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New Bittiinae (Gastropoda, Cerithiidae) from the Middle Miocene of the Central Paratethys Sea

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https://zoobank.org/A7E62D50-4735-4B51-8791-93BD910F3BFB

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Abstract

We describe five new Middle Miocene Cerithiidae (Bittiinae) species from the Middle Miocene (Badenian) of Austria, Romania and Ukraine. Three species were part of the biodiversity peak during the Middle Miocene Climatic Optimum, and one species belonged to the fauna of the Miocene Climate Transition and might be an endemic species of the Polish-Ukrainian Fore-Carpathian Basin. The total diversity of Middle Miocene Bittiinae is now raised to 13 species, which is almost double the diversity known from the modern Mediterranean Sea. *Bittium biskupici* **sp. nov.**, *Bittium castori* **sp. nov.**, *Bittium pallgergelyi* **sp. nov.**, *Bittium parvapyramis* **sp. nov.** and *Bittium polluxi* **sp. nov.** are introduced as new species.

Key Words

Miocene, Central Paratethys, Gastropoda, Bittiinae, Miocene Climatic Optimum

Introduction

The Paratethyan Bittiinae were revised recently by Harzhauser et al. (2025), who described eight *Bittium* species from the Middle Miocene of the Central Paratethys Sea. During the ongoing revision of Miocene Paratethyan gastropod families five additional *Bittium* species were misplaced in the paleontological collection of the Natural History Museum Vienna. The specimens were misidentified as *Cerithiopsis* and were stored within Triphoroidea. All described species derive from Badenian deposits. Four species were found at middle Badenian localities, corresponding to the Langhian (Middle Miocene) and one species derives from upper Badenian deposits of the Ukrainian Fore-Carpathian Basin, corresponding to the Serravallian (Middle Miocene). All species are abundant at the type localities but have not been recorded from any other locality. For an overview of the research history and systematics of Neogene Bittiinae from the Paratethys Sea see Harzhauser et al. (2025).

Geological and paleogeographic setting

The described specimens derive from three localities (coordinates indicate centers of villages):

- Gainfarn (Austria), 47.960149°N, 16.202252°E, Vienna Basin; Middle Badenian (late Langhian), Middle Miocene.
- Lăpugiu de Sus (Romania), 45.847217°N, 22.479694°E, Făget Basin; Middle Badenian (late Langhian), Middle Miocene.
- Golubytsya (Hołubica) (Ukraine), 49.919908°N, 25.166353°E, Voronyaky Hills; Late Badenian (early Serravallian), Middle Miocene.

All three basins were part of the Central Paratethys Sea, which was a huge epicontinental sea that came into existence around the Eocene/Oligocene boundary due to emerging mountain changes that divided the former Tethys Ocean during the Alpidic orogeny (Rögl 1998; Popov et al. 2004). During the Langhian (early and middle Badenian), the biota of this sea was strongly influenced by the global Middle Miocene Climatic Optimum (Holbourn et al. 2015; Westerhold et al. 2020), resulting a peak of marine biodiversity (Harzhauser et al. 2024). Maximum diversity of the late Langhian (middle Badenian) developed in the Vienna and Făget basins whereas diversities decreased during the Middle Miocene Climate Transition when the semi-isolated early Serravallian (late Badenian) faunas of the Polish-Ukrainian Fore-Carpathian Basin were characterized by high endemicity (Harzhauser et al. 2024).

Materials and methods

The material is stored in the collections of the Geological-Paleontological Department of the Natural History Museum Vienna (**NHMW**). The terminology in the descriptions follows Harzhauser et al. (2025). **SL**: shell length, **MD**: maximum diameter. For terminology of spiral cords see Fig. 1.

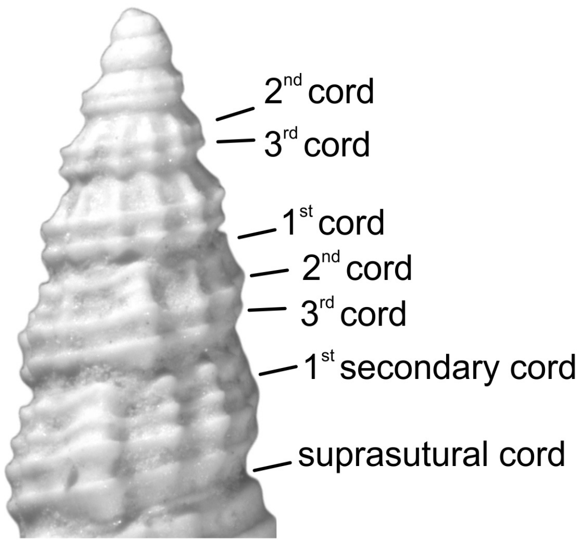

Figure 1. Terminology of spiral cords used herein.

Systematic Paleontology

Family Cerithiidae Fleming, 1822
Subfamily Bittiinae Cossmann, 1906

Genus *Bittium* Gray, 1847

Type species. *Strombiformis reticulatum* Da Costa, 1778, subsequent designation by Gray (1847: 270). Present-day, Europe.

***Bittium biskupici* sp. nov.**
https://zoobank.org/87110067-95F0-4CB2-9C52-B4999F3AE063
Figs 2A, 3A–R

Type material. Holotype, NHMW-GEO-2013-0479-0877a, SL: 6.1 mm, MD: 1.9 mm, Gainfarn (Austria), Fig. 3E, F. Paratype, NHMW-GEO-2025-0240-0001, SL: 5.8 mm, MD: 1.8 mm, Gainfarn (Austria), Fig. 3A, B. Paratype, NHMW-GEO-2025-0240-0002, SL: 5.3 mm, MD: 1.6 mm, Gainfarn (Austria), Fig. 3C, D. Paratype, NHMW-GEO-2013-0479-0877b, SL: 5.3 mm, MD: 1.5 mm, Gainfarn (Austria), Figs 2A, 3G, H. Paratype, NHMW-GEO-2025-0240-0003, SL: 6.8 mm, MD: 2.1 mm, Gainfarn (Austria), Fig. 3I, J. Paratype, NHMW-GEO-2025-0240-0004, SL: 5.4 mm, MD: 1.8 mm, Gainfarn (Austria), Fig. 3K, L. Paratype, NHMW-GEO-2025-0240-0005, SL: 6.4 mm, MD: 2.1 mm, Gainfarn (Austria), Fig. 3M, N. Paratype, NHMW-GEO-2025-0240-0006, SL: 6.6 mm, MD: 2.4 mm, Gainfarn (Austria), Fig. 3O, P. Paratype, NHMW-GEO-2025-0240-0007, SL: 6.5 mm, MD: 2.0 mm, Gainfarn (Austria), Fig. 3Q, R.

Other material. Paratypes, 71 specimens, NHMW-GEO-2013-0479-0878b, Gainfarn (Austria).

Diagnosis. Small, slender conical to pagodiform shell with protoconch of 2.5 whorls with two spiral cords and teleoconch whorls with weakly angled periphery placed below mid-whorl, two tuberculate spiral cords on subsutural ramp and two prominent tuberculate cords below mid-whorl; outer lip with two prominent denticles.

Description. Small, slender conical to slightly pagodiform shell of up to ten teleoconch whorls, attaining ~5–7 mm in height; apical angle 17–22°. Protoconch of about 2.5 whorls (dp = ~300 µm). Earliest protoconch whorl convex, smooth; later with broad subsutural ramp and two broad spiral cords (2nd and 3rd spiral cords). Early teleoconch whorls with broad subsutural ramp and prominent axial ribs (~10 axial ribs on first teleoconch whorl). Axial ribs overrun by two spiral cords bearing tubercles at intersection with axial ribs. 2nd cord placed just below mid-whorl, forming slightly angled periphery, 3rd cord some distance above deeply incised suture. Weaker 1st spiral cord with weak tubercles appears on fourth teleoconch whorl and delicate 1st secondary spiral cord with small tubercles becomes intercalated on subsutural ramp on fourth to fifth whorl. Further weak suprasutural spiral cord appears at abapical suture of later whorls. Sculpture of later whorls with two prominent abapical spiral rows of tubercles and two weaker adapical cords. Whorl profile becoming more convex with flat to weakly convex subsutural ramp. Up to three varices on spire whorls and prominent dorsal and terminal varices on last whorl. Last whorl attaining ~35% of total height; ~14–16 axial ribs. Tubercles weakening on last whorl. Base strongly constricted with two prominent peribasal spiral cords and two weaker cords over fasciole. Columella moderately excavated; columellar callus forming broad, detached rim. Anal canal indistinct. Outer lip

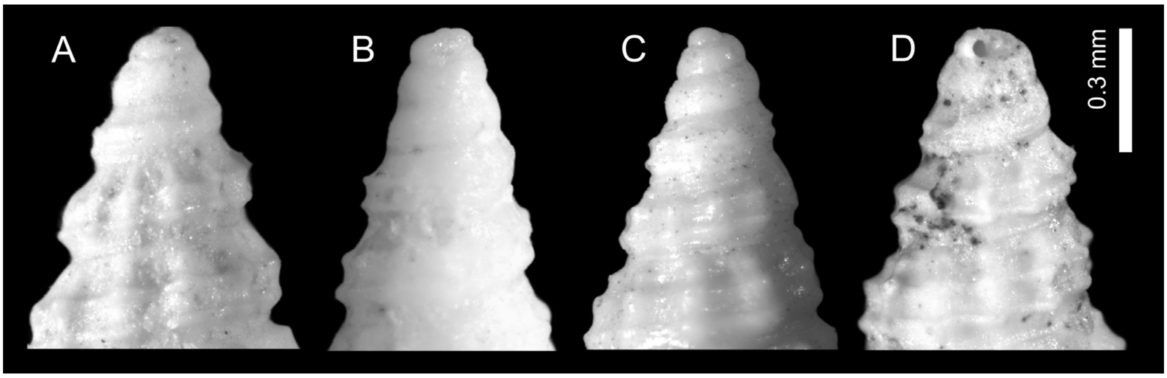

Figure 2. A. *Bittium biskupici* sp. nov., Paratype, NHMW-GEO-2013-0479-0877b, Gainfarn (Austria); **B.** *Bittium parvapyramis* sp. nov., Paratype, NHMW-GEO-1870-0014-0007g, Golubytsya (Hołubica) (Ukraine); **C.** *Bittium polluxi* sp. nov., Paratype, NHMW-GEO-2025-0241-0003, Lăpugiu de Sus (Romania); **D.** *Bittium pallgergelyi* sp. nov., Paratype, NHMW-GEO-2013-0479-0878i, Gainfarn (Austria).

thickened by terminal varix with two prominent denticles below mid-whorl and at siphonal canal. Siphonal canal short, moderately wide, slightly bent to the left.

Etymology. In honor of Radoslav Biskupič (Poprad, Slovakia), in recognition of his contributions to the Paleontology of the Vienna Basin.

Type locality. Gainfarn (Austria), Vienna Basin.

Type stratum. Silt sand of the Baden Formation.

Age. Middle Miocene, middle Badenian (Langhian).

Paleoenvironment. Shallow marine, inner neritic with sea grass cover (Zuschin et al. 2007).

Distribution in Central Paratethys. Badenian (Middle Miocene): Vienna Basin: Gainfarn (Austria).

Remarks. *Bittium konkense* Sokolov, 1899, from the Konkian (Middle Miocene) of the Eastern Paratethys Sea and the late Badenian of the Moldavian Platform, is most similar in outline and size but lacks denticles within the outer lip and has much weaker varices. Its tubercles are coarser and rounded whereas those of the new species are smaller and more horizontally elongated (see Harzhauser et al. 2025: fig. 13).

Denticles are rarely reported for Bittiinae from the Badenian of the Central Paratethys; e.g., *Bittium amibouei* Harzhauser, Guzhov & Landau, 2025, *Bittium turritella* (Eichwald, 1851). *Bittium amibouei* differs from *Bittium biskupici* sp. nov. in its almost straight-sided spire whorls and cancellate sculpture with three band-like spiral cords (see Harzhauser et al. 2025: fig. 5) and *Bittium turritella* is distinguished from *B. biskupici* sp. nov. by its numerous, close-set spiral cords and very weak axial sculpture (see Harzhauser et al. 2025: figs 23–24). *Bittium biskupici* differs from *Bittium pallgergelyi* sp. nov. in its smaller size, slenderer late teleoconch, angled periphery and presence of four tuberculate spiral cords. *Bittium walaszczyki* Harzhauser, Guzhov & Landau, 2025 is reminiscent of *B. biskupici* sp. nov. in size and general shape but differs in its more strongly pagodiform late spire whorls, reduced sculpture on the weakly concave subsutural ramp, the markedly angulated periphery, and lacks denticles within the outer lip (see Harzhauser et al. 2025: fig. 25).

Bittium castori sp. nov.

https://zoobank.org/37AC83EA-1C96-4C3F-8AC1-FD6BF8516B03

Fig. 4A–R

Type material. Holotype, NHMW-GEO-1876-0011-0059a, SL: 8.2 mm, MD: 2.4 mm, Lăpugiu de Sus (Romania), Fig. 4A, B. Paratype, NHMW-GEO-1876-0011-0059b, SL: 7.7 mm, MD: 2.5 mm, Lăpugiu de Sus (Romania), Fig. 4C, D. Paratype, NHMW-GEO-1876-0011-0059c, SL: 7.5 mm, MD: 2.5 mm, Lăpugiu de Sus (Romania), Fig. 4E, F. Paratype, NHMW-GEO-1876-0011-0059d, SL: 6.5 mm, MD: 2.3 mm, Lăpugiu de Sus (Romania), Fig. 4G, H. Paratype, NHMW-GEO-1876-0011-0059e, SL: 7.5 mm, MD: 2.8 mm, Lăpugiu de Sus (Romania), Fig. 4I, J. Paratype, NHMW-GEO-1876-0011-0059f, SL: 6.3 mm, MD: 2.2 mm, Lăpugiu de Sus (Romania), Fig. 4K, L. Paratype, NHMW-GEO-1876-0011-0059g, SL: 8.4 mm, MD: 2.9 mm, Lăpugiu de Sus (Romania), Fig. 4M, N. Paratype, NHMW-GEO-1876-0011-0059h, SL: 8.0 mm, MD: 2.6 mm, Lăpugiu de Sus (Romania), Fig. 4O, P. Paratype, NHMW-GEO-1876-0011-0059i, SL: 8.0 mm, MD: 2.6 mm, Lăpugiu de Sus (Romania), Fig. 4Q, R.

Diagnosis. Medium-sized, moderately slender conical shell with weakly convex whorls; three spiral rows of slightly pointed tubercles on early spire whorls, overriding weak axial ribs; slightly more prominent mid-whorl spiral; fourth cord intercalated between adapical cords on 8th whorl; prominent pair of peribasal cords, coalescent in some specimens, 2–3 weaker cords over base and fasciole; two weak denticles in inner lip.

Description. Medium-sized, moderately slender conical shell attaining ~7–8 mm in height; apical angle ~23–27°. Protoconch unknown. Early teleoconch whorls angled with moderately broad subsutural ramp and prominent axial ribs (~10–11 axial ribs on first teleoconch whorl), overrun by two weak spiral cords (2nd and 3rd spiral cords) forming weak tubercles at intersections. 1st spiral cord with small tubercles appears on subsutural ramp on fourth to fifth teleoconch whorls. Later whorls weakly convex with moderately

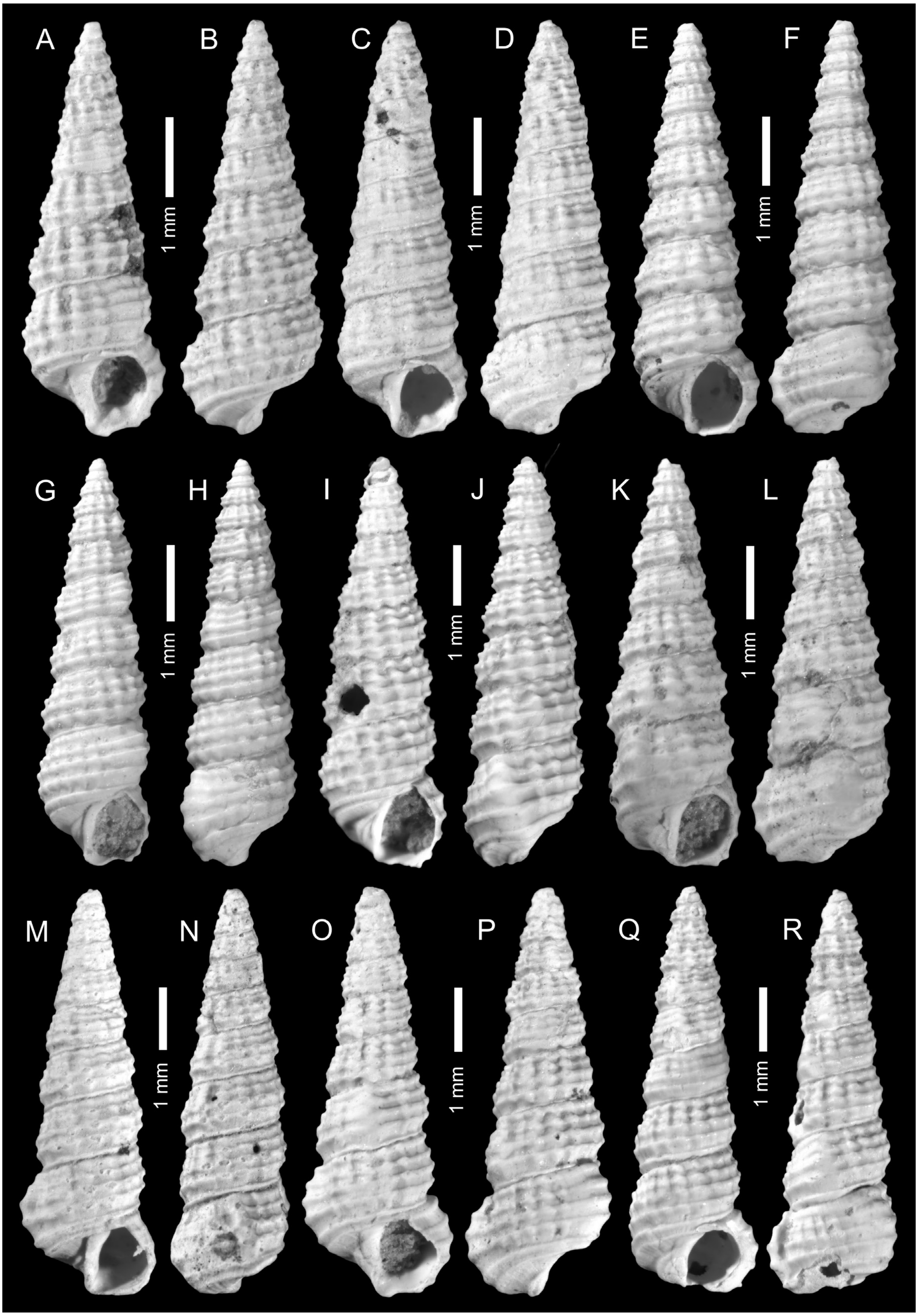

Figure 3. *Bittium biskupici* sp. nov. **A, B.** Paratype, NHMW-GEO-2025-0240-0001; **C, D.** Paratype, NHMW-GEO-2025-0240-0002; **E, F.** Holotype, NHMW-GEO-2013-0479-0877a; **G, H.** Paratype, NHMW-GEO-2013-0479-0877b; **I, J.** Paratype, NHMW-GEO-2025-0240-0003; **K, L.** Paratype, NHMW-GEO-2025-0240-0004; **M, N.** Paratype, NHMW-GEO-2025-0240-0005; **O, P.** Paratype, NHMW-GEO-2025-0240-0006; **Q, R.** Paratype, NHMW-GEO-2025-0240-0007. All Badenian (Middle Miocene), Gainfarn (Austria).

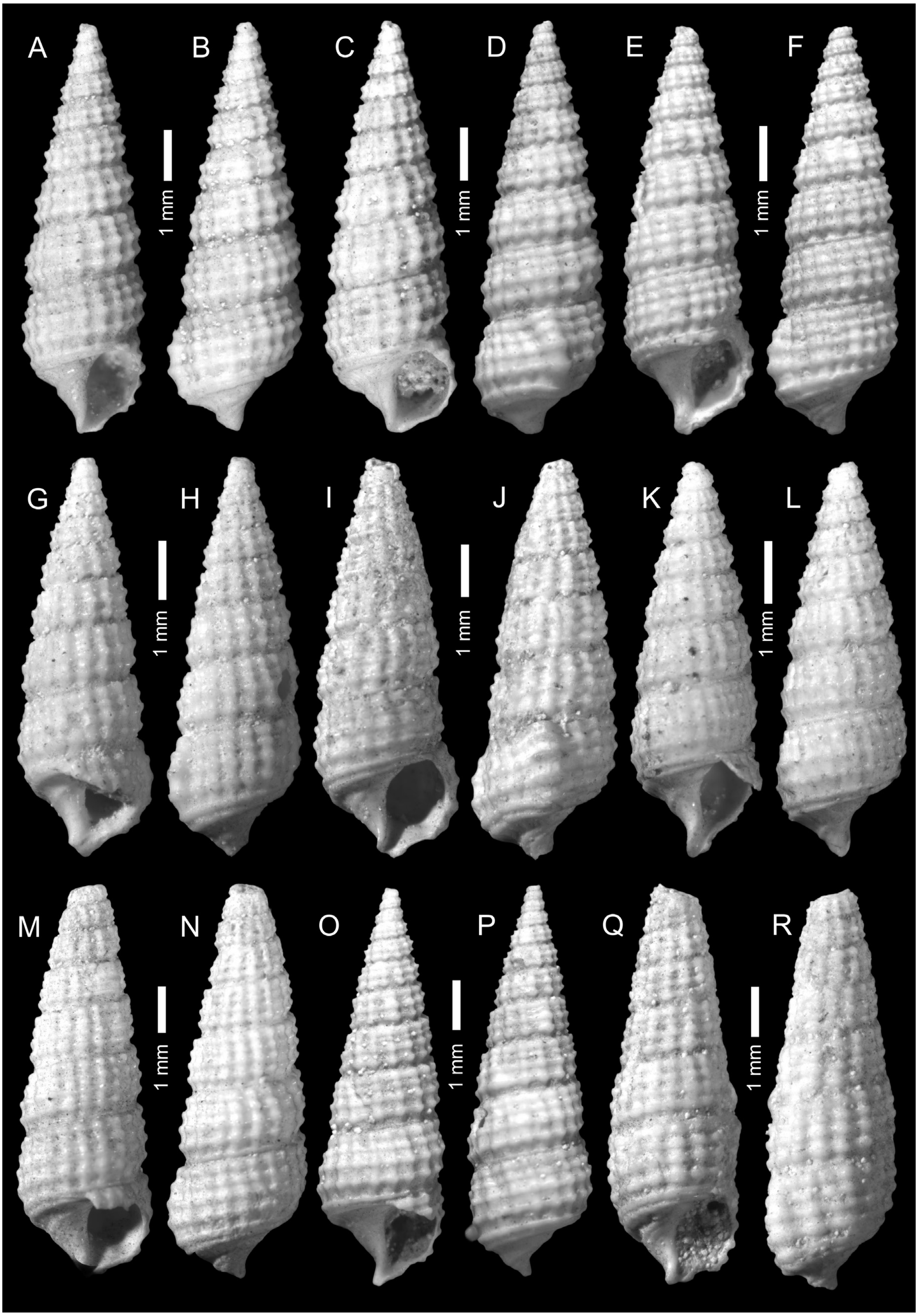

Figure 4. *Bittium castori* sp. nov. **A, B.** Holotype, NHMW-GEO-1876-0011-0059a; **C, D.** Paratype, NHMW-GEO-1876-0011-0059b; **E, F.** Paratype, NHMW-GEO-1876-0011-0059c; **G, H.** Paratype, NHMW-GEO-1876-0011-0059d; **I, J.** Paratype, NHMW-GEO-1876-0011-0059e; **K, L.** Paratype, NHMW-GEO-1876-0011-0059f; **M, N.** Paratype, NHMW-GEO-1876-0011-0059g; **O, P.** Paratype, NHMW-GEO-1876-0011-0059h; **Q, R.** Paratype, NHMW-GEO-1876-0011-0059i. All Badenian (Middle Miocene), Lăpugiu de Sus (Romania).

incised suture. Adapical spiral cord slightly weaker, mid-whorl cord most prominent. 1st tuberculate secondary spiral cord intercalated between adapical spirals on eighth teleoconch whorl rapidly becoming subequal in strength to adjacent cords. Delicate suprasutural spiral cord may appear at abapical suture on later whorls. Last whorl attaining ~37% of total height, regularly tuberculate with two prominent varices (~17–19 axial ribs on last whorl). Base moderately constricted with prominent pair of close-set peribasal cords, two to three weaker spirals over base and fasciole. Aperture ovate. Columella weakly excavated. Columellar callus forming narrow, weakly detached rim. Anal canal indistinct. Outer lip with two weak denticles at terminal varix. Siphonal canal short, moderately narrow, slightly bent to the left.

Etymology. Referring to Castor, one of the twins birthed from Leda in Greek mythology.

Type locality. Lăpugiu de Sus (Romania), Făget Basin.

Type stratum. Silt and clay of the Dej Formation.

Age. Middle Miocene, middle Badenian (Langhian).

Paleoenvironment. Unknown.

Distribution in Central Paratethys. Badenian (Middle Miocene): Făget Basin: Lăpugiu de Sus (Romania).

Remarks. *Bittium castori* sp. nov. is reminiscent of *Bittium polluxi* sp. nov. and shells of both species were mixed in the NHMW-collection. However, *Bittium castori* sp. nov. is distinctly larger, the 1st secondary spiral cord is intercalated at a later stage of growth and the tubercles are more pointed. In addition, the peribasal cords are often slightly coalescent in *Bittium castori* sp. nov. but well separated in *Bittium polluxi* sp. nov. At least at the type locality, shells of *Bittium castori* sp. nov. are always whitish but are brownish in *Bittium polluxi* sp. nov. *Bittium grinzingense* Harzhauser, Guzhov & Landau, 2025 has comparable sculpture with pointed tubercles but is slenderer and has more convex whorls and more deeply incised suture (see Harzhauser et al. 2025: fig. 12). *Bittium amibouei* Harzhauser, Guzhov & Landau, 2025 has only three spiral cords on late teleoconch whorls and differs in its cancellate sculpture (see Harzhauser et al. 2025: fig. 5).

Bittium pallgergelyi sp. nov.

https://zoobank.org/7085C485-7996-48FB-BE8F-8A53EEA341B5

Figs 2D, 5A–R

Type material. Holotype, NHMW-GEO-2013-0479-0878a, SL: 9.6 mm, MD: 3.3 mm, Gainfarn (Austria), Fig. 5A, B. Paratype, NHMW-GEO-2013-0479-0878b, SL: 10.8 mm, MD: 3.0 mm, Gainfarn (Austria), Fig. 5C, D. Paratype, NHMW-GEO-2013-0479-0878c, SL: 7.9 mm, MD: 2.6 mm, Gainfarn (Austria), Fig. 5E, F. Paratype, NHMW-GEO-2013-0479-0878d, SL: 8.1 mm, MD: 2.6 mm, Gainfarn (Austria), Fig. 5G, H. Paratype, NHMW-GEO-2013-0479-0878e, SL: 8.7 mm, MD: 2.9 mm, Gainfarn (Austria), Fig. 5I, J. Paratype, NHMW-GEO-2013-0479-0878f, SL: 8.9 mm, MD: 2.8 mm, Gainfarn (Austria), Fig. 5K, L. Paratype, NHMW-GEO-2013-0479-0878g, SL: 9.4 mm, MD: 3.0 mm, Gainfarn (Austria), Fig. 5M, N. Paratype, NHMW-GEO-2013-0479-0878h, SL: 8.6 mm, MD: 2.6 mm, Gainfarn (Austria), Fig. 5O, P. Paratype, NHMW-GEO-2013-0479-0878i, SL: 6.6 mm, MD: 2.6 mm, Gainfarn (Austria), Figs 2D, 5Q, R.

Other material. Paratypes, 15 specimens. NHMW-GEO-2013-0479-0878j, Gainfarn (Austria).

Diagnosis. Medium-sized, slender shell of weakly convex to subcylindrical whorls with three narrow spiral cords bearing rows of small, widely spaced, pointed tubercles, and one to two prominent varices per whorl, strong pair of peribasal and weaker pair fasciolar cords; outer lip with two weak denticles.

Description. Medium-sized, slender shell of up to 11 teleoconch whorls, attaining ~8–11 mm in height; apical angle 22–25°. Protoconch conical of > 2 whorls (initial part missing in all available specimens). Last protoconch whorl with two prominent spiral cords. Transition to teleoconch marked by moderately deep sinusigera. Early teleoconch whorls with broad subsutural ramp and prominent axial ribs (~10 axial ribs on first teleoconch whorl). Axial ribs overrun by two prominent but narrow spiral cords (2nd and 3rd spiral cords) bearing small, widely spaced tubercles at intersection with axial ribs. 1st, narrow spiral cord with tubercles appearing on subsutural ramp on third to fourth teleoconch whorl. Whorl profile on early whorls straight-sided, gradually becoming weakly convex to subcylindrical with periphery placed just above distinctly incised suture on later whorls. Weak suprasutural spiral cord appears at abapical suture around fifth to sixth teleoconch whorl. Tubercles on later teleoconch whorls becoming sharply pointed. Broad varices especially on later teleoconch whorls (about two varices per whorl). Sculpture on varices consisting of spiral cords with strongly reduced to subobsolete tubercles. Last whorl attaining ~35% of total height; axial ribs often reduced to isolated tubercles, ~ 14–22 axial ribs or tubercles on last whorl. Base strongly constricted with two peribasal spiral cords, adapical one more prominent, coinciding with slight basal angulation. Additional pair of spiral cords over fasciole, adapical one being more prominent. Columella moderately excavated; columellar callus forming broad, slightly thickened rim, sharply demarcated from base. Anal canal weakly incised, indistinct. Outer lip strongly convex, often with terminal varix and two weak denticles. Siphonal canal short, narrow, bent to the left.

Etymology. In honor of Barna Páll-Gergely (Centre for Agricultural Research, Hungary), in recognition of his contributions to malacology.

Type locality. Gainfarn (Austria), Vienna Basin.

Type stratum. Silt sand of the Baden Formation.

Age. Middle Miocene, middle Badenian (Langhian).

Paleoenvironment. Shallow marine, inner neritic with sea grass cover (Zuschin et al. 2007).

Distribution in Central Paratethys. Badenian (Middle Miocene): Vienna Basin: Gainfarn (Austria).

Remarks. *Bittium digitatum* (Zhizhchenko, 1934), from the Chokrakian (Middle Miocene) of the Eastern Paratethys Sea, has a comparable outline and pointed

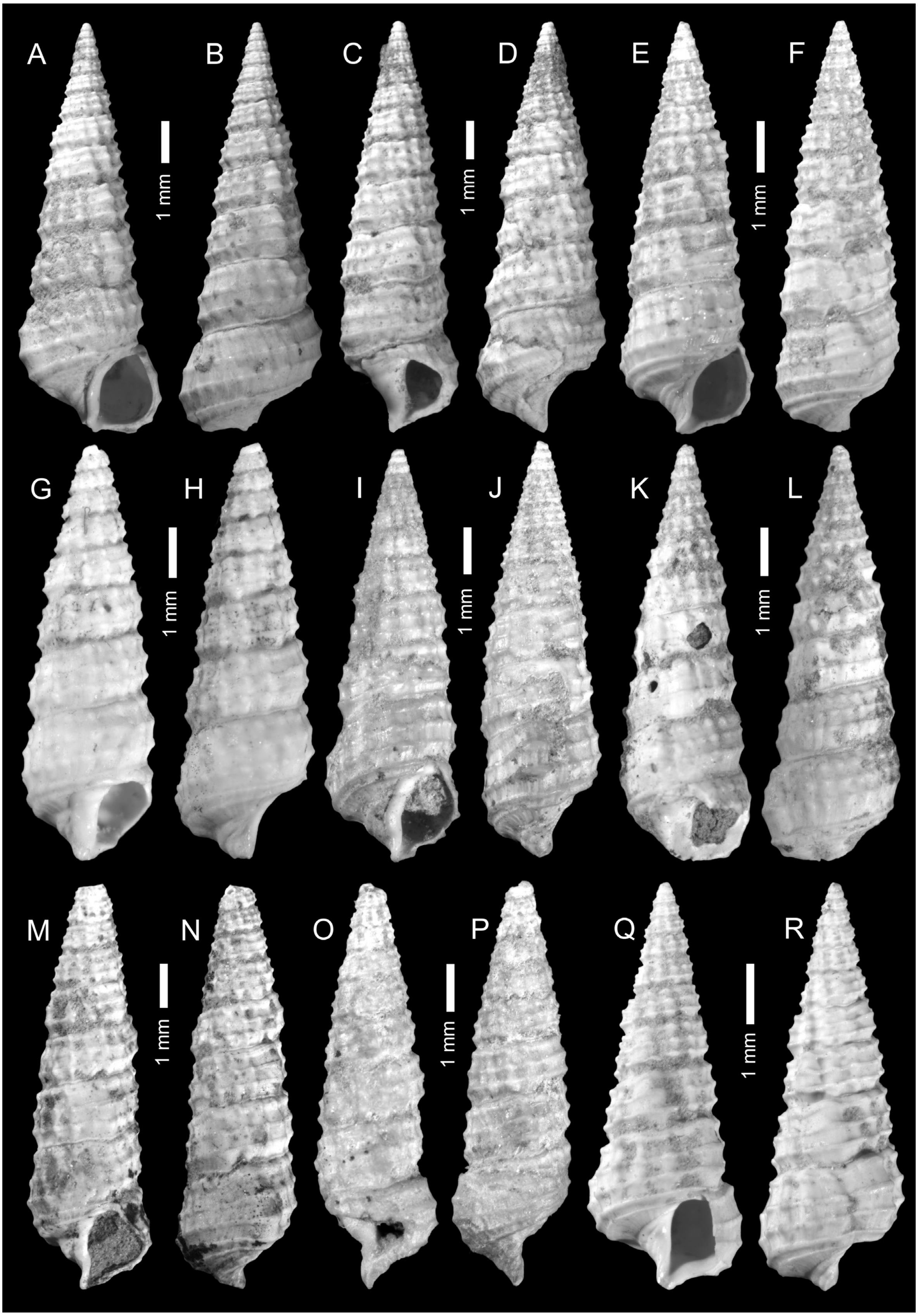

Figure 5. *Bittium pallgergelyi* sp. nov. **A, B.** Holotype, NHMW-GEO-2013-0479-0878a; **C, D.** Paratype, NHMW-GEO-2013-0479-0878b; **E, F.** Paratype, NHMW-GEO-2013-0479-0878c; **G, H.** Paratype, NHMW-GEO-2013-0479-0878d; **I, J.** Paratype, NHMW-GEO-2013-0479-0878e; **K, L.** Paratype, NHMW-GEO-2013-0479-0878f; **M, N.** Paratype, NHMW-GEO-2013-0479-0878g; **O, P.** Paratype, NHMW-GEO-2013-0479-0878h; **Q, R.** Paratype, NHMW-GEO-2013-0479-0878i. All Badenian (Middle Miocene), Gainfarn (Austria).

tubercles but is much larger (SL 17–19 mm), has four instead of three primary spirals on later spire whorls, and its tubercles are closer-set, more uniform and its suture is less incised (see Harzhauser et al. 2025: fig. 10). *Bittium amibouei* Harzhauser, Guzhov & Landau, 2025, with which the new species co-occurs, is most similar, but differs in its broader, band-like spiral cords that form a peculiar cancellate sculpture, the third spiral appears slightly later, on the third to fourth teleoconch whorl as opposed to the second to third in *B. amibouei*, and the tubercles are less pointed (see Harzhauser et al. 2025: fig. 5). *Argyropeza spina* (Hörnes, 1855), from the Badenian of the Central Paratethys, is superficially reminiscent concerning the pointed tubercles but differs in its slenderer shell and has two predominant spiral rows of tubercles on early spire whorl instead of three.

Bittium parvapyramis sp. nov.

https://zoobank.org/D96CE80A-CE0D-4A2E-8EC6-F7F2A530DE17

Figs 2B, 6A–O

Type material. Holotype, NHMW-GEO-1870-0014-0007a, SL: 3.7 mm, MD: 1.7 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6A, B. Paratype, NHMW-GEO-1870-0014-0007b, SL: 3.5 mm, MD: 1.8 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6C, D. Paratype, NHMW-GEO-1870-0014-0007c, SL: 3.2 mm, MD: 1.5 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6E. Paratype, NHMW-GEO-1870-0014-0007d, SL: 3.7 mm, MD: 1.8 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6F, G. Paratype, NHMW-GEO-1870-0014-0007e, SL: 3.9 mm, MD: 1.8 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6H, I. Paratype, NHMW-GEO-1870-0014-0007f, SL: 4.2 mm, MD: 1.7 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6J, K. Paratype, NHMW-GEO-1870-0014-0007g, SL: 3.2 mm, MD: 1.5 mm, Golubytsya (Hołubica) (Ukraine), Figs 2B, 6L, M. Paratype, NHMW-GEO-1870-0014-0007h, SL: 3.9 mm, MD: 1.8 mm, Golubytsya (Hołubica) (Ukraine), Fig. 6N, O.

Other material. Paratypes, 120 specimens, NHMW-GEO-1870-0014-0007i, Golubytsya (Hołubica) (Ukraine).

Diagnosis. Minute, relatively broad conical shell with multispiral protoconch and teleoconch whorls with widely spaced axial ribs overrun by three spiral cords with slightly pointed tubercles; sharply angled, flattened base delimited by strong peribasal cord, weaker second peribasal placed just below, 2–3 weaker cords over base and fasciole.

Description. Minute, relatively broad conical shell of up to six teleoconch whorls, attaining ~4 mm in height; apical angle ~26–32°. Protoconch multispiral, high conical of 3.5 whorls, first whorl depressed, last protoconch whorl with two spiral cords and shallow subsutural ramp. First two teleoconch whorl with shallow, weakly concave subsutural ramp and two prominent spiral cords (2nd and 3rd spiral cords) forming periphery. Later whorls with widely spaced axial ribs (about 10–12 axial ribs on first teleoconch whorl) overrun by two spiral cords forming slightly pointed tubercles at axial intersections. 1st weakly tuberculate spiral cord appears on subsutural ramp on fourth teleoconch whorl, tubercles always weaker than on abapical spiral cords. Delicate suprasutural spiral thread may occur at abapical suture on penultimate whorl. Whorl profile weakly convex to nearly straight sided with periphery placed just above abapical suture. Suture deeply incised. Varices indistinct. Last whorl attaining ~46–48% of total height; ~12–16 axial ribs on last whorl. Base strongly constricted, nearly flat, strongly angled at prominent peribasal spiral cord placed at periphery, second, weaker peribasal cord placed just below, one to three faint cords over base and fasciole. Aperture wide, ovate. Columella moderately excavated. Columellar callus forming narrow, adherent rim. Anal canal indistinct. Outer lip simple. Siphonal canal short, moderately narrow, slightly bent to the left.

Etymology. Latin *parva* (small) and *pyramis* (pyramid), referring to the shape; noun in apposition.

Type locality. Golubytsya (Hołubica) (Ukraine).

Type stratum. Upper Baden silt and sand (we are not aware of the formal lithostratigraphic name).

Age. Middle Miocene, late Badenian (Serravallian).

Paleoenvironment. Inner neritic, shallow marine based on associated fauna (own data M.H.).

Distribution in Central Paratethys. Badenian (Middle Miocene): Voronyaky Hills: Golubytsya (Hołubica) (Ukraine).

Remarks. Despite its very small size, relatively few whorls and the immature aspect of its outer lip, none of the 120 specimens at hand have a greater number of whorls, nor can we match the specimens to any juveniles of other Paratethyan *Bittium* species. *Bittium badzoshviliae* Harzhauser, Guzhov & Landau, 2025, from the early Meotian (Late Miocene) of the Eastern Paratethys Sea resembles *Bittium parvapyramis* sp. nov. but has a steep and broad subsutural ramp, giving the spire whorls a pagodiform profile, and is strongly constricted below the abapical spiral cord. Moreover, the base is less strongly constricted and flattened (see Harzhauser et al. 2025: fig. 2G). *Bittium tschokrakense* Özsayar, 1977, from the early Chokrakian (Middle Miocene) of the Eastern Paratethys, is superficially reminiscent of *Bittium parvapyramis* sp. nov. in its stout outline but its protoconch has only 2.5 whorls and it differs in its broad subsutural ramp with weak to subobsolete adapical spiral cord, and again less flattened base (see Harzhauser et al. 2025: fig. 21).

Bittium polluxi sp. nov.

https://zoobank.org/52895E53-2D82-4DEC-8A4B-E73FA5D7037A

Figs 2C, 7A–R

Type material. Holotype, NHMW-GEO-1876-0011-0059j, SL: 4.3 mm, MD: 1.4 mm, Lăpugiu de Sus (Romania), Fig. 7G, H. Paratype, NHMW-GEO-2025-0241-0001, SL: 5.3 mm, MD: 1.7 mm, Lăpugiu de Sus (Romania), Fig. 7A, B. Paratype, NHMW-GEO-2025-0241-0002, SL: 4.6 mm, MD: 1.6 mm, Lăpugiu de Sus (Romania), Fig. 7C, D. Paratype, NHMW-GEO-2025-0241-0003, SL: 3.2 mm, MD: 1.2 mm, Lăpugiu de Sus (Romania), Figs 2C, 7E, F. Paratype, NHMW-GEO-1876-0011-0059k, SL: 4.5 mm, MD: 1.5 mm, Lăpugiu de Sus (Romania), Fig. 7I, J. Paratype, NHMW-GEO-1876-0011-0059l, SL: 4.5 mm, MD: 1.6 mm, Lăpugiu de Sus (Romania), Fig. 7K, L. Paratype, NHMW-GEO-1876-0011-0059m, SL: 4.9 mm, MD: 1.8 mm, Lăpugiu de Sus (Romania), Fig. 7M, N. Paratype, NHMW-GEO-2025-0241-0004, SL: 4.8 mm,

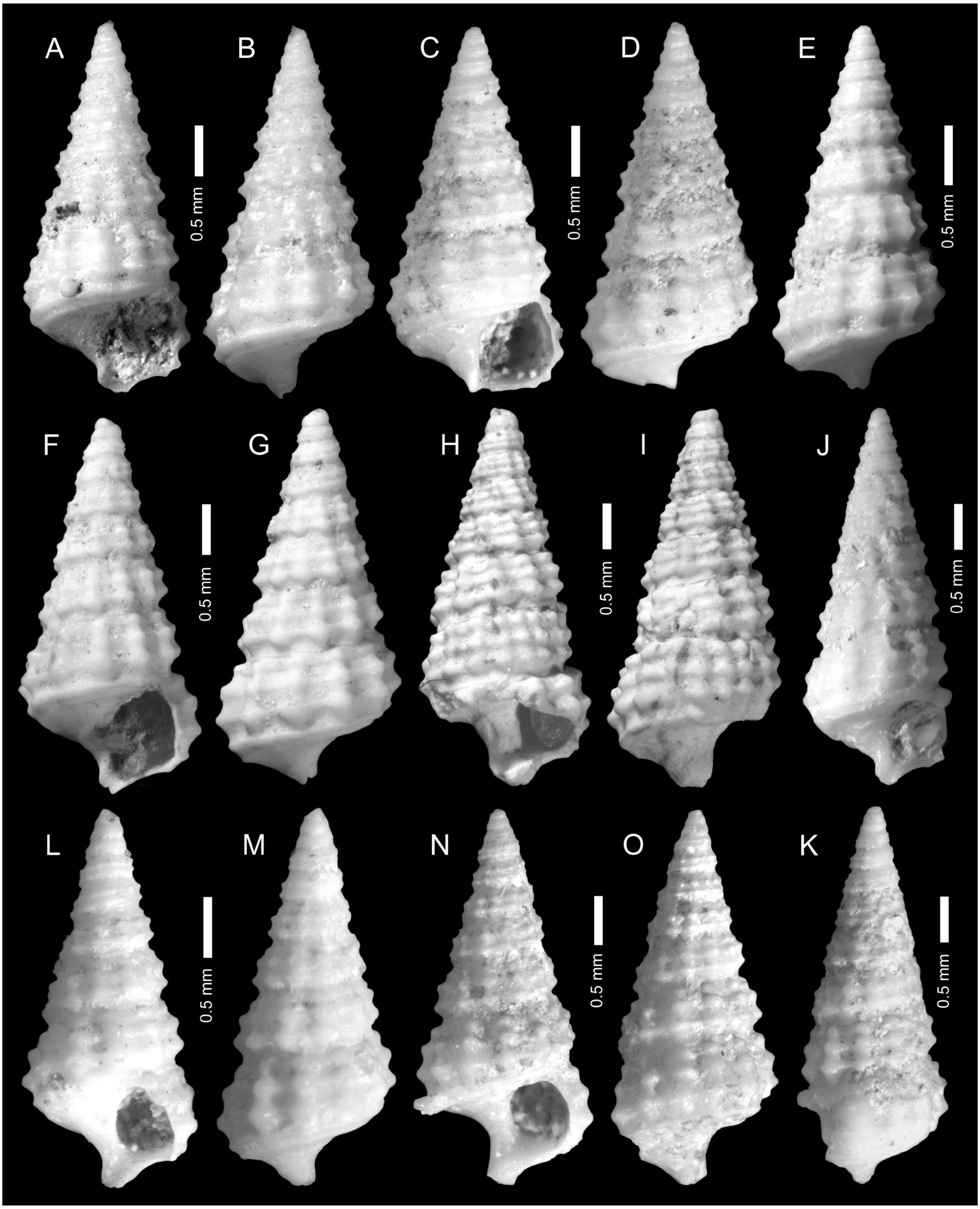

Figure 6. *Bittium parvapyramis* sp. nov. **A, B.** Holotype, NHMW-GEO-1870-0014-0007a; **C, D.** Paratype, NHMW-GEO-1870-0014-0007b; **E.** Paratype, NHMW-GEO-1870-0014-0007c; **F, G.** Paratype, NHMW-GEO-1870-0014-0007d; **H, I.** Paratype, NHMW-GEO-1870-0014-0007e; **J, K.** Paratype, NHMW-GEO-1870-0014-0007f; **L, M.** Paratype, NHMW-GEO-1870-0014-0007g; **N, O.** Paratype, NHMW-GEO-1870-0014-0007h. All Badenian (Middle Miocene), Golubytsya (Hołubica) (Ukraine).

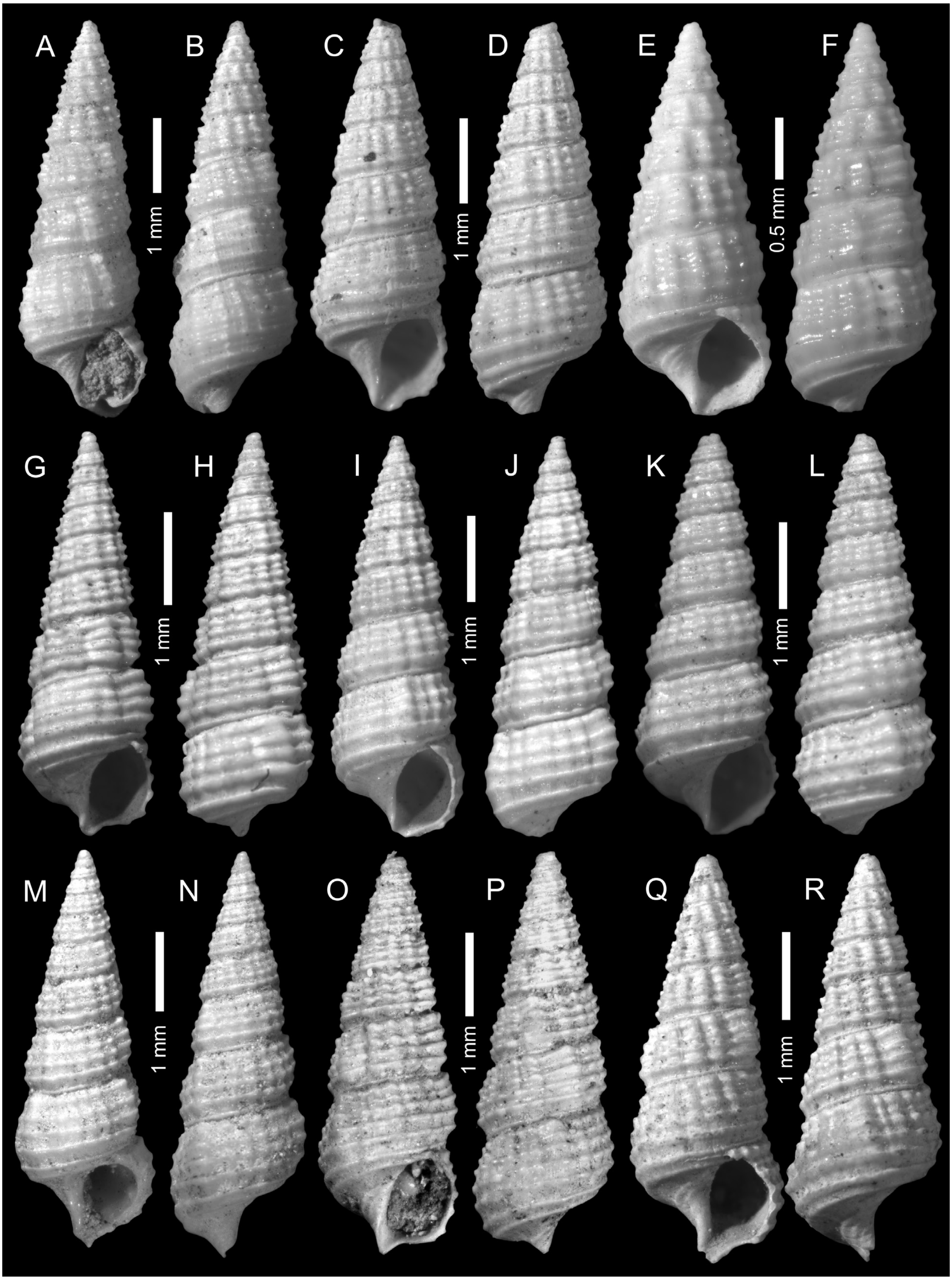

Figure 7. *Bittium polluxi* sp. nov. **A, B.** Paratype, NHMW-GEO-2025-0241-0001; **C, D.** Paratype, NHMW-GEO-2025-0241-0002; **E, F.** Paratype, NHMW-GEO-2025-0241-0003; **G, H.** Holotype, NHMW-GEO-1876-0011-0059j; **I, J.** Paratype, NHMW-GEO-1876-0011-0059k; **K, L.** Paratype, NHMW-GEO-1876-0011-0059l; **M, N.** Paratype, NHMW-GEO-1876-0011-0059m; **O, P.** Paratype, NHMW-GEO-2025-0241-0004; **Q, R.** Paratype, NHMW-GEO-2025-0241-0005. All Badenian (Middle Miocene), Lăpugiu de Sus (Romania).

MD: 1.7 mm, Lăpugiu de Sus (Romania), Fig. 7O, P. Paratype, NHMW-GEO-2025-0241-0005, SL: 4.8 mm, MD: 1.8 mm, Lăpugiu de Sus (Romania), Fig. 7Q, R.

Diagnosis. Small, moderately slender conical shell with conical protoconch of three whorls; teleoconch whorls weakly convex to nearly straight sided, with four subequal, moderately tuberculate spiral cords and weak axial ribs; fourth spiral cord appears on fifth teleoconch whorl, two prominent peribasal cords, three to four weaker fasciolar cords.

Description. Small, moderately slender conical shell attaining ~5 mm in height; apical angle ~23°. Protoconch conical of three smooth, convex whorls. Last protoconch whorl with two weak spiral cords. Early teleoconch whorl with moderately broad, slightly concave subsutural ramp and widely spaced, prominent axial ribs (9–10 on first teleoconch whorl), overrun by two weak spiral cords (2nd and 3rd spiral cords) forming weak tubercles at intersections. 1st spiral cord with small tubercles appears on subsutural ramp on third teleoconch whorl. Later whorls weakly convex to nearly straight sided, slightly angled at abapical cord, with distinctly incised suture. 1st secondary spiral cord intercalated between 1st and 2nd spiral cords on fifth teleoconch whorl; cords, ribs and tubercles rather uniform. Weak suprasutural spiral cord may appear at abapical suture on later whorls. One or two weak varices on late spire whorls. Last whorl attaining ~40% of total height, regularly tuberculate with two more prominent varices (about 16–18 axial ribs on last whorl). Tubercles of abapical spiral cord often strongly reduced on dorsal side of last whorl. Base strongly constricted with two prominent peribasal cords, three to four weaker spiral cords over fasciole. Aperture ovate. Columella weakly excavated. Columellar callus forming indistinct, adherent rim. Anal canal weakly incised. Outer lip simple. Siphonal canal short, moderately narrow, bent to the left.

Etymology. Referring to Pollux, one of the twins birthed from Leda in Greek mythology.

Type locality. Lăpugiu de Sus (Romania), Făget Basin.

Type stratum. Silt and clay of the Dej Formation.

Age. Middle Miocene, middle Badenian (Langhian).

Paleoenvironment. Unknown.

Distribution in Central Paratethys. Badenian (Middle Miocene): Făget Basin: Lăpugiu de Sus (Romania).

Remarks. *Bittium tani* Harzhauser, Guzhov & Landau, 2025 has comparable sculpture but is much larger, higher, has subcylindrical whorls, the tubercles are much larger and rounded, and the peribasal and fasciolar spirals are much stronger (see Harzhauser et al. 2025: fig. 19). *Bittium preascabrum* Harzhauser, Guzhov & Landau, 2025 is slenderer, has less regular sculpture and more prominent varices (see Harzhauser et al. 2025: fig. 18). *Bittium krenni* Harzhauser, Guzhov & Landau, 2025 has only one protoconch whorl, weaker spiral cords and sharper tubercles (see Harzhauser et al. 2025: fig. 14). *Bittium bosphoranum* (Andrussow, 1890), from the early Meotian (Late Miocene) of the Eastern Paratethys Sea, is comparable in sculpture but differs in its strongly convex whorls and larger varices (see Harzhauser et al. 2025: fig. 6). *Bittium deforme* (Eichwald, 1829), from the Badenian of the Polish-Ukrainian Fore-Carpathian Basin, has a comparable whorl profile but is much larger (SL 10–14 mm) and has only three prominent spiral cords bearing larger tubercles.

Discussion and conclusion

The newly described species raise the number of known Bittiinae species from the Badenian of the Central Paratethys Sea to 13 species. This is nearly twice the number of extant species in the Mediterranean Sea (seven species, Coll et al. 2010) and more than twice the number known from the modern tropical eastern Atlantic (five species, Ardovini and Cossignani 2004). Middle Miocene Paratethyan diversity even exceeded that of the present-day Indo-West Pacific Region, where only two species are described from the Red Sea (Dekker and Orlin 2000) and only six from the Coral Triangle (OBIS 2024). Comparison with the coeval Middle Miocene Proto-Mediterranean Sea fauna is difficult as no comparable gastropod revisions have been published so far.

Thus, the Central Paratethys acted as outstanding center of diversity of Bittiinae. Maximum biodiversity was reached during the middle Badenian, coinciding with the Miocene Climatic Optimum. The archipelago-like landscape probably provided numerous different and possibly partially or intermittently isolated habitats that led to greater diversity in the central and southern basins of the sea (Harzhauser et al. 2024). *Bittium biskupici* sp. nov., *Bittium castori* sp. nov., *Bittium pallgergelyi* sp. nov. and *Bittium polluxi* sp. nov. were part of this middle Badenian fauna. The diversity peak ended with the onset of the cooling of the Miocene Climate Transition (Westerhold et al. 2020). This event resulted in a general decline of marine diversity during the late Badenian (Harzhauser et al. 2024). At that time many endemic species developed in the Polish-Ukrainian Fore-Carpathian Basin, which was semi-isolated due to the lowered sea level (Harzhauser et al. 2024). *Bittium parvapyramis* sp. nov. may represent one of these endemics. Finally, only one species survived the tectonically induced Badenian/Sarmatian extinction event before the Bittiinae became extinct in the region during the middle Sarmatian (Harzhauser and Piller 2007; Harzhauser et al. 2025).

The new species were misplaced in the systematic collection of the NHMW and were detected during the revision of Paratethyan cerithiopsids. Therefore, this case shows that museum collections may be surprising archives for past biodiversity and that the final word has not yet been spoken even after thorough revisions of certain systematic groups.

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