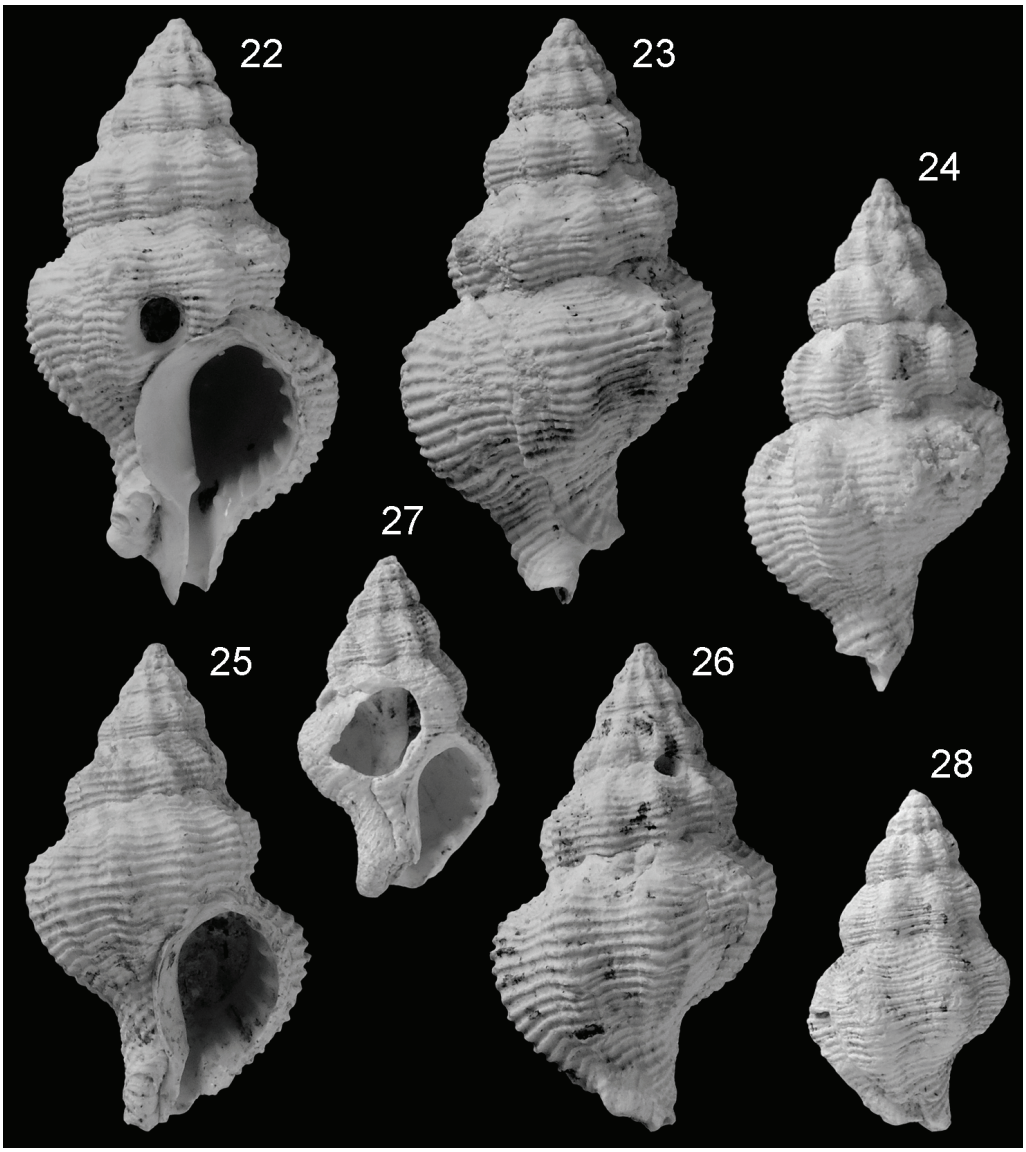
ZooBank registration – zoobank.org:pub:7E297CCC-283D-449C-84CB-10367BE69514

Holotype – HNHM PAL 2024.1.1., SL 20.5 mm, SW 11 mm (Figs 22–23).
Paratype 1 – Vicián Collection, SL 17 mm, SW 10.8 mm (Figs 25–26).

Paratype 2 – HNHM PAL 2024.2.1., SL 18 mm, SW 9.6 mm (Fig. 24).

Paratype 3 – HNHM PAL 2024.3.1., SL 12 mm, SW 7.2 mm (Figs 27–28).

Type strata and locality – Lower Badenian (Middle Miocene) clayey sand (Pécsszabolcs Member of the Lajta Limestone Formation), Letkés, Bagoly Hill, Börzsöny Mts, Hungary.



Figs 22–28. *Attiliosa juhaszi* n. sp. – **Figs 22–23.** Holotype, SL 20.5, SW 11 (3.5×), apertural and abapertural views. – **Fig. 24.** Paratype 2, SL 18, SW 9.6 (3.5×), abapertural view. – **Figs 25–26.** Paratype 1, SL 17, SW 10.8 (3.5×), apertural and abapertural views. – **Figs 27–28.** Paratype 3, SL 12, SW 7.2 (3.5×), apertural and abapertural views. Locality: Letkés, Bagoly Hill

Derivation of name – In honour of Gergely Juhász, Hungarian fossil collector (Miskolc).

Material – Holotype, paratypes and 3 specimens in private collections of the authors.

Diagnosis – *Attiliosa* species with fusiform shell, paucispiral protoconch, five rounded teleoconch whorls, folded columella, sculpture of fine spiral cords of almost equal strength, broad, rounded axial ribs.

Description – Fusiform shell, protoconch worn, paucispiral of approx. 1½ smooth, rounded whorls. Teleoconch of 5 rounded whorls, last whorl bearing rounded shoulder, constricted at base. Aperture wide ovate, outer lip thickened by varix, denticulate within, ID–D6 denticles narrow, elongate. Siphonal canal short, open. Columellar callus weakly expanded, bearing two folds abapically. Narrow pseudoumbilicus on adult specimens. Spiral sculpture of fine, non-spiny cords. P1–P4 slightly stronger than s1–s3 on penultimate whorl, P1–P6 and s1–s6 all of equal strength on last whorl, cords scabrous by close set axial growth lines. Axial sculpture of broad, rounded ribs, 7 on last whorl.

Remarks – Genus *Attiliosa* is morphologically highly variable (Merle *et al.* 2011). *Attiliosa juhaszi* n. sp. is characterized by fine spiral sculpture and absence of spines. It is somewhat similar to the Late Miocene *Attiliosa pouweri* Landau, Merle, Coulemans et Van Dingenen (Landau *et al.* 2019, pl. 21, figs 1–7) but is distinguished by its higher spire, slightly longer siphonal canal, absence of P1 spinelets, and presence of two columellar folds as opposed to three folds on *A. pouweri*. The Early Miocene *Attiliosa nassatella* (Grateloup, 1845) clearly differs by its lower spire with less rounded whorls (Lozouet 2023, pl. 6, figs 10–15). Genus *Attiliosa* is a new record in the Miocene Paratethys.

Genus *Pazinotus* E. H. Vokes, 1970

Pazinotus martonszaboi n. sp.
(Figs 29–32)

ZooBank registration – zoobank.org:pub:7E297CCC-283D-449C-84CB-10367BE69514

Holotype – HNHM PAL 2024.6.1., SL 12.1 mm, SW 7.6 mm, Tekeres (Figs 29–30).

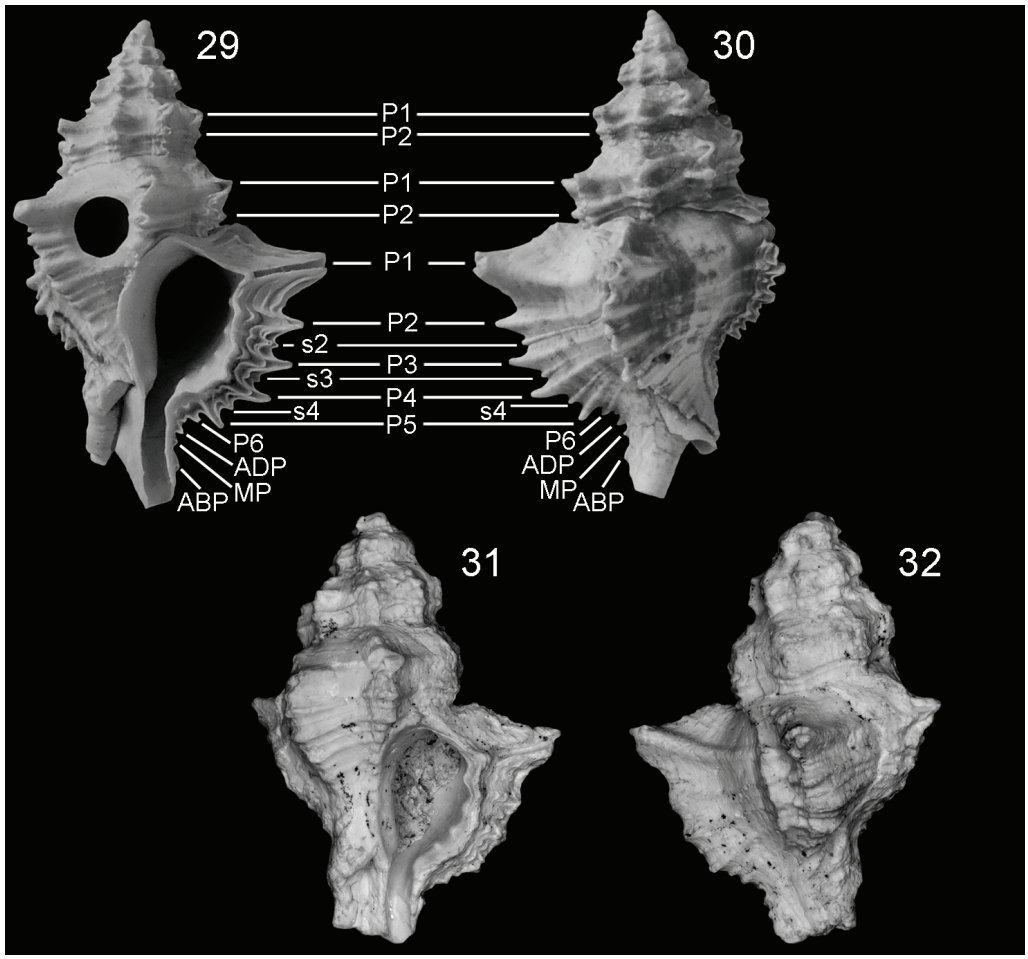
Paratype – HNHM PAL 2024.7.1., SL 10.5 mm, SW 6.9 mm, Letkés (Figs 31–32).

Type strata and locality – Badenian clayey sand (Tekeres Schlier Formation), Tekeres, Mecsek Mts, Hungary.

Derivation of name – In honour of Márton Szabó, museologist and palaeontologist (HNHM), who collected the holotype.

Diagnosis – *Pazinotus* species of small shell, multispiral protoconch, shouldered teleoconch whorls, ovate aperture, smooth columellar lip, sculpture of marked primary cords, and varices with projected P1 spines.

Description – Small shell, protoconch of 2½ smooth, rounded whorls. Teleoconch of 4½ shouldered whorls with sloping sutural ramp. Last whorl rounded, constricted at base. Ovate aperture, smooth columellar lip. Outer lip thickened by varix, bearing five small denticles (D1–D5) within. Slightly curved, open siphonal canal, narrower penultimate siphonal canal present. Spiral sculpture of primary cords P1–P2, and secondary cord s1 on spire whorls, and P1–P6, s1–s5, ADP on last whorl. Axial sculpture of varices from the first teleoconch whorl: 8 spiny varices on the penultimate, while 5 varices on the last whorl.



Figs 29–32. *Pazinotus martonszaboi* n. sp. – **Figs 29–30.** Holotype, SL 12.1, SW 7.6 (5×), Tekeres, apertural and abapertural views. – **Figs 31–32.** Paratype, SL 10.5, SW 6.9 (5×), Letkés, apertural and abapertural views

Projected, open P1 spines from the second teleoconch whorl, P2–P4 spinelets on the last whorl.

Remarks – Based on morphological features, the new species is assigned to genus *Pazinotus*. The multispiral protoconch appears on fossil representatives of the genus, e.g., on the Badenian *Pazinotus attonans* (Boettger, 1906) from the Făget Basin (Romania). The latter species differs by more elongated shell, narrower aperture, longer siphonal canal, and well-developed, foliaceous varices (Zilch 1934, pl. 15, fig. 80; Merle *et al.* 2022, pl. 116, fig. 10). The most closely allied congener in size and morphology is the Pliocene *Pazinotus depontaillieri* (Cossmann, 1903) (see Merle *et al.* 2022, pl. 116, figs 11–12) from which *P. martonszaboi* n. sp. is distinguished in stratigraphic range and morphology by its subhorizontal P1 spine, slightly more developed P2–P4 spines, and weaker denticles. The new species somewhat resembles *Murex* (*Muricidea*) *hamulifer* Boettger, 1906 (assigned to *Paziella* by Merle *et al.* 2011) from the Badenian of the Făget Basin (Romania) in size and morphology (see Zilch 1934, pl. 15, figs 77a–b; holotype refigured by Merle *et al.* 2011, pl. 132, fig. 6). We have studied the photos of the holotype courtesy of Sigrid Hof and Ronald Janssen (Senckenberg Forschungsinstitut und Naturmuseum), and the following differences are recognized: the type specimen has subconical last whorl (as opposed to rounded on *Pazinotus martonszaboi* n. sp.), its siphonal canal is more curved backwards (it is very slightly curved on our new species), it bears more varices on the last whorl (7 as opposed to 5 on *martonszaboi* n. sp.).

Subfamily Ocenebrinae Cossmann, 1903
Genus *Ocinebrina* Jousseaume, 1880

Ocinebrina boeckhi (Hoernes et Auinger, 1885)
(Figs 33–34)

1885 *Murex* (h *Occenebra*) *Boeckhi* nov. form. – Hoernes & Auinger, p. 221, pl. 27, fig. 3.
non 2018 *Ocinebrina boeckhi* (Hoernes et Auinger) – Kovács *et al.*, p. 122, figs 5W–X.
2020 *Ocinebrina boeckhi* (Hoernes et Auinger) – Kovács, pl. 2, figs 22–23.

Material – 7 specimens (Bánd, Herend).

Remarks – *Ocinebrina boeckhi* is characterized by moderate morphological variability (Hoernes & Auinger 1885) but it generally has angulate whorls bearing scabrous spiral cords and sealed siphonal canal. The species was recorded from the Herend Sub-basin by Kókay (1966) without any description or illustration. The specimen figured by Kovács *et al.* (2018, figs 5W–X) has an elongated shell with gradate spire and open siphonal canal, it represents another species.

Distribution – Middle Miocene. Badenian: Central Paratethys (Austria, Hungary, and Romania).

Genus *Gracilipurpura* Jousseaume, 1880

Gracilipurpura? *evae* n. sp.
(Figs 35–36)

ZooBank registration – zoobank.org:pub:7E297CCC-283D-449C-84CB-10367BE69514

Holotype – HNHM PAL 2024.8.1., SL 19 mm, SW 10 mm.

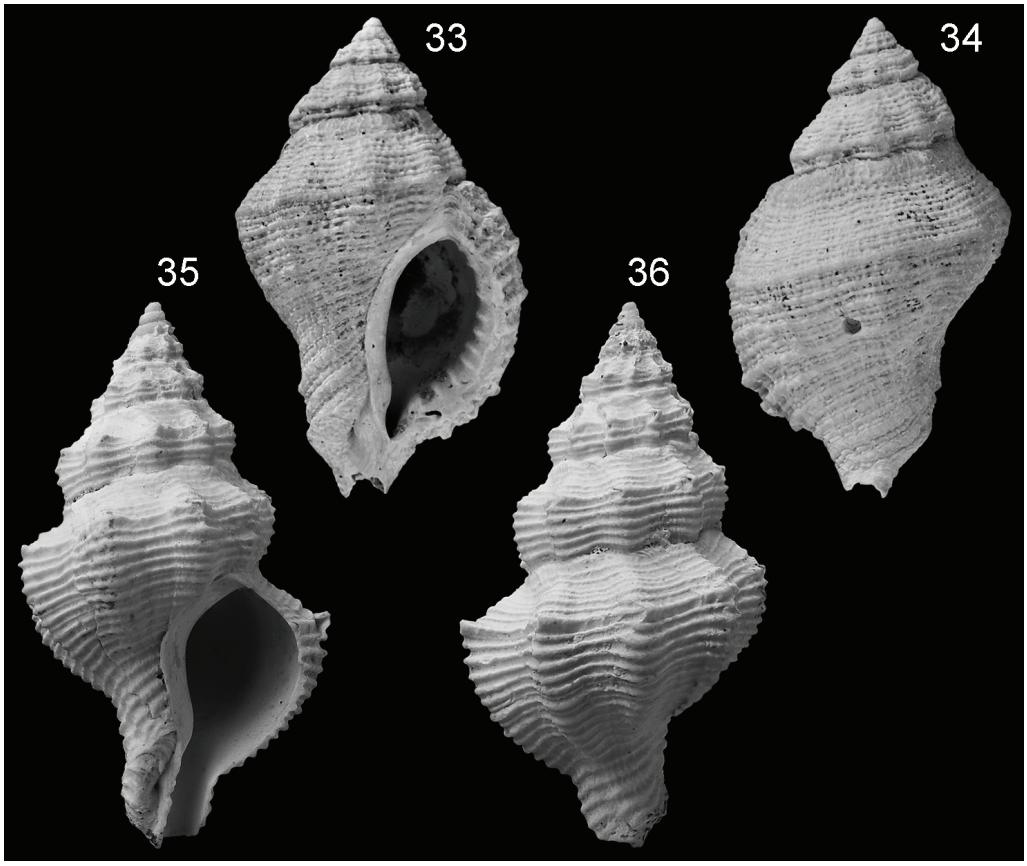
Type strata and locality – Lower Badenian (Middle Miocene) clayey sand (Pécsszabolcs Member of the Lajta Limestone Formation), Letkés, Bagoly Hill, Börzsöny Mts, Hungary.

Derivation of name – In honour of Éva Erzsébet Kiss, Hungarian fossil collector (Őrbottyán).

Diagnosis – *Gracilipurpura*? species with fusiform shell, high spire, teleoconch of 5 shouldered whorls, wide ovate aperture, outer lip smooth within, smooth parietal callus and columella, short, open siphonal canal. Sculpture of numerous fine, scabrous spiral cords, P1 bearing small, open spines, broad, rounded axial ribs.

Description – Fusiform shell with high spire. Protoconch conical, eroded, fragments of the last 1½ rounded whorls visible. Teleoconch of 5 shouldered whorls with undulating suture and sloping infrasutural ramp. Early whorls eroded. Last whorl angulated at shoulder, rounded below, strongly constricted at base. Aperture wide ovate, outer lip thin, smooth within, parietal callus smooth, somewhat extended, sharply delimited, columella smooth, siphonal canal short, open, slightly curved. Spiral sculpture of six infrasutural threads, numerous fine primary spiral cords, scabrous by close set axial growth lines, 6 on penultimate whorl, secondaries appear on last whorl, 5 primary cords on siphonal fasciole. P1 cords bearing small, open spines on axial ribs from the third teleoconch whorl. Axial sculpture of rounded, prominent ribs, 8 on last whorl.

Remarks – Based on its general morphological similarity to the Miocene–Recent *Gracilipurpura craticulata* (Bucquoy et Dautzenberg, 1882), except the shorter siphonal canal, the new species is provisionally assigned to genus *Gracilipurpura* with question mark (Didier Merle pers. com.). (The taxonomic clarification concerning genera *Hadriania* Bucquoy et Dautzenberg, 1882 and *Gracilipurpura* Jousseaume, 1880 was arranged by Fassio *et al.* 2022: 633. *Hadriania* is a junior synonym of *Gracilipurpura* which is not a fasciolariid but a muricid genus.) *Gracilipurpura*? *evae* n. sp. differs from the NE Atlantic–Mediterranean *G. craticulata*, the Central Paratethyan *G. mioincrassata* (Sacco, 1904) – which is known in the Badenian Pannonian Basin (Kovács 2020) – and the Paratethyan–Proto-Mediterranean *G. polonica* (Bałuk, 1995) by its shorter siphonal canal, much finer spiral sculpture, and absence of denticles.



Figs 33–34. *Ocinebrina boeckhi* (Hoernes et Auinger), Herend, SL 23.6, W 14 (2.5×), apertural and abapertural views. – **Figs 35–36.** *Gracilipurpura*? *evae* n. sp., Holotype, Letkés, Bagoly Hill, SL 19, SW 10 (3.5×), apertural and abapertural views

Subfamily Coralliophilinae Chenu, 1859
Genus *Coralliophila* H. Adams et A. Adams, 1853

Coralliophila subscarrosa n. sp.
(Figs 37–39)

2013 *Coralliophila scarrosa* – Landau *et al.*, p. 163, pl. 24, figs 10–11 (*non* Bellardi, 1873).

ZooBank registration – zoobank.org:pub:7E297CCC-283D-449C-84CB-10367BE69514

Holotype – HNHM PAL 2024.4.1., SL 13.2 mm, SW 7.4 mm.

Type strata and locality – Lower Badenian (Middle Miocene) clayey sand (Pécsszabolcs Member of the Lajta Limestone Formation), Letkés, Bagoly Hill, Börzsöny Mts, Hungary.

Derivation of name – Name refers to the morphological similarity to *Coralliophila scarrosa* (Bellardi, 1873).

Diagnosis – *Coralliophila* species with subfusiform shell, multispiral protoconch, five rounded teleoconch whorls, ovate aperture, lirate outer lip within, short siphonal canal, smooth columella. Sculpture of fine, scabrous spiral cords, broad, rounded axial ribs.

Description – Broad, subfusiform shell. Fragmentary protoconch: the last 2 preserved whorls rounded, smooth. Teleoconch of 5 rounded whorls, last whorl 70% of total length, constricted at base. Aperture wide ovate, outer lip broken, lirate within, siphonal canal short, open. Columella smooth, columellar callus weakly expanded. Spiral sculpture of fine, scabrous cords. P1–P2 on first and second teleoconch whorls; IP, abis, P1–P3, s1 on third whorl; adis, IP, abis (of equal strength), P1–P3, s1–s2 on penultimate whorl; adis, IP, abis (of equal strength), P1–P7 (P7 strongest at base), s1–s2, s6 on convex part of last whorl, 4 primaries and 4 secondaries on siphonal canal. Axial sculpture of broad, rounded ribs, 11 on penultimate, 8 on last whorl.

Remarks – Genus *Coralliophila* is widespread in the early Badenian Pannonian Basin, it was recorded from four regions: Börzsöny Mts (Letkés), Bükk Mts (Borsodbóta), Bakony Mts (Bánd), and Mecsek Mts (Mecsekpölöske) (Kovács 2020). Eight species occur at these localities; the highest alpha diversity is typical of Letkés, where five species were described by Kovács *et al.* (2018). During the last years a new form was collected at the Bagoly Hill locality which is close in size and morphology to the Serravallian material illustrated as *Coralliophila scarrosa* by Landau *et al.* (2013, pl. 24, figs 10–11). However, the types of the latter taxon (*Murex scarrosus* and *Murex concrispatus* in Bellardi 1873, p. 125, pl. 8, fig. 15 and p. 125, pl. 8, fig. 16, respectively) differ from the Karaman Basin (Türkiye) material by their more elongated and more slender shell with longer siphonal canal. Therefore, the Karaman Basin specimens are regarded herein as representatives of *Coralliophila subscarrosa* n. sp. The new species is distinguished from the Miocene Central Paratethyan congeners by its subfusiform shell with rounded whorls.

Distribution – Middle Miocene. Badenian: Central Paratethys (Hungary), Serravallian: Proto-Mediterranean Sea (Türkiye).

Genus *Leptoconchus* Rüppell, 1834

Leptoconchus jaegeri Rolle, 1863
(Figs 40–42)

1863 *Leptoconchus jaegeri* Rolle – Rolle, p. 243, fig. 15.
1934 *Magilus jaegeri* Boettger – Zilch, p. 252, pl. 15, figs 85–86.
2018 *Leptoconchus jaegeri* Boettger – Kovács *et al.*, p. 130, figs 9P–V.
2020 *Leptoconchus jaegeri* Boettger – Kovács, p. 459, pl. 4, figs 30–31.

Material – 7 specimens (Letkés), 2 specimens (Bánd), 2 specimens (Márkháza.

Remarks – Within the Coralliophilidae the *Coralliophila* species are ectoparasitic gastropods on corals, while the *Leptoconchus* species are endoparasitic living in bore-holes in corals (A. Gittenberger & E. Gittenberger 2011). The European Miocene *Leptoconchus* is rare and poorly known, only four species were described in the literature: *L. costatus* (Chenu, 1843), *L. duvergieri* (Cossmann et Peyrot, 1923), *L. jaegeri* Rolle, 1863, and *L. rollei* (Boettger, 1906) (Lozouet & Renard 1998; Kovács *et al.* 2018). (The arrangement of *Magilus*? *ficiformis* Bałuk, 1995 requires further research.) In the Pannonian Basin the genus is far less common than *Coralliophila* and only *Leptoconchus jaegeri* was previously recorded at two Badenian sites: Bánd and Letkés. The distribution is completed herein as the species also appears in the Márkháza gastropod assemblage. *Leptoconchus jaegeri* is closely allied in size and morphology to the Aquitanian (Early Miocene) *L. costatus* from which it differs by bearing more and much finer spiral cords. *Leptoconchus costatus* is associated with colonial coral species of the Faviidae and Fungiidae. Representatives of scleractinian colonial corals are abundant at the Middle Miocene localities of the Pannonian and Făget basins (Kopek 1954; Hegedűs 1970; Chaix *et al.* 2018). Most Badenian *Leptoconchus* specimens in the Pannonian Basin were not associated with corals, so the parasite–host relationship could not be examined. The material figured herein is of special interest as the specimen in Fig. 42 appears in its bore-hole in a merulinid *Echinopora oligophylla* (Reuss, 1871) colony, and the other specimen (Figs 40–41) from Márkháza was also found in the same coral species (discussion of the Scleractinia fauna of the Bagoly Hill locality by Kovács *in press*). These records offer a possibility to understand the host specificity of *Leptoconchus jaegeri*.

Distribution – Middle Miocene. Badenian: Central Paratethys (Hungary, and Romania).

Genus *Galeropsis* Hupé, 1860

Galeropsis badenica n. sp.
(Figs 43–44)

2018 *Coralliophila* sp. – Kovács *et al.*, p. 130, fig. 9N–O.

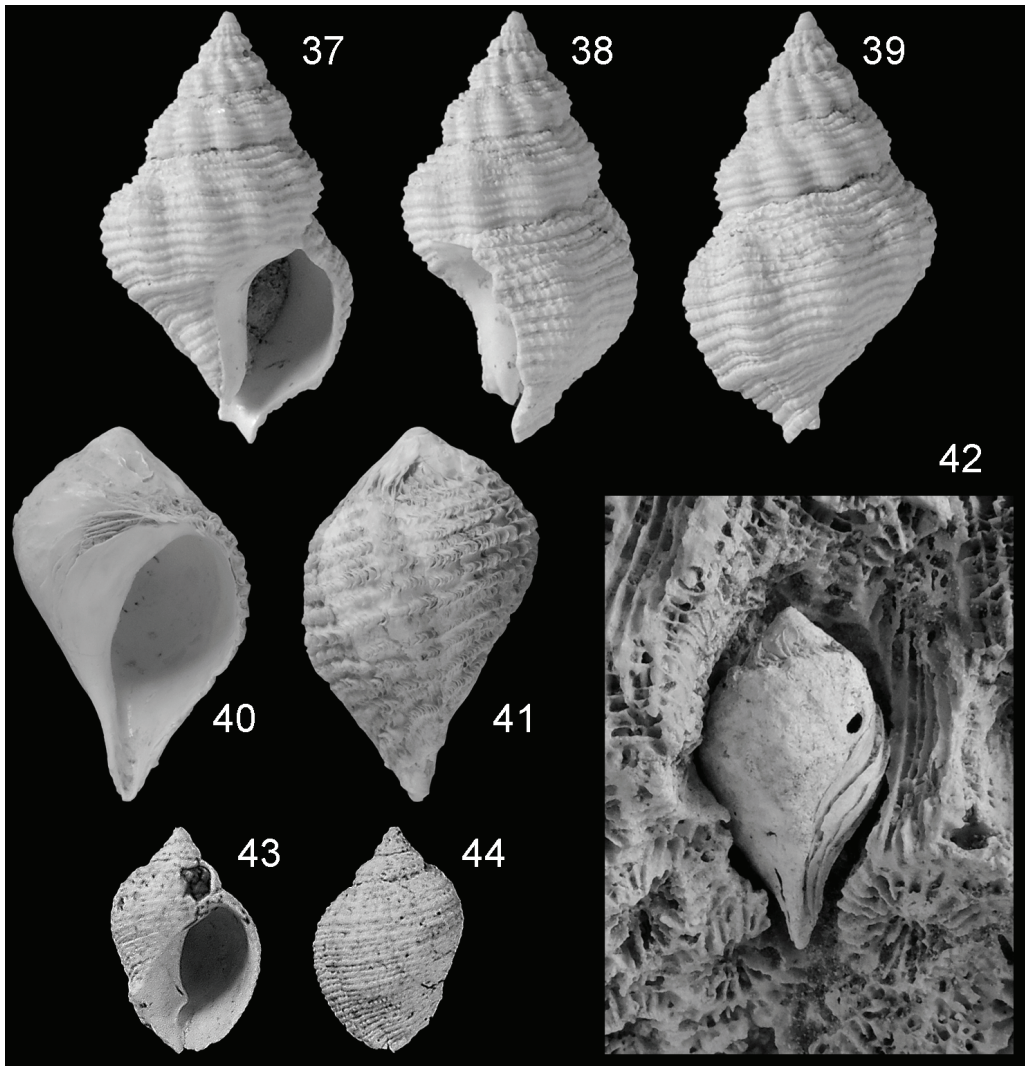
ZooBank registration – zoobank.org:pub:7E297CCC-283D-449C-84CB-10367BE69514

Holotype – HNHM PAL 2024.9.1., SL 10 mm, SW 6.6 mm.

Type strata and locality – Lower Badenian (Middle Miocene) clayey sand (Pécsszabolcs Member of the Lajta Limestone Formation), Letkés, Bagoly Hill, Börzsöny Mts, Hungary.

Derivation of name – Name refers to the stratigraphic range of the new species. Badenian is a Middle Miocene regional stage in the Central Paratethys, equivalent to the standard Langhian stage.

Diagnosis – *Galeropsis* species with small shell, low spire of two teleoconch whorls, globose last whorl, ovate aperture, outer lip smooth within, short siphonal canal, folded columella, expanded callus, sculpture of numerous fine, beaded spiral cords.



Figs 37–39. *Coralliophila subscarrosa* n. sp. Holotype, SL 13.2, SW 7.4 (4×), Letkés, apertural, lateral, and abapertural views. – **Figs 40–42.** *Leptoconchus jaegeri* Rolle. – **Figs 40–41.** SL 15.3, SW 9.5 (3×), Márkháza, apertural and abapertural views. – **Fig. 42.** SL 15.8 (2.6×), Letkés, lateral view. – **Figs 43–44.** *Galeropsis badenica* n. sp., Holotype, SL 10, SW 6.6 (2.8×), Letkés, apertural and abapertural views

Description – Small, globose shell. Eroded conical protoconch with remains of two rounded whorls, low spire of two rounded whorls. Last whorl globose, 87% of total shell length, slightly constricted at base. Aperture wide ovate, outer lip smooth within, siphonal canal short. Columella bearing a prominent basal fold, columellar callus expanded, smooth. Sculpture of fine, beaded spiral cords. Two primaries on spire whorls, last whorl bearing primary, secondary, and tertiary cords on upper half, primaries and secondaries on lower half.

Remarks – The study specimen was assigned to *Coralliophila* by Kovács *et al*. (2018). However, its morphology (globose shell with a well-developed columellar fold) differs from that of genera *Coralliophila* and *Leptoconchus* and is much closer to the Recent *Galeropsis monodonta* (Blainville, 1832), so the new species is assigned to genus *Galeropsis*. Late Oligocene–Early Miocene representatives of *Galeropsis lavenayana* Hupé, 1860 were discussed by Lozouet & Renard (1998) and Lozouet (2023). This species differs from *Galeropsis badenica* n. sp. by its lower spire, more developed parietal callus, and much weaker columellar fold (see Lozouet & Renard 1998, fig. 7.1–9). *Galeropsis monodonta* is a morphologically highly variable species but is distinguishable by its much wider aperture with thickened outer lip, and more oblique siphonal canal (see the lectotype online: http://mediaphoto.mnhn.fr/media/1414167250119ckurDv3iRWeGtSwE). It is worth noting that in the absence of fossil records, the linkage between the Miocene and Recent representatives of the genus has not been clarified.

Subfamily Rapaninae Gray, 1853
Genus *Acanthais* Vermeij et Kool, 1994

Acanthais? *sutii* n. sp.
(Figs 45–52)

2018 *Thaisella*? sp. – Kovács *et al*., p. 126, figs 8I-J.

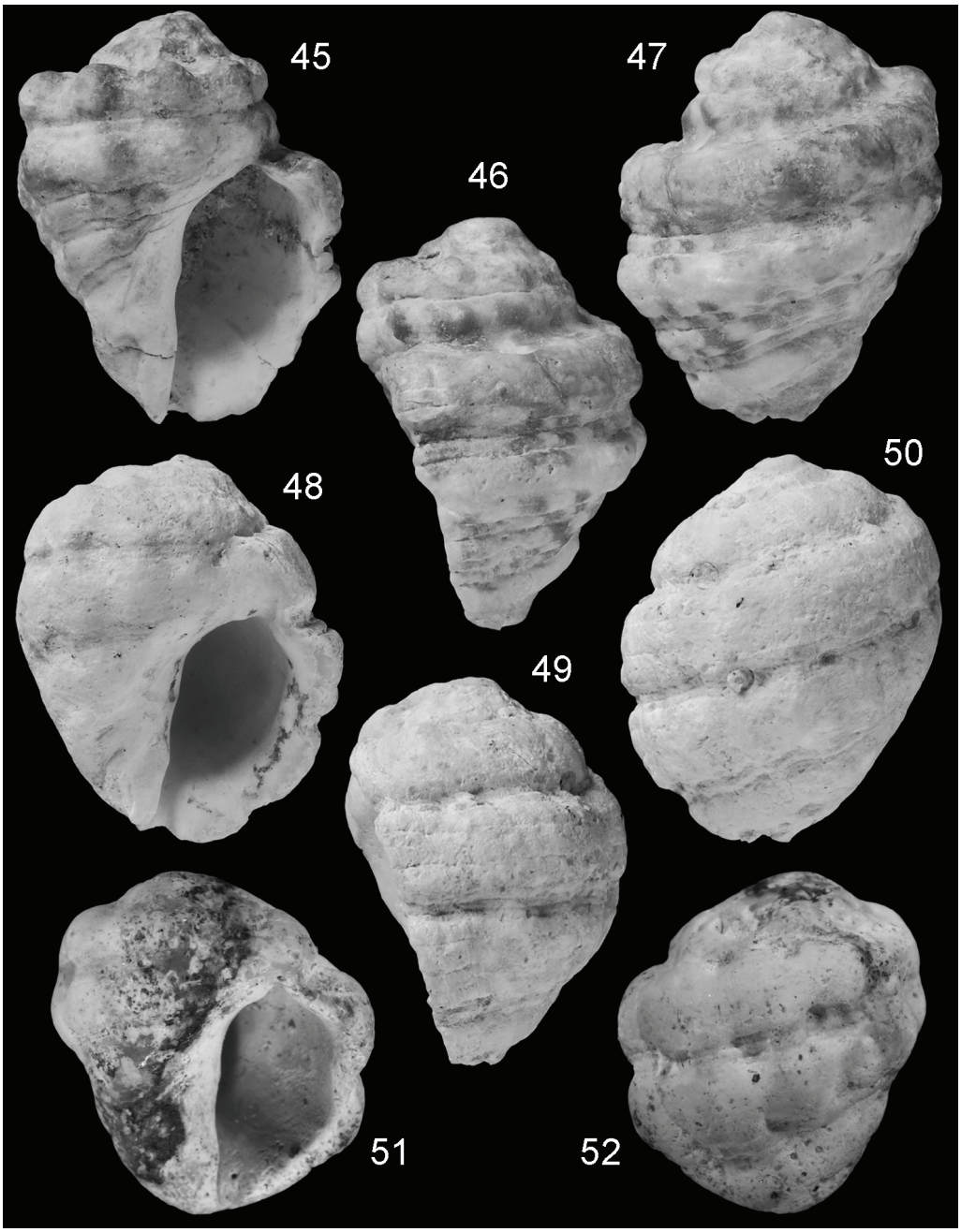
ZooBank registration – zoobank.org:act:62F04095-F9E6-4F04-B1FD-039B2B580234

Holotype – HNHM PAL 2024.138.1., SL 18 mm, SW 14 mm (Figs 45–47).

Paratype 1 – 2024.11., Zoltán Vicián Collection, SL 17.2 mm, SW 14.3 mm (Figs 48–50).

Paratype 2 – 444119, Helmut Krock Collection, Senckenberg Forschungsinstitut und Naturmuseum, SL 14.9 mm, SW 13.3 mm (Figs 51–52).

Type strata and locality – Lower Badenian (Middle Miocene) clayey sand (Pécsszabolcs Member of the Lajta Limestone Formation), Letkés, Bagoly Hill, Börzsöny Mts, Hungary.



Figs 45–52. *Acanthais*? *sutii* n. sp. – **Figs 45–47.** Holotype, SL 18, SW 14 (3×), apertural, lateral, and abapertural views. – **Figs 48–50.** Paratype 1, SL 17.2, SW 14.3 (3×), apertural, lateral, and abapertural views. – **Figs 51–52.** Paratype 2, SL 14.9, SW 13.3 (3×), apertural and abapertural views. Locality: Letkés, Bagoly Hill

Derivation of name – In honour of László ("Süti") Sütő, Jr. (Hungary).

Material: Holotype (donated to the HNHM by Tamás Hirmetzl), two paratypes.

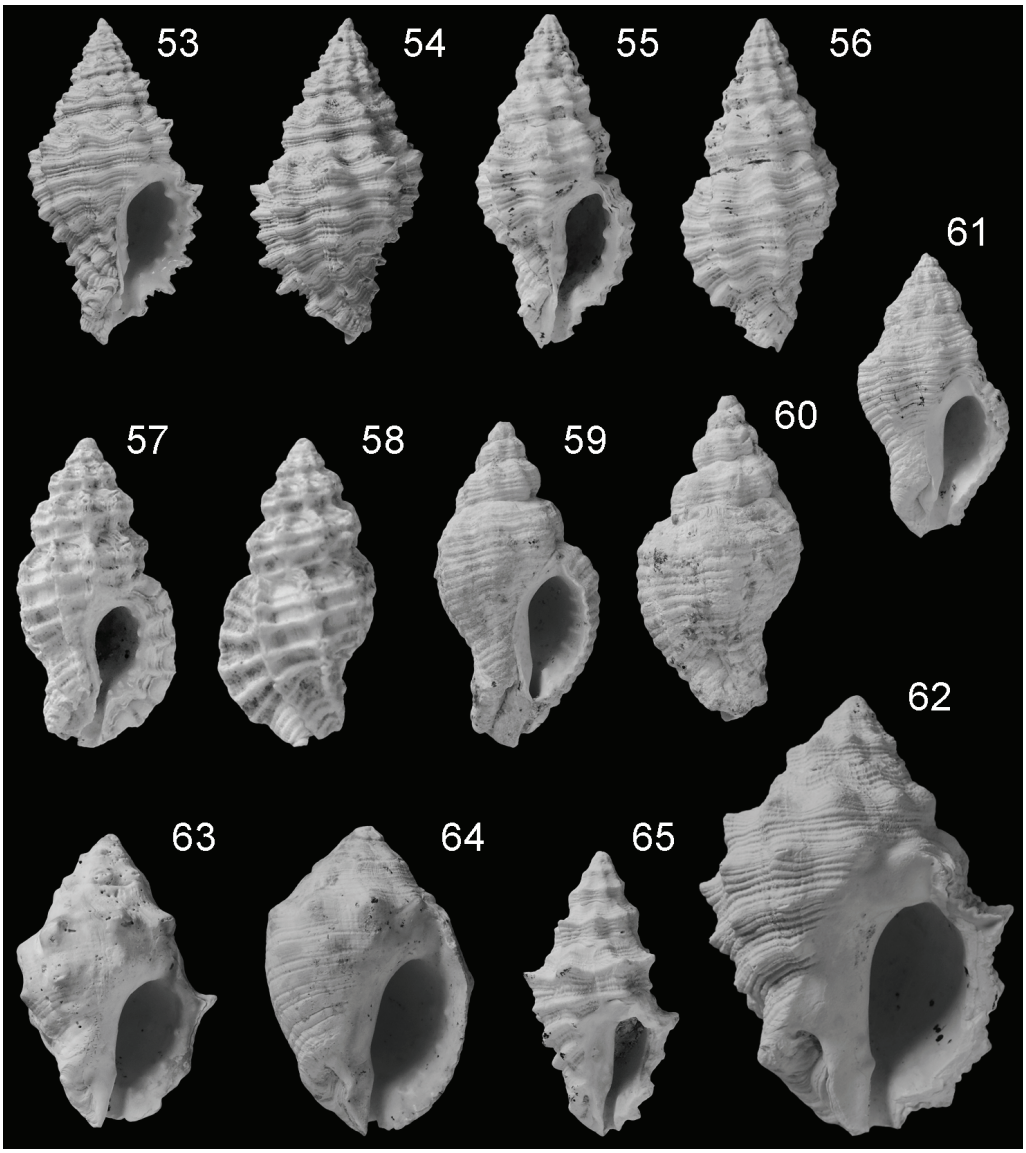
Diagnosis – *Acanthais* species with robust shell, rounded teleoconch whorls, canaliculate sutural ramp, ovate aperture with four denticles within outer lip, developed anal canal, one weak columellar fold in the middle of inner lip, 5 strong primary cords with inflated tubercles on P1–P2.

Description – Medium-sized, robust shell with low, worn spire and worn protoconch. Teleoconch of about three rounded whorls, canaliculate sutural ramp on holotype and paratype 2, rounded infrasutural part and shoulder on paratype 1. Last whorl globose to subconical in shape. Moderately broad, ovate aperture, deep and moderately broad anal canal, outer lip slightly thickened, bearing four small denticles within. Smooth columella bearing one weakly developed fold in the middle, siphonal canal short and broad. Sculpture of 4–5 low, strong, broad primary cords, weaker secondaries between primaries, and one infrasutural cord on last whorl. P1–P2 of equal strength, strongly tuberculate (12 inflated, rounded tubercles on P1 of last whorl of holotype), bearing two narrow spiral grooves, P3–P5 weaker on holotype, P3 bearing grooves, P4–P5 smooth. Subsutural part of holotype is beaded close to aperture. Axial sculpture of fine growth lines.

Remarks – The new species differs in sculpture from the Badenian *Janssenia*, *Cathymorula*, and *Menathais* species by bearing inflated tubercles instead of projected spines. The holotype was previously assigned to genus *Thaisella*? by Kovács *et al.* (2018), however, its morphology seems closer to the Recent *Acanthais triangularis* (Blainville, 1832). Although neither the protoconch – which is multispiral in the type species, *Acanthais brevidentata* (Wood, 1828) –, nor the characteristic labral spine can be traced on the type specimens, the new species is provisionally recognized as a representative of *Acanthais*. Paratypes display intraspecific variability in sculpture by broader development of spiral cords on last whorls. *Acanthais* has been known as a ?Pliocene–Recent genus (Vermeij & Kool 1994).

CONCLUSION

Based on new field works in the last years and reinvestigation of museum collections seven new muricid taxa are described from the Middle Miocene Central Paratethys: six new species in the Pannonian Basin (Hungary) and one new species in the Făget Basin (Romania). Beside this achievement extended palaeogeo-



Figs 53–56. *Muricopsis cristata* (Brocchi). – **Figs 53–54.** SL 19.9, SW 10 (2×), apertural and abapertural views. – **Figs 55–56.** SL 20.6, SW 9.6 (2×), apertural and abapertural views. – **Figs 57–58.** *Pygmaepterys transsylvanicus* (Hoernes et Auinger), SL 10.7, SW 5.5 (3.5×), apertural and abapertural views. – **Figs 59–61.** *Ocinebrina credneri* (Hoernes et Auinger). – **Figs 59–60.** SL 19.5, SW 9.5 (2×), apertural and abapertural views. – **Fig. 61.** SL 17.6, SW 9.5 (2×), apertural view. – **Fig. 62.** *Janssenia echinulata* (Pusch), SL 36, SW 25.6 (1.5×), apertural view. – **Fig. 63.** *Janssenia spinosa* (Kojumdgieva), SL 23.5, SW 15.8 (1.5×), apertural view. – **Fig. 64.** *Cathymorula exilis* (Hörnes), SL 25.2, SW 17 (1.5×), apertural view. – **Fig. 65.** *Morula austriaca* (Hoernes et Auinger), SL 20.6, SW 11.7 (1.5×), apertural view. Locality: Márkháza, Buda Hill North

graphical distributions of several muricid genera are documented in the region, and genera *Attiliosa*, *Acanthais*, and *Galeropsis* are recorded for the first time in the Paratethyan realm. The high diversity and abundance of the Muricidae in the Early–Middle Badenian Central Paratethys are the results of the Miocene Climatic Optimum (Harzhauser & Piller 2007; Gebhardt *et al*. 2023).

*

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