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A NEW SPECIES OF *CASPIA* CLESSIN ET W. DYBOWSKI, 1887 (GASTROPODA: TRUNCATELLOIDEA: HYDROBIIDAE) IN THE DANUBE OF BULGARIA

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ABSTRACT: Species of the genus *Caspia* Clessin et W. Dybowski, 1887 are only known from brackish waters of the Caspian Sea and the Azov-Black Sea Basins. The first freshwater species of *Caspia* is described from the Danube. Inclusion of *Caspia* in the Hydrobiidae is discussed. *C. makarovi* Anistratenko, 2013 is synonymised with *C. knipowitschii* Anistratenko, 2013.

KEYWORDS: Hydrobiidae, *Caspia milae* Boeters, Glöer et Georgiev n. sp., Danube, Bulgaria

INTRODUCTION

The freshwater mollusc fauna of the Danube, the border river of Bulgaria and Romania, has been well known for a long time. The river and its delta are inhabited by many operculate snails representing at least nine families (Table 1). According to CIOBOIU (2010: 3) also spring snails of the family Hydrobiidae can be found there (Table 2). At least for one of them, that is *Bythinella austriaca* (Frauenfeld, 1857), CIOBOIU (2010: 1) defined the habitat as "on rocky banks".

Despite the fact that during the last decades continuous investigations contributed to the knowledge of the Bulgarian and Romanian freshwater mollusc fauna, no previously unrecorded operculates were observed in the Danube and its delta. It is true that already in 1956 GROSSU mentioned a species of *Caspia* Clessin et W. Dybowski, 1887 for the Bulgarian coast; consequently, GOLIKOV & STAROBOGATOV (1966: 354) wondered if this species might inhabit the Danube. Later, ANISTRATENKO (2007a: 795, figs 1.1–7) presented maps of the Azov-Black Sea Basin with estuarine areas such as that of the Danube, and added a photograph of *Caspia* sp., as one of the species known to inhabit at least some of the estuaries of the Basin. Whereas GROSSU (1956) listed this species as *Caspia gmelinii* Clessin et W. Dybowski, 1887 (Figs 1–6) and later (in GROSSU 1986) as *Caspia g. aluschtensis* (Golikov et Starobogatov, 1966), GOLIKOV & STAROBOGATOV (1966) named it *C. makarovi* (Golikov et Starobogatov, 1966). However, the presence of a representative of *Caspia* in the Danube was never reported. This is all the more surprising that recently a previoulsy unknown representative of *Caspia* was found at the Danubian Island Vardim.

Up to now representatives of *Caspia* were known only from the Caspian Sea and the Azov-Black Sea Basins. For example, according to GROSSU (1956: 122, 1986: 277) *C. gmelinii aluschtensis* inhabits the Black Sea and its limans. It was found in the Black Sea at the Romanian coast at Constanta at the depth of 20–25 m, and at "Razelm", obviously Lacul Razelm and Lacul Razim, respectively, a complex of lakes formed by a few estuaries and lagoons at the Black Sea beach south of the Bulgarian Danube

Table 1. Prosobranch molluscs reported from the Danube and its delta by (1) Cioboiu (2010), (2) Georgiev & Hubenov (2013) and (3) Glöer & Georgiev (2014)

Neritidae Rafinesque, 1815
Theodoxus danubialis (C. Pfeiffer, 1828) (1), (2)
Theodoxus euxinus (Clessin, 1886) (1)
Theodoxus fluviatilis (Linnaeus, 1758) (1), (2)
Theodoxus pallisi Lindholm, 1924 (1), (2)
Theodoxus prevostianus (C. Pfeiffer, 1828) (1)
Theodoxus transversalis (C. Pfeiffer, 1828) (1), (2)
Viviparidae J. E. Gray, 1847
Viviparus acerosus (Bourguignat, 1862) (1), (2)
Viviparus ater (De Cristofori et Jan, 1832) (1)
Viviparus contectus (Millet, 1813) (1), (2)
Viviparus sphaeridius Bourguignat, 1880 (3)
Viviparus mamillatus (Küster, 1852) (1)
Viviparus viviparus (Linnaeus, 1758) (1), (2)
Melanopsidae H. & A. Adams, 1854
Esperiana (*Esperiana*) *esperi* (A. Férussac, 1823) (1), (2)
Esperiana (*Microcolpia*) *daudebartii* (Prevost, 1821) (1), (2)
Holandriana holandrii (C. Pfeiffer, 1828) (1), (2)
Bithyniidae Leach, 1818
Bithynia (*Bithynia*) *danubialis* Glöer et Georgiev, 2012 (2)
Bithynia (*Bithynia*) *mostarensis* Möllendorf, 1873 (1)
Bithynia (*Bithynia*) *tentaculata* (Linnaeus, 1758) (1), (2)
Bithynia (Codiella) troschelii (Paasch, 1842) (1)
Bithynia (*Codiella*) *leachi* (Sheppard, 1823) (1)
Hydrobiidae Stimpson, 1865 (? **Pyrgulidae** Brusina, 1882)
Turricaspia (*Clessiniola*) *variabilis* (Eichwald, 1838) (1), (2)
Turricaspia (*Laevicaspia*) *lincta* (Milaschewitch, 1908) (1), (2)
Turricaspia (*Oxypyrgula*) *ismailensis* (Golikov et Starobogatov, 1966) (1)
Turricaspia (*Turricaspia*) *dimidiata* (Eichwald, 1841) (1)
Potamopyrgus antipodarum (J. E. Gray, 1843) (1), (2)
Lithoglyphidae Tryon, 1866
Lithoglyphus apertus (Küster, 1852) (1)
Lithoglyphus fuscus (C. Pfeiffer, 1828) (1)
Lithoglyphus naticoides (C. Pfeiffer, 1828) (1), (2)
Lithoglyphus pygmaeus (Frauenfeld, 1863) (1)
Lithoglyphus pyramidatus Möllendorf, 1873 (2)
Valvatidae J. E. Gray, 1840
Valvata (*Valvata*) *cristata* O. F. Müller, 1774 (1), (2)
Valvata (*Tropidina*) *macrostoma* (Mörch, 1864) (1), (2)
Valvata (*Cincinna*) *piscinalis* (O. F. Müller, 1774) (1), (2)
Valvata (*Cincinna*) *studeri* Boeters et Falkner, 1998 (1)
Borysthenia naticina (Menke, 1845) (1), (2)

Delta. However, according to Anistratenko (2007b: 23), being aware of Golikov & Starobogatov's (1966) publication with the description of the mentioned subspecies, the Azov Sea and the Black Sea are inhabited by the following four species of *Caspia*

Figs 1–6. *Caspia gmelinii* Clessin et W. Dybowski, 1887, Caspian Sea (SMF 141 483; labels: "*Nematura gmelini* Dyb. Caspi-See" and "141483/37"): 1–2 – shell (frontal and lateral view) [specimen 1, height (h) 2.175, diameter (d) 1.175 mm, h : d 1.85]; 3 – shell (frontal view) [specimen 2, height (h) 2.20, diameter (d) 1.10 mm, h : d = 2.00]; 4 – detail of shell surface (same shell as figs 1–2); 5–6 – two labels. According to the original description the shell dimensions were: height (h) 1.6 and diameter (d) 0.8 mm, i.e. h : d 2.0; Figs 1–3 show the only shells of the SMF sample which meet h : d 2.0, for all other shells of the sample with altogether 37 specimens h : d is greater than 2

Table 2. Spring snails (Hydrobiidae) reported from the Danube, after Cioboiu (2010)

Bythinella austriaca (Frauenfeld, 1857)
Bythinella cylindrica (Frauenfeld, 1857)
Bythinella hungarica Hazay, 1880
Pseudamnicola dobrogica Grossu, 1986
Pseudamnicola leontina Grossu, 1986
Pseudamnicola penchinati (Bourguignat, 1870)
Pseudamnicola razelmiana Grossu, 1986

only: 1. *C. knipowitschii* Makarov, 1938 reported from the deltas of the Dniester River (Makarov 1938: 1058 line 14, Golikov & Starobogatov 1966: 354, 362) and the Dnieper River (Makarov 1938: loc. cit., Anistratenko 2013: 52); 2. *C. logvinenkoi* (Golikov et Starobogatov, 1966) found in the estuary of the Don River to the Sea of Azov (Golikov & Starobogatov 1966: 354); 3. *C. makarovi* (Golikov et Starobogatov, 1966) reported from the Don River (Sea of Azov) and the deltas of the Dnieper River and the Dniester River (Black Sea) (Golikov & Starobogatov 1966: 354, 362, Anistratenko 2013: 52); 4. *C. stanislavi* Alexenko et Starobogatov, 1987 reported from the delta of the Dnieper River (Alexenko & Starobogatow 1987: 33). These four species predominantly inhabit the estuarine areas and limans of big rivers flowing into the Azov Sea and the Black Sea (Golikov & Starobogatov 1966: 362, Anistratenko 2013: 52). For the Black Sea, Golikov & Starobogatov (1966: 362) mention exclusively the estuaries of big rivers as inhabited.

CHARACTERISTICS OF THE GENUS *CASPIA* CLESSIN ET W. DYBOWSKI, 1887

Caspia comprises two subgenera (see below). Its type species was described from the Caspian Sea based on conchological characters only. Overall, the knowledge of morphological, anatomical, biological and ecological characters and behaviour of species of *Caspia* is scanty. The existing information can be briefly summarised as follows:

Radula: The radulae of *C. knipowitschii* and of *C. gmelinii* were examined by Anistratenko (2013: 58, fig. 5) and Sitnikova & Starobogatov (1998: 1361, fig. 3.12, 1363, fig. 5.4), respectively. According to Anistratenko (2013: 57–58) they are almost identical and are of taenioglossate type.

Male genitalia: The penis of any species of *Caspia* was not described despite its possible taxonomic value.

Female genitalia: According to Sitnikova & Starobogatov (1998: 1363), as interpreted by Anistratenko (2013: 61), the renal oviduct of *C. gmelinii* Clessin et W. Dybowski, 1887 and *C. gaillardi* Tadjalli-Pour, 1977 lacks bursa and distal receptaculum (RS1). Accordingly, the only receptaculum described by Sitnikova & Starobogatov (1998: 1359, figs 1.12–13) should be the proximal receptaculum (RS2).

Reproduction: Alexenko & Anistratenko (1998: 63, figs 2.1–3) reported laboratory observations. *C. knipowitschii* and *C. makarovi* deposited their single eggs on conspecific shells, or shells and byssus threads of *Dreissena* Beneden, 1835.

Habitat: All species of *Caspia* were predominantly found in estuarine areas (limans) of big rivers.

The discovery of a new species of *Caspia* in the Danube will help to improve the insufficient knowledge of the representatives of *Caspia*.

MATERIAL AND METHODS

The snails were collected at the Island Vardim (Fig. 7), situated in the Danube about 500 km up of the Black Sea (Fig. 8) with a sieve or by hand, sorted on site from live material and preserved in 75% ethanol. The dissections and measurements of the genital organs and shells were carried out using a stereomicroscope (Zeiss); the photographs were taken with a digital camera system (Leica). The measurements are given as minimum-mean-maximum values.

Abbreviations: BOE – collection Boeters München, SMF – Forschungsinstitut und Natur-Museum Senckenberg (Frankfurt am Main), ZMH – Zoologisches Museum Hamburg.

Fig. 7. Type locality: sampling site of *Caspia milae* n. sp. (Island Vardim, view towards Danube)

Fig. 8. Map showing the Danube from its Island Vardim to the Eastern Black Sea

SYSTEMATIC PART WITH DESCRIPTION OF *CASPIA MILAE* N. SP.
by Boeters, Glöer et Georgiev

Caspia Clessin et W. Dybowski, 1887 [err. 1888]

1887 Clessin et W. Dybowski in W. Dybowski (1887–1888: 34). Type species [secondary designation]: *Caspia baerii* Clessin et W. Dybowski, 1887. Type locality: “Kaspi-See”.

Caspia milae n. sp.

Figs 7–21

Holotype: shell height 2.4 mm, width 1.3 mm, ZMH 4887

Paratypes: 4 specimens ZMH 4888, 2 ex. coll. Glöer, BOE 3330/10 adults + 8 juveniles.

Type locality: Bulgaria, Danube Island Vardim, 43°37’N, 25°28’E (Figs 7–8), Mila Ihtimanska leg. 28.08.2013.

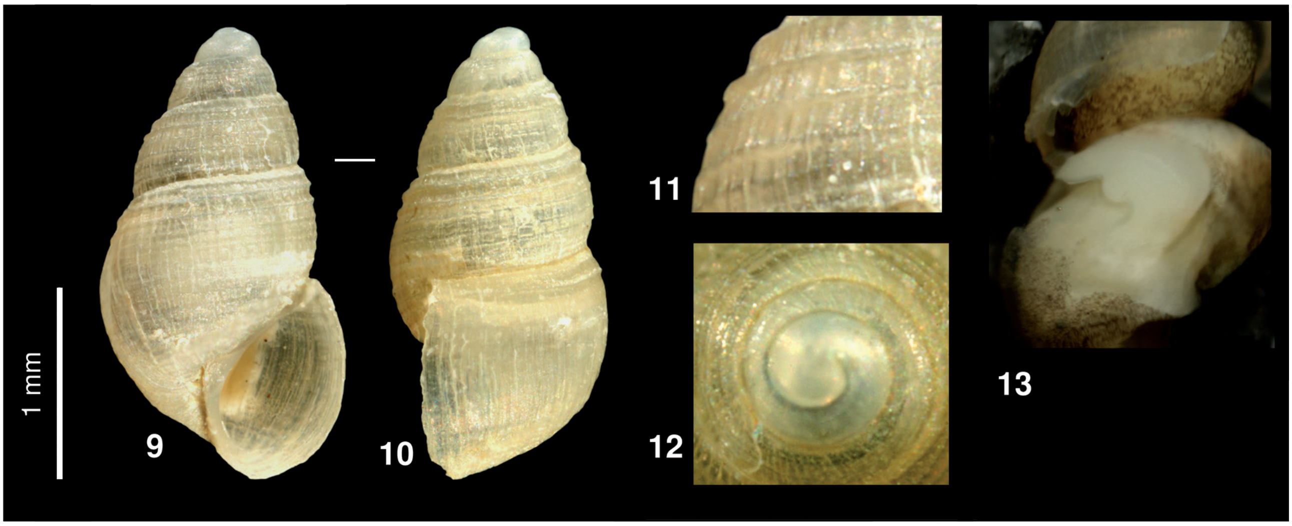
Derivatio nominis: The new species is named for its collector Mila Ihtimanska.

Shell: The protoconch has 1.00–1.20 whorls (Figs 12, 14) and a diameter of about 0.4 mm (Table 3). Shell elongated conical with nearly straight sidelines and 4.25–4.50 moderately convex thick-walled whorls, separated by a moderately deep suture (Figs 9–10); walls with a lattice-like sculpture formed by spiral ridges crossed by longitudinal lines or striae (Fig. 11); the thickness of the spiral ridges on each whorl decreases from the upper to the lower suture, in frontal view forming pronounced steps to very flat waves; about eight spiral ridges on the body whorl above the corner of the aperture (Fig. 11); this sculpture weakens towards the aperture and is replaced by growth lines; suture of the last quarter of body whorl ascends slightly, indicating maturity; aperture obliquely ovate with slightly pointed upper corner; peristome sharp; umbilicus completely closed by the lobed columellar border of the aperture; parietal border completely fused with shell wall and connected with a spiral filamentous thickening, which connects the suture inside the whorls; the columellar margin runs nearly straight down before passing into the basal margin. Measurements: heigth 2.15–2.50 mm (mean 2.33, SD 0.117, n = 9), diameter 1.20–1.35 mm (mean 1.28, SD 0.061, n = 8).

Operculum spiral, without any hook, horn-coloured.

Table 3. Protoconch of *C. milae* n. sp. and *C. knipowitschii*. All data for *C. knipowitschii* [= *C. makarovi*] after Anistratenko (2013: 57 table 1)

Species	Number of whorls	Maximum diameter [mm]	Diameter of 1st whorl [mm]	Diameter of crescent-shaped beginning [mm]	n
C. knipowitschii	1.25–1.30	0.28–0.35	0.25–0.31	0.11–0.15	4
C. milae n. sp.	1.00–1.20	0.38–0.42	0.36–0.40	0.18–0.20	3



Figs 9–13. *Caspia milae* n. sp.: 9–12 – shell, holotype, ZMH4887 (9–10 – frontal and lateral view (height of shell 2.4 mm); 11 – detail of shell surface (80×); 12 – apical view (80×)); 13 – male, paratype, BOE 3330 (head with penis exposed through slit mantle)

Remark: We have not seen shells with a thickened palatal and basal margin of the aperture, that is those with completed growth as distinctly visible as in *C. gmelinii* (Figs 1 and 3).

Soft parts: Ommatophores with a median black stripe, head and mantle except for its white margin with scattered black pigment (Fig. 18). Gill with 12–13 lamellae (n = 1 ♀, 2 ♂♂) (Fig. 17). Intestine in the roof of mantle cavity shaped like a very flat U (Fig. 19). Anus at a distance of about two times the width of the unpigmented and slightly thickened mantle margin behind its edge, in females only slightly protruding beyond the complex of albumen and capsule glands.

Penis: In contracted specimens the unpigmented short, blunt, broad penis is bent towards the opening of the mantle cavity; in top view its left side shows a semicircular protrusion which continues on the lower side as a lamella; the median penial duct runs to the penis tip and opens at a pointed protrusion (Figs 13, 17).

Female genitalia: The unpigmented renal oviduct turns from the gonopericardial duct towards the distal wall of the stomach, forming a V-like loop, and from there, forming another V-like loop, runs straight towards the complex of albumen and capsule glands; the second loop carries a large ovate receptaculum (proximal receptaculum = RS2); distal receptaculum (RS1) and bursa are missing (Figs 18–21).

Sex ratio: The sex ratio among the eight dissected animals was 2♂ : 6♀ (BOE 3330).

Diagnosis: Reticulate (lattice like) sculpture of the shell and the female genitalia with only one receptaculum but with no bursa place the new species within *Clathrocaspia* Lindholm, 1929, a subgenus of *Caspia*, a genus of the Hydrobiidae.

Differential diagnosis:

1. Compared to *C. knipowitschii* (= *C. makarovi*; see below) the umbilicus is covered by a lobed columellar margin and not narrow and slit-like to closed (Anistratenko 2013: 54, 56); furthermore, in *C. milae* n. sp. the transition from the columellar to the basal margin is less regularly rounded than in *C. knipowitschii*. In *C. knipowitschii* the protoconch has 1.25–1.30 and its diameter is 0.28–0.35 mm, whereas in *C. milae* n. sp. the number of whorls is only 1.00–1.20, however the diameter is 0.38–0.42 mm (Table 3). Finally, in the Black Sea region, *C. knipowitschii* inhabits the deltas of the Dnieper River and the Dniester River. *C. milae*. sp. was found in a different environment: about 500 km upstream of the Danube estuary.

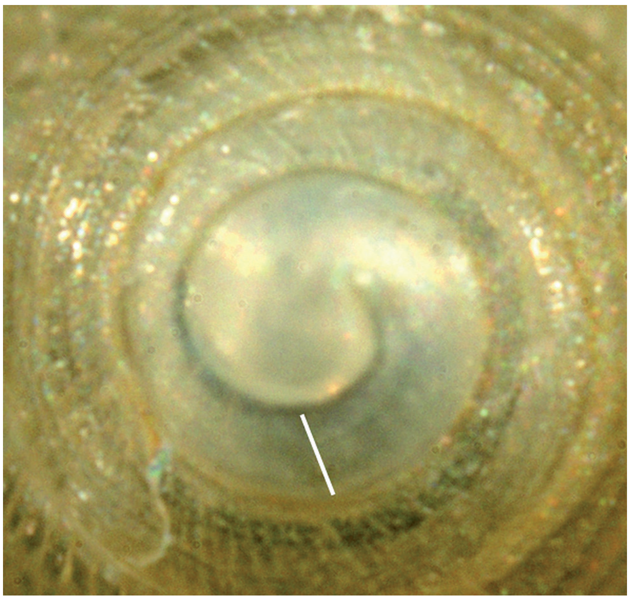
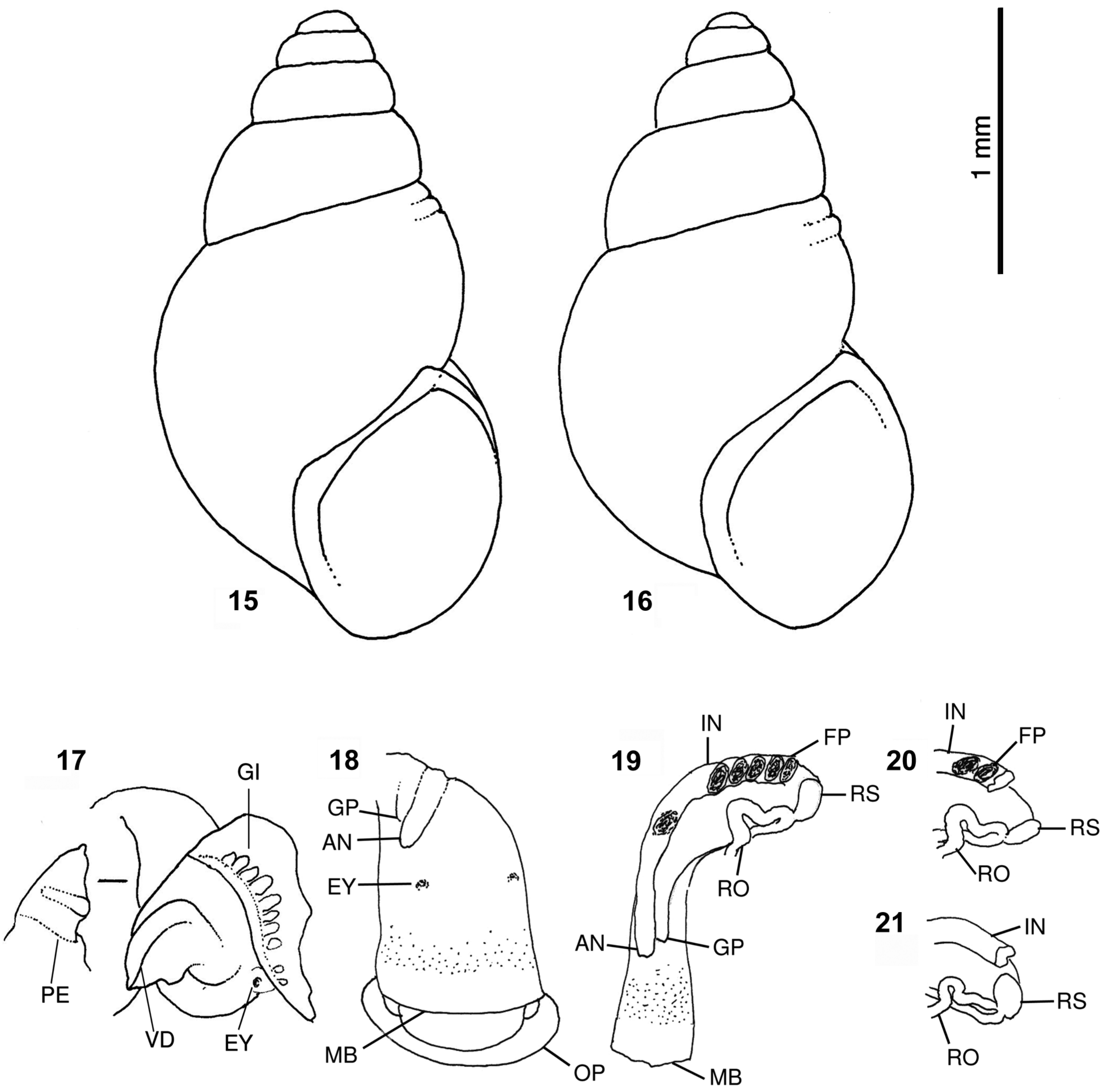


Fig. 14. *Caspia milae* n. sp. – shell (holotype, ZMH4887: apical view with peristome of protoconch marked (same shell as Figs 9–12); 195×



Figs 15–21. *Caspia milae* n. sp. (paratypes, BOE 3330): 15–16 – female shells (15 – same ♀ as for 18 and 19; 16 – same ♀ as for 21); 17 – male (head with penis and gill exposed through slit mantle); 18–21 – females (18 – body with head covered by mantle and with operculum, first whorls of visceral sac removed, 19 – body and mantle cavity opened to show renal oviduct, complex of albumen and capsule glands and intestine, partially broken away, 19–21 – renal oviduct with receptaculum). Scale bars – 1 mm for figs 15–16 and 0.5 mm for figs 17–21. Abbreviations: AN – anus, EY – eye spot, FP – faecal pellet, GI – gill, GP – gonoporus, IN – intestine, MB – mantle border, OP – operculum, PE – penis, RO – renal oviduct, RS – receptaculum, VD – vas deferens

2. Shells of *C. milae* n. sp. are more elongated than those of of *C. logvinenkoi*: the height : diameter (h : d) ratio in *C. milae* n. sp. is 1.76–1.84–2.00, and in *C. logvinenkoi* it is 1.48–1.55–1.65 (Table 4).
3. According to Anistratenko (2007b: 26) "in both the Taganrog and the Western-Black Sea estuary provinces … two [species of *Caspia*] are common: *C. makarovi* and *C. knipowitschii*, [one] species (*C. stanislavi*) is endemic to the Western-Black Sea province". Thus, *C. stanislavi* seems to be restricted to its type locality, the Delta of the Dnieper River, where it lives sympatrically with *C. knipowitschii* [= *C. makarovi*]. Shells of *C. stanislavi* are more elongated than those of *C. milae* n. sp., which is reflected by the height : diameter (h : d) ratio of more than 2 (h : d = 2.1) in *C. stanislavi*, which in *C. milae* n. sp. is smaller than 2 (h : d = 1.8). Furthermore, in *C. milae* n. sp. the height ratio of body whorl to shell is ca. 0.70, whereas in *C. stanislavi* it is 0.57 (Table 4).

Table 4. Shell measurements of different species of *Caspia* – differentiating characters

Species	Shell height (h) [mm]		Shell diameter (d) [mm]		h : d		Body whorl height : shell height
	range	mean	range	mean	range	mean	
C. milae n. sp.	2.15–2.50	2.33 (n = 9)	1.20–1.35	1.28 (n = 8)	1.76–2.00	1.84 (n = 8)	0.70 (n = 1)
C. g. gmelinii	2.1–2.61 (n = 6) (a)					1.8 (b)	
C. g. aluschtensis	2.4		1.2			greater 2	less then 0.67
C. knipowitschii	2.4 (c)				1.63–1.7 (d)		
	2.2–2.3 (k)		up to 1.3 (k)		1.77 (e)		0.74 (e)
C. logvinenkoi	1.8		1.2			1.5	
	1.65–2.40	1.95 (n = 4) (f)	1.0–1.62	1.27 (n = 4) (f)	1.48–1.65 (n = 4) (f)	1.55	
C. makarovi	2.4		up to 1.3			1.85	
	2.2–2.4 (l)		1.30 (l)		1.89 (g)		0.70 (g)
C. stanislavi	2.45		1.15			2.13	0.57

Data sources: (a) Makarov 1938: 1058; (b) Makarov 1938: 1058, 1062; (c) Makarov 1938: 1058 fig. 1 (Dnieper); (d) Makarov 1938: 1058 (Dniester and Dnieper); (e) Anistratenko 2013: 55 fig. 3D (Dnieper); (f) Anistratenko 2007b: 25 table 1 (Don Delta); (g) Anistratenko 2013: 55 fig. 3E (Dnieper); (h) Anistratenko 2013: 53; (i) Anistratenko 2007b: 56; (k) Anistratenko 2013: 53; (l) Anistratenko 2013: 56; all other data see original descriptions.

4. *Pyrgula* (*Caspia*) *gmelinii aluschtensis* Golikov et Starobogatov, 1966 was described as subfossil from "faseolin mud" on the Crimean coast. However, Anistratenko (2007b: 56) regards this subspecies as a synonym of *Pyrgula* (*Caspia*) *makarovi* Golikov et Starobogtov, 1966, which in our opinion is a junior synonym of *C. knipowitschii* (see below). The shell sculpture in *C. gmelinii aluschtensis* is composed of weak spiral lines (Golikov & Starobogatov 1966: 355, fig. 1.8). Furthermore, in *C. milae* n. sp. the h : d ratio is 1.84 and the height ratio of body whorl to shell is ca. 0.70, whereas in *C. g. aluschtensis* the h : d ratio is more than 2 and the body whorl : shell height ratio is less than 0.67.

Habitat and distribution: Right bank of the point of the Vardim Island (Fig. 7), situated on the Danube about 500 km upstream of its estuary to the Black Sea (Fig. 8). The snails were collected on a heterogeneous substratum formed by large stones (boulders), coarse gravel and fine gravel (10 : 60 : 30%). The water parameters, measured on 28 August 2013, are listed in Table 5. It cannot be excluded that *C. milae* n. sp. inhabits the Danube also downstream of the type locality, to the Danube Delta, and its limans such as Lacu Razelm, since the drawing published by Grossu (1986: 277, fig. 109 contrary to Grossu 1956: 122, fig. 60) shows a shell without a thickened lip.

Table 5. Water parameters at the type locality

Flow rate	0.4–0.9 km/h
Water temperature	27°C
Oxygen concentration	5.7 mg/l
Oxygen saturation	72%
pH	7.75
Redox potential	–47 mV

DISCUSSION

IDENTITY OF *CASPIA* AND ITS SUBGENERA

Caspia comprises two subgenera, the nominate subgenus and *Clathrocaspia* Lindholm, 1929 (W. Dybowski 1887–1888, Lindholm 1929). The type species of the nominate subgenus is *C. baerii*. According to the original description, its shell is 1.6 mm high, very weakly radially striated and shows a very weak spiral stria below the suture.

The type species of *Clathrocaspia* is *C. pallasi* Clessin et W. Dybowski, 1887. Its shell was originally described (W. Dybowski 1887–1888) as 1.8–1.9 mm high, spirally striated, with about eight striae on the body whorl. In addition to the spiral striation, the original description of *C.* (*Clathrocaspia*) *gmelinii* (W. Dybowski 1887–1888) states that its shell, 1.6 mm in height, is very weakly radially striated. The renal oviduct in *C.* (*Clathrocaspia*) *gmelinii* is known to be provided with a proximal receptaculum (RS2) but no bursa or distal receptaculum (RS1) (Sitnikova & Starobogatov 1998, Anistratenko 2013). The reticulate shell sculpture and the female genitalia with only one receptaculum but no bursa place *C. milae* n. sp. also in *Clathrocaspia*. The shells of all three species are provided with a strong columellar callus.

Unfortunately, no shell photographs of *C. baerii* or *C. pallasi* are available, and none of them has been anatomically examined. More studies on the poorly known genus *Caspia* with its two subgenera, and especially their type species, are required. Moreover, we failed to obtain at least photographs of the holotypes of *Pyrgula* (*Caspia*) *gmelinii aluschtensis* Golikov et Starobogatov, 1966 and *Caspia gmelinii stanislavi* Alexenko et Starobogatov, 1987 which are allegedly deposited at the Institute of Zoology, Russian Akademy of Sciences (RAS) in St. Petersburg.

FAMILY ASSIGNMENT

The renal oviduct of representatives of the Hydrobiidae can be provided with a proximal receptaculum (RS2), a distal receptaculum (RS1) and a bursa below the distal receptaculum. When the proximal receptaculum is present, it is shaped like a more or less elongated sac which is connected with the oviduct by a short receptaculum duct. In females of *Caspia milae* n. sp. there is no bursa or distal receptaculum (RS1), and only the proximal receptaculum (RS2) is present. It has the form of an elongated smooth sac connected with the oviduct by a very short duct.

Pyrgula annulata (Linnaeus, 1758) is the type species of *Pyrgula* Cristofori et Jan, 1832, the type genus of the Pyrgulidae Brusina, 1882. In this species, in the position of the hydrobiid RS2, instead of a smooth sac the renal oviduct carries a coarse to warty pouch (Giusti & Pezzoli 1980: 59, fig. 25B, Radoman 1983: 135, figs 75A–B). The pouch is characteristic of the Pyrgulidae; for representatives of *Pyrgula* and *Falsipyrgula*, see, for example, Sitnikova & Starobogatov (1998: 1359, figs 1.14–15). Consequently, *Caspia milae* n. sp. belongs to the Hydrobiidae and not the Pyrgulidae.

CASPIA KNIPOWITSCHII AND *C. MAKAROVI*

Anistratenko (2013: 56) listed several characters to discern between these two species (Table 6): both species "are similar in size, general shape and ornamentation patterns [...]. They differ in the dimensions of the protoconch" [i.e.] "the protoconch of *C. makarovi* is slightly smaller than that of *C. knipowitschii*" [...] "in the proportions and degree of inflation of the whorls. The shell of *C. makarovi* is more slender and has slightly more inflated whorls than *C. knipowitschii*: the apical angle in *C. makarovi* is 40–45° compared with 45–50° in *C. knipowitschii*." In his table (Anistratenko 2013: 57, table 1) he gave values of protoconch measurements for only two specimens of each species; they may not be representative and useful as reliable diagnostic characters. Furthermore, except for the protoconch maximum diameter, the ranges of measurements in Table 6, including the apical angle, are identical or overlap. Finally, the radulae of the two species have not been compared, whereas the radulae of *C. knipowitschii* and *C. gmelinii* are "almost identical" (Anistratenko 2013: 58). The difference in the spiral striation seems to be insignificant, since both species are "similar in … ornamentation patterns". Here, we assume that *C. makarovi* is a junior synonym of *C. knipowitschii*, however the status of both species should be studied in detail.

FEMALE GENITALIA

As mentioned above, according to Sitnikova & Starobogatov (1998: 1363), as interpreted by Anistratenko (2013: 61), the renal oviduct of *Caspia* lacks bursa and distal receptaculum (RS1); only the proximal receptaculum (RS2) was found by Sitnikova & Starobogatov (1998) in *C. gmelinii* and *C. gaillardi*. This is confirmed by our results. On the other hand, the figures presented by Sitnikova & Starobogatov (1998) are not clear. The receptaculum duct enters the renal oviduct at its distal end (Sitnikova & Starobogatov 1998: 1359, fig. 1.12) or it directly enters the complex of albumen and capsule glands together with the renal oviduct (Sitnikova & Starobogatov 1998: 1359, fig. 1.13). The receptaculum in their figure is located in the position of the bursa. Besides, according to Sitnikova & Starobogatov (1998) the receptaculum is U-shaped – a shape we did not observe in our specimens. In their opinion (Sitnikova & Starobogatov 1998: 1558) in females of *Turricaspia* B. Dybowski et Grochmalicki, 1915, which also inhabit the Danube

Table 6. Shell characters of *C. knipowitschii* and *C. makarovi* after Anistratenko (2013)

	C. knipowitschii	*C. makarovi*
Shell height	2.2–2.3 mm	2.2–2.4 mm
Shell diameter	up to 1.3 mm	up to 1.3 mm
Spiral striae on body whorl	up to 15–17	up to 20
Maximum diameter of protoconch	0.34–0.35 mm	0.28–0.30 mm
Whorls of protoconch	1.25–1.30	1.25
Whorls of teleoconch	4.0–4.5	4.0–4.5

(Table 1), the renal oviduct is provided with a bursa in addition to a single receptaculum (RS1).

HABITAT OF *CASPIA* SPECIES IN THE BLACK SEA BASIN

When describing *Caspia* based on 200 shells of *C. baerii*, 70 shells of *C. gmelinii*, 25 shells of *C. ulskii* and more than 300 shells of *C. grimmi* presumably from a depth of 0–27 m ["0 bis 15 Faden"] from the Caspian Sea, Clessin & W. Dybowski (in Dybowski 1887–1888: 35, 69) added that they had never seen a live animal. The same applies to the description of *C. gaillardi* from the Caspian Sea at depths of 0–30 m (Tadjalli-Pour 1977). It can be assumed that they dealt with samples of shells brought and deposited by sea currents, probably from estuaries – a view supported by the obervations from the Azov-Black Sea Basin.

The Black Sea's circulation patterns are primarily controlled by the basin topography and fluvial inputs, which result in a strongly stratified vertical structure. The deep waters of the Black Sea do not mix with the upper layers, so that over 90% of the deeper Black Sea volume is anoxic water. The surface water leaves the Black Sea with a salinity of 17 psu. Grossu (1986: 277) mentioned a depth of 20–25 m for *C. gmelinii aluschtensis* in the Black Sea. However, it is not obvious whether really live animals were found at those depths. The same applies to Golikov & Starobogatov's (1966: 354) report of *C. gmelinii* in the Caspian Sea at depths of 30–81 m.

According to Alexenko & Anistratenko (1998: 60) and also Anistratenko (2013: 52) live *C. knipowitschii* and *C. makarovi* could be found in the Dnieper River at depths of 1.5–3 m. It would not be surprising to see that the habitat of *Caspia* species at least in the Black Sea Basin is indeed restricted to the estuarine areas of large rivers flowing into the Sea. This assumption is in conformity with observations reported by Alexenko & Starobogatov (1987: 36–37 with tables 1–2) for *C. knipowitschii* and *C. stanislavi* at a depth of 1.1–3.0 m in the Dnieper Delta, since their population density decreases towards the river mouth. It is remarkable that of the three species of *Caspia* from the Azov-Black Sea Basin two are endemic to specific estuaries: *C. logvinenkoi* to the Don Delta and *C. stanislavi* to the Dnieper Delta.

The conditions of salinity, tides and topographical isolation of the areas inhabited by *Caspia* resemble those of the habitats of *Mercuria* in West European estuaries. Anistratenko (2007b: 23, 25) reports a salinity from freshwater to 1 psu for the type locality of *C. logvinenkoi*, the estuary of the Don River, while in the tidal areas of Dutch estuaries inhabited by *Mercuria anatina* (Poiret, 1801) the salinity is 0.5–5.4 psu (Gittenberger et al. 1998: 82). The Black Sea tides of the semidiurnal type have the maximum amplitude of only 12 cm, but at the coast offshore winds can rise the Black Sea level up to 60–80 cm and winds from the land decrease the sea level by 60 cm. Consequently, the water level in the estuaries of the rivers flowing into the Black Sea may be subject to tides with amplitudes of up to 140 cm (Bondar 2007: 47).

The above considerations do not seem to apply to the habitat of *C. milae* n. sp. which lives in the Danube about 500 km upstream of the Black Sea coast, far from the estuary.

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