

Description of a new species of the genus *Cylichna* (Gastropoda: Heterobranchia: Cylichnidae) from the Tatar Strait (Sea of Japan), with discussion of its taxonomical position

Описание нового вида рода *Cylichna* (Gastropoda: Heterobranchia: Cylichnidae) из Татарского пролива (Японское море) с обсуждением его таксономического положения

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Abstract. *Cylichna inflata* **sp. nov.** is described based on nine specimens collected in 1931 in the Tatar Strait (northern part of the Sea of Japan) at a depth of 69 m. The new species differs from other species of the genus in the morphology of the shell, radula, gizzard plates, and in the presence of a seminal vesicle in the copulatory apparatus. The shell proportions of *C. inflata* **sp. nov.** are similar to those of some species of the genus *Cylichnoides* Minichev, 1977 (Eoscapandridae). The emended diagnoses of *Cylichna* Lovén, 1846 and *Cylichnoides* are provided.

Резюме. *Cylichna inflata* **sp. nov.** описана по девяти экземплярам, собранным в 1931 г. из Татарского пролива (север Японского моря) с глубины 69 м. Новый вид отличается от других видов рода морфологией раковины, радулы, пластинок гизарда, а также наличием семенного пузырька в копулятивном аппарате. Пропорции раковины *Cylichna inflata* **sp. nov.** имеют сходство с таковыми у видов рода *Cylichnoides* Minichev, 1977 (Eoscapandridae). Приведены уточненные диагнозы родов *Cylichna* Lovén, 1846 и *Cylichnoides*.

Key words: taxonomy, morphology, shell, crop, gizzard, copulatory apparatus, North-West Pacific, Gastropoda, Heterobranchia, Cephalaspidea, *Cylichna*, *Cylichnoides*, new species

Ключевые слова: таксономия, морфология, раковина, зоб, гизард, копулятивный аппарат, северо-западная Пацифика, Gastropoda, Heterobranchia, Cephalaspidea, *Cylichna*, *Cylichnoides*, новый вид

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Introduction

Heterobranch sea slugs of the genus *Cylichna* Lovén, 1846 (Gastropoda: Heterobranchia: Cylichnidae) are widely distributed all over the World Ocean (Adams, 1862; Watson, 1883; Streb, 1908). They inhabit soft silty deposits at dif-

ferent depths, from the intertidal zone (Martynov et al., 2006; Valdés, 2019) to the abyssal (Minichev, 1969). Most of species descriptions of *Cylichna* are based on shell morphology only (Reeve, 1855; Gould, 1859; Dall, 1889; Thiele, 1925; Lemche, 1948; Habe & Ando, 1985) but the descriptions of the radula and/or gizzard plates have

often been presented (Sars, 1878; Thompson, 1976; Bouchet & Warén, 1979; McLean & Gosliner, 1996; Behrens, 2004), as well as the descriptions of the genital structures of these molluscs (Bergh, 1901; Lemche, 1956; Minichev, 1977; Valdés & Camacho-Garcia, 2004; Valdés, 2008).

Only three species of the genus *Cylichna*, *C. alba* (T. Brown, 1827), *C. corticata* (Møller, 1842) and *C. toyamaensis* Habe, 1955, are known in the seas of Russia (*C. arctica* Minichev, 1977 is currently considered as a junior synonym of *C. alba*) (Chaban, 2004; Chaban & Martynov, 2006; Chaban & Chernyshev, 2013), which does not reflect the real species diversity. The collection of the Zoological Institute of the Russian Academy of Sciences (St Petersburg) contains a sample of specimens of *Cylichna* from the Sea of Japan that differ from the known species of the genus both in shell and soft body morphology. The aim of the study is to provide a detailed description of the morphology of these specimens, which are described herein as a new species for science.

Material and methods

The material was sampled during the expedition to the Tatar Strait (the Sea of Japan), June 1931, aboard the R/V “Rossinante” at a depth of 69 m using a trawl. All nine specimens were used for the examination of their external morphology under a Leica stereomicroscope. Two specimens were dissected. The penial apparatus of the studied specimens was mounted in glycerol and examined under a light microscope Leica DME. Buccal masses and shells were cleaned in hypochlorite solution for 20 min, then they were rinsed in distilled water, air-dried, mounted on an aluminum stub, and sputter-coated with platinum for examination using a scanning electron microscope (SEM; Quanta-250). Gizzard plates and some gizzard contents were also mounted on an aluminum stub for study under the SEM Quanta-250. The specimens were deposited at the Zoological Institute of the Russian Academy of Sciences, St Petersburg.

The following abbreviations are used: H – shell height; D – shell diameter; Lpl – length of a gizzard plate; ZIN – Zoological Institute of the Russian Academy of Sciences.

Taxonomy

Order Cephalaspidea

Superfamily Cylichnoidea

Family Cylichnidae

Genus *Cylichna* Lovén, 1846

Cylichna inflata sp. nov.

(Figs 1–3)

Holotype. Russia, Sea of Japan: northwestern part of Tatar Strait, 50°54'N 141°47'E, 69 m depth, silt and broken shells, 20.VI.1931, R/V “Rossinante”, station 68/36 (ZIN 63733).

Paratypes. Same data as for holotype, 8 specimens (2 specimens dissected) (ZIN 63734).

Diagnosis. Shell wide-oval; apex slightly oval; shell height up to 9.9 mm; D/H = 56–65%; periostracum yellow with bright brown band at ends of shell. Spiral sculpture of frequent shallow spiral grooves, ribs throughout shell. Digestive system with crop; gizzard plate length about 9.6% of shell height; inner side of gizzard plate (connecting with gizzard wall) slightly concave, outer surface (connecting with contents of gizzard) highly convex. Radula formula: (11–12) × 4:1:1:1:4; rachidian tooth without central depression. Male copulatory apparatus without differentiated penial sac but with seminal vesicle at end of prostate.

Description. *Shell* (Fig. 1) involuted wide-oval with one whorl visible; shell height up to 9.9 mm; D/H = 56–65%. (Holotype: shell height 8.3 mm, shell width 5.0 mm). Apex slightly oval; umbilicus closed. Aperture as long as shell, wider anteriorly, narrowing gradually at about one-fourth of its length. Outer lip thin, fragile; upper edge not extended or slightly extended beyond shell apex; lower edge rounded. Shell widest at mid-length. Columellar margin thickened; columella simple, without fold. Columellar umbilicus closed. Parietal callus very thin. Shell covered with faint growth lines, frequent shallow spiral grooves, ribs (Fig. 2D) throughout shell, 19–22 grooves per 1 mm shell surface. Periostracum yellow with bright brown band at ends of shell.

Anatomy. Radula formula (11–12) × 4:1:1:1:4. Rachidian teeth (Fig. 2B) broad, flattened, fan-shaped, without central depression, about 35 µm in width, with 14–16 sharp denticles. Innermost

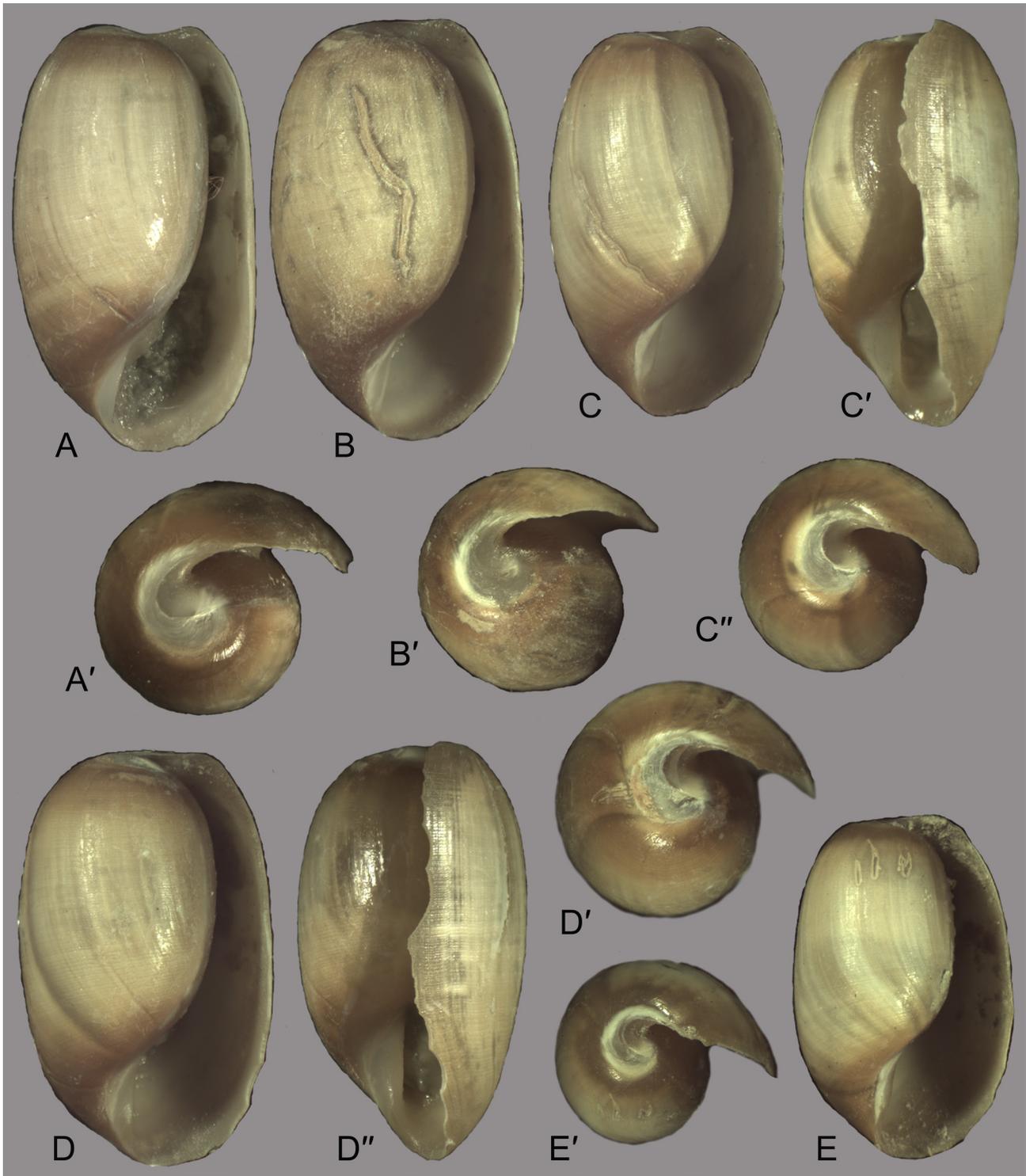


Fig. 1. *Cylichna inflata* sp. nov., shells. **A, A'**, paratype (H = 9.8 mm); **B, B'**, paratype (H = 8.9 mm); **C, C', C''**, paratype (H = 7.8 mm); **D, D', D''**, holotype (H = 8.3 mm); **E, E'**, paratype (H = 5.5 mm). **A, B, C, D, E**, ventral view; **A', B', C'', D', E'**, apical view; **C', D''**, lateral view.

lateral teeth (Fig. 2A) about 120 μm in length, with 9–10 well-developed sharp denticles. Four outermost hook-shaped teeth in each half-row

(Fig. 2C) with a narrow cusp 60–35 μm in length bearing numerous short denticles. Salivary glands short. Esophagus widened into thin-walled

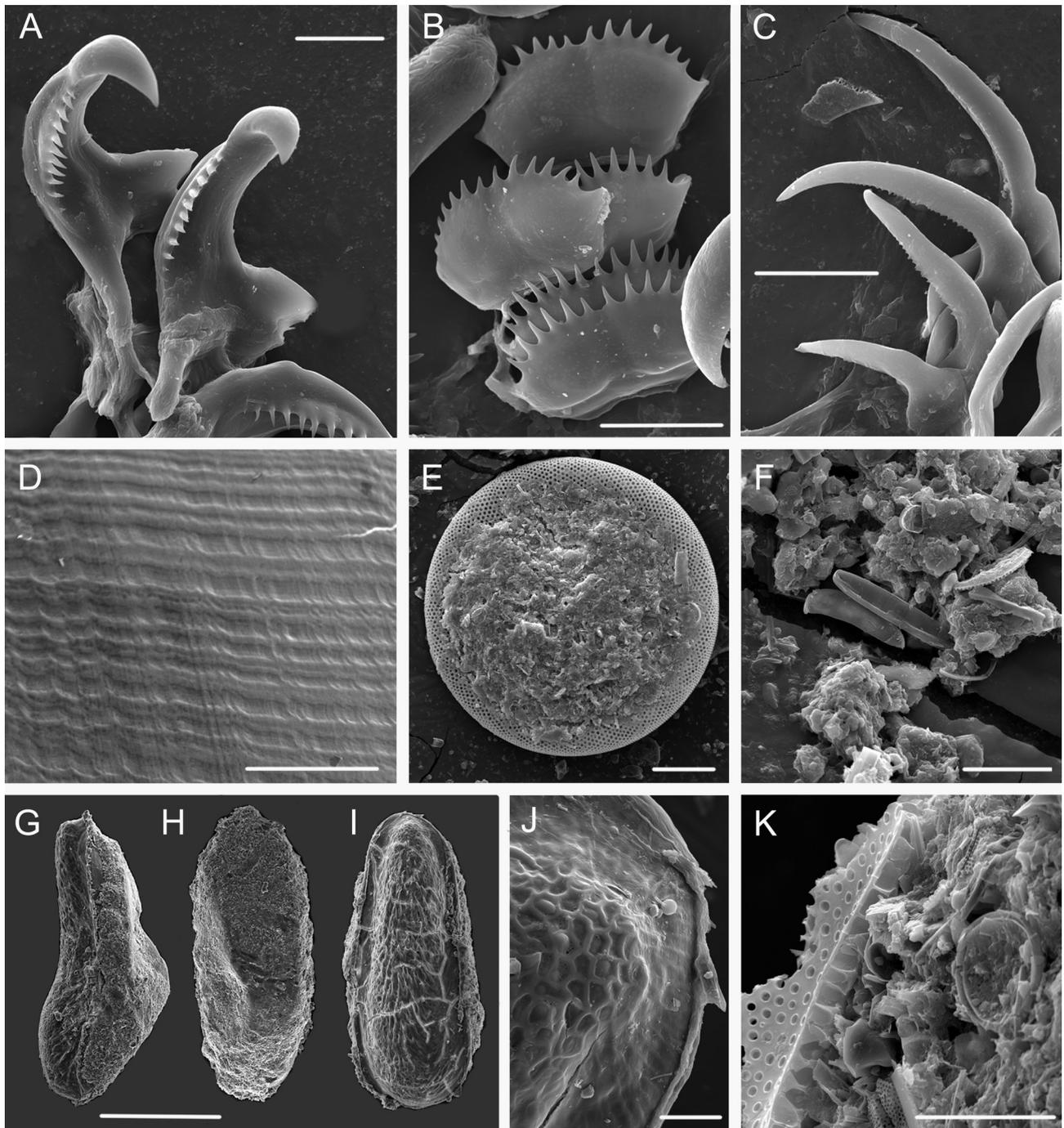


Fig. 2. *Cylichna inflata* sp. nov., morphology and gizzard content (SEM). **A**, lateral teeth; **B**, rachidian teeth; **C**, marginal teeth; **D**, shell sculpture; **E**, **F**, gizzard contents (diatom shells and detritus); **G–K**, gizzard plate (**G**, lateral view; **H**, outer side; **I**, inner side; **J**, microsculpture of inner surface; **K**, fragment of outer surface covered with fragments of diatoms and detritus). Scale bars: 25 μ m (**A**, **J**), 20 μ m (**B**, **C**, **F**, **K**), 250 μ m (**D**), 50 μ m (**E**), 400 μ m (**G**, **H**, **I**).

voluminous crop (Fig. 3A, B). Contents of crop clearly visible through its wall (Fig. 3A). Gizzard bearing three small gizzard plates located behind crop. Gizzard three times as large as crop. Plates

of 900–950 μ m long, 400 μ m wide, 400 μ m thick (for paratype with shell height 9.9 mm). Gizzard plate length about 9.6 % of shell height. Inner surface of gizzard plates slightly concave with a cell

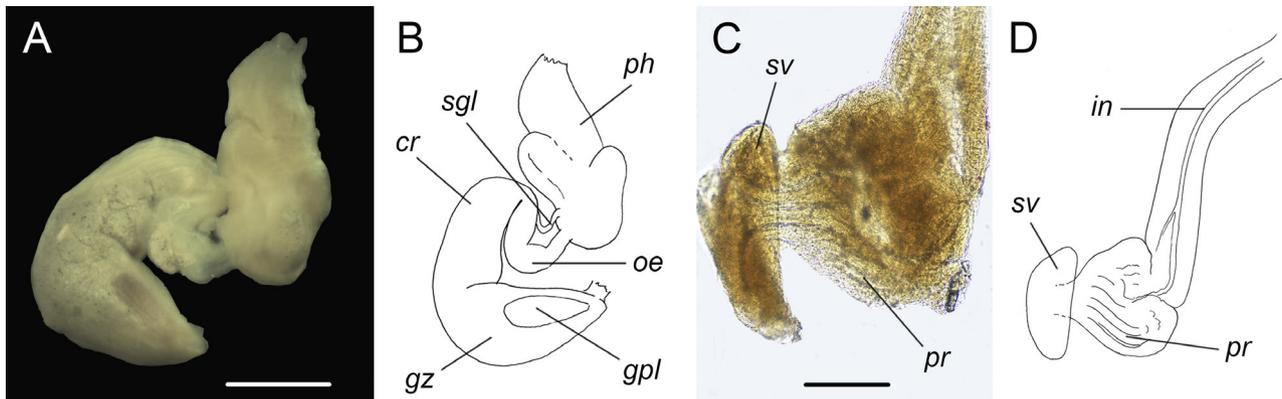


Fig. 3. *Cylichna inflata* sp. nov., anatomy (light microscopy). **A, B**, anterior portion of digestive system; **C, D**, male copulatory organs. Abbreviations: *cr* – crop, *gpl* – gizzard plate, *gz* – gizzard, *in* – incurrent seminal duct, *oe* – esophagus, *ph* – pharynx, *pr* – prostate, *sgl* – salivary gland, *sv* – seminal vesicle. Scale bars: 1 mm (A), 0.25 mm (C).

pattern of irregular polygons 8–10 μm in width. Outer surface of gizzard plates highly convex, covered with organic and non-organic matter (Fig. 2K). Copulatory apparatus including long narrow incurrent seminal duct, saccular prostate and well-differentiated seminal vesicle at end of prostate (Fig. 3C, D).

Etymology. The specific name is a Latin participle referring to the inflated shell outline of the new species.

Distribution. This species is known from the type locality only.

Bionomics. The specimens were collected on silty sediment and broken shells at a depth of 69 m and a bottom temperature of +0.3 $^{\circ}\text{C}$. The crop and gizzards dissected were filled with detritus, sand and diatoms.

Discussion

Cylichna inflata sp. nov. differs from most species of *Cylichna* in the wider shell outline. *Cylichna* sp. 3 sensu Valdés, 2008 (Valdés, 2008: fig. 37E, F) from the southwestern Pacific is also wide. However, its shell of 3.5 mm in length has a different apex and was considered a subadult specimen (Valdés, 2008). The shell of *C. consobrina* A. Gould, 1859 (Okutani, 2000: pl. 370, fig. 25) is narrower ($D/H = 0.49$) than in *C. inflata* sp. nov., additionally its spiral sculpture is irregular (deeper at the ends of shell) and has a columella with a small fold (Okutani, 2000: 745). The shell

of *C. corticata* is also narrower than in the new species ($D/H = 0.50$; Schiøtte & Warén, 1992: figs 2, 3) and has almost parallel sides. *Cylichna bulloidea* Dell, 1956 is another species with a very wide shell. It was described based on an empty shell from New Zealand. Both its shell outline and the characteristics of the longitudinal sculpture of the holotype (photo available online: *Cylichna*..., 2025; *Marine*..., 2025) suggest that *C. bulloidea* is a member of the family Haminoeidae. Dell (1956) has noted that the generic position of this species is tentative. *Cylichna inflata* sp. nov. differs from all species of *Cylichna* with studied morphology of the copulatory apparatus in the presence of the seminal vesicle.

On the other hand, *Cylichna inflata* sp. nov. has some similarities with *Cylichnoides occultus* (Mighels et C.B. Adams, 1842) (the type species of *Cylichnoides* Minichev, 1977), e.g. the wide oval shell outline. The shells of *Cylichnoides occultus* have the same spiral sculpture and H/D ranging from 1.58 to 1.78 (Minichev, 1977) as in *Cylichna inflata* sp. nov. (Table 1). However, the gizzard plates of *Cylichnoides occultus* are large ($Lpl/H = 29\%$), whereas the plates of *Cylichna inflata* sp. nov. are very small ($Lpl/H = 8\text{--}9\%$), as are those of *Cylichna alba* and *Cylichna cylindracea* (Pennant, 1777) (Table 2). The diagnosis of the genus *Cylichnoides* is mostly based on the penial morphology (Minichev, 1977; Chaban, 2016). It should be noted that the male copulatory apparatus of *Cylichna inflata* sp. nov. differs

Table 1. Dimensions of shells of *Cylichna inflata* sp. nov. (in mm).

| n | H (mm) | D (mm) | D/H | H/D | L pl (mm) | Lpl/H (%) | Type status |
|----|--------|--------|------|------|-----------|-----------|-------------|
| 1 | 9.8 | 5.5 | 0.56 | 1.78 | | | paratype |
| 2* | 9.9 | 5.5 | 0.56 | 1.80 | 0.95 | 9.6 | paratype |
| 3 | 8.9 | 5.3 | 0.60 | 1.68 | | | paratype |
| 4 | 7.8 | 4.8 | 0.62 | 1.63 | | | paratype |
| 5 | 8.3 | 5.0 | 0.60 | 1.66 | | | holotype |
| 6 | 5.5 | 3.6 | 0.65 | 1.53 | | | paratype |
| 7 | 5.8 | c. 3.7 | – | – | | | paratype |
| 8 | c. 6.0 | – | – | – | | | paratype |
| 9* | 8.4 | – | – | – | | | paratype |

* Dissected specimens.

from both *Cylichna cylindracea* (the type species of *Cylichna*), and *Cylichnoides occultus* (Table 2). Obviously, the taxonomical position of *Cylichna inflata* sp. nov. within the superfamily Cylichnoidea requires clarification, because at present these two genera belong to the different families: *Cylichna* to Cylichnidae, and *Cylichnoides* to Eoscapandridae (Siegwald et al., 2022). The problem is that the family Eoscapandridae includes such different genera as *Eoscapander* T. Habe,

1952 with two gizzard plates (Chaban & Kijashko, 2016) and *Cylichnoides* with three gizzard plates (Minichev, 1977). The diagnosis of the family Eoscapandridae (according to Siegwald et al., 2022) does not allow a clear delineation of *Cylichna* and *Cylichnoides* and their diagnoses need further clarification. However, there are clear differences in morphology of the digestive system of these two genera. Lemche (1956) noted that the esophagus of *Cylichna cylindracea* widens into a large cavity, proventriculus. The first part of the proventriculus is a thin-walled crop and the second part of it is a muscular gizzard containing three gizzard plates. This also is known for *Cylichna alba* (see Lemche, 1956) and *Cylichna lemchei* Bouchet et Warén, 1979 (Bouchet & Warén, 1979, fig. 16A). On the

other hand, *Cylichnoides occultus* (Lemche, 1956; as *Cylichna occulta*) lacks a crop (Lemche, 1956; Table 2). In our opinion, the presence of the crop in *Cylichna cylindracea* and its absence in *Cylichnoides occultus* is the most valuable and distinctive diagnostic difference between *Cylichna* and *Cylichnoides*. Based on the morphology of the digestive system, we consider that *Cylichna inflata* sp. nov. belongs to the genus *Cylichna* (the family Cylichnidae).

Table 2. Comparison of morphology of *Cylichna* spp. (Cylichnidae) and *Cylichnoides occultus* (Eoscapandridae).

| Species | Radula formula | Parts of proventriculus | Lpl (mm) | Lpl/H (%) | Prostate | Penial sac | References |
|----------------------------------|----------------|-------------------------|----------|-----------|----------------------|------------|--|
| <i>Cylichna cylindracea</i> | 3:1:1:1:3 | crop and gizzard | 0.50 | 8–9 | saccular | absent | Lemche, 1956 |
| <i>Cylichna alba</i> | 5–6:1:1:1:5–6 | crop and gizzard | 1.00 | 8–9 | saccular | absent | Lemche, 1956; Minichev, 1977 |
| <i>Cylichna arctica</i> * | 4:1:1:1:4 | crop and gizzard? | 0.50 | <11 | saccular | absent | Minichev, 1977 |
| <i>Cylichna inflata</i> sp. nov. | 4:1:1:1:4 | crop and gizzard | 0.95 | 9.6 | with seminal vesicle | absent | this study |
| <i>Cylichnoides occultus</i> | 2:1:1:1:2 | gizzard only | 2.50 | 25 | saccular | present | Lemche, 1956; Minichev, 1977; Chaban, 2016 |

* Currently considered a junior synonym of *C. alba* (see text).

Based on this discussion, the refined diagnoses of the genera *Cylichna* and *Cylichnoides* are provided herein.

Genus *Cylichna* Lovén, 1846

Diagnosis (after Valdés, 2008, emended). Shell external, oval to elongate, with involuted spire; aperture longitudinal, mostly as long as shell, anteriorly rounded; columella simple. Copulatory apparatus without penial sac; penis unarmed; prostate sac-like with/or without seminal vesicle. Proventriculus consisting of thin-walled crop and gizzard. Gizzard with three simple oval small gizzard plates (ratio of gizzard plate length to shell height no more than 10–11%). Radula formula 3–7:1:1:1:3–7.

Family **Eoscapandridae**

Genus *Cylichnoides* Minichev, 1977

Diagnosis (after Chaban, 2016, emended). Shell external, wide, oval, with involuted spire; aperture longitudinal, mostly as long as shell, anteriorly rounded; columella simple. Copulatory apparatus with penial sac; penis unarmed; prostate sac-like; seminal vesicle absent. Proventriculus consisting of muscular gizzard. Gizzard with three simple oval large gizzard plates (ratio of gizzard plate length to shell height ca. 25%). Radula formula 2:1:1:1:2.

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