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MUSTAFA EMRE GÜRLEK

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Three new truncatelloidean gastropod species from Turkey (Caenogastropoda: Littorinimorpha)

Mustafa Emre GÜRLEK*
Vocational School of Health Services, Mehmet Akif Ersoy University, Burdur, Turkey

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Abstract: New species of Bithyniidae (*Pseudobithynia adiyamanensis* **sp. nov.**), Hydrobiidae (*Pseudorientalia ceriti* **sp. nov.**), and Bythinellidae (*Bythinella yerlii* **sp. nov.**) are described from three different locations in Turkey. Samples were collected in 2013 and 2016 and the shell and male genital tract morphology of the new species were studied. All of these new taxa were compared to congeners that live in Turkey and adjacent countries.

Key words: *Pseudobithynia*, *Pseudorientalia*, *Bythinella*, Littorinimorpha, new species

1. Introduction

The family Bithyniidae Gray, 1857 is represented by two genera in Europe. These are *Bithynia* Leach, 1818 and *Pseudobithynia* Glöer & Pesic, 2006. In Turkey, this family is represented by nine species thus far. Seven of the species belong to the genus *Bithynia* and two to the genus *Pseudobithynia* (*Bithynia tentaculata* Linnaeus, 1758; *B. pseudemmericia* Schütt, 1965; *B. phialensis* Conrad, 1852; *B. badiella* Küster, 1852; *B. pesicii* Glöer & Yıldırım, 2006; *B. yildirimi* Glöer & Georgiev, 2012a; *B. timmii* Odabaşı & Arslan, 2015; *Pseudobithynia pentheri* (Sturany, 1904); and *P. yildirimi* (Odabaşı, Kebapçı & Akbulut, 2013). With this study, the number of *Pseudobithynia* species in Turkey has increased to three. Whether *B. badiella* actually occurs in Turkey is uncertain because this species was misinterpreted by Schütt (1983). He depicted the penis of this species as belonging to the genus *Bithynia*, while Glöer et al. (2012) described this species as *Pseudobithynia badiella*.

So far, the genus *Pseudorientalia* Radoman, 1973 has been found in northwestern Turkey, Greece, and Samos Island (in the Aegean Sea). Radoman (1973) described *Paludina natolica* (Küster, 1852) as *Pseudorientalia natolica*, found in NW Turkey at 'Bursa, Gemlik, Vedelek village, Pinar Basa (in Turkish: Pınarbaşı) spring and two springs of Inkaya 6 km West of Bursa' (Radoman, 1983). We looked at the recent studies and found that Glöer and Georgiev (2012b) described the new species as '*Pseudorientalia tzekovi*' from N Greece at 'Kefalari village of thermal spring at fish tank near Drama town'; Szarowska et al. (2014) recorded the genus from Samos Island. However, while morphological data confirmed the genus as *Pseudorientalia*, molecular data did not.

The family Bythinellidae Kobelt, 1878 has one genus, namely *Bythinella* Moquin-Tandon, 1856. Members of this genus are known to have conical, cylindrical-conical, or ovoid shells (Radoman, 1983). The genitalia are characterized by a penial appendix with a flagellum in the male (Glöer and Pesic, 2010). This genus shows wide distribution from Central Europe to East Europe, Ukraine and Turkey, and North Africa to the Iberian Peninsula (Yıldırım et al., 2015). In Turkey, eight species have been described to date: *Bythinella opaca* Gallenstein, 1848; *B. turca* Radoman, 1976; *B. occasiuncula* Boeters & Falkner, 2001; *B. kazdaghensis* Odabaşı & Georgiev, 2014; *B. anatolica* Yıldırım, Kebapçı & Bahadır Koca 2015; *B. istanbulensis* Yıldırım, Kebapçı & Yüce 2015; *B. magdalenae* Yıldırım, Kebapçı & Bahadır Koca 2015; and *B. wilkei* Yıldırım, Kebapçı & Bahadır Koca 2015 (Yıldırım et al., 2015). Among these species, the presence of *B. opaca* Gallenstein, 1848 was accepted by Schütt (1965), but he later refuted that acceptance (Schütt, 1980); thus, the taxonomic situation of this species remains uncertain.

In this paper, *Pseudobithynia adiyamanensis* **sp. nov.**, *Pseudorientalia ceriti* **sp. nov.**, and *Bythinella yerlii* **sp. nov.** are described from Balıkesir, Kahramanmaraş, and Adıyaman provinces of Turkey.

* Correspondence: malacoturk@gmail.com

2. Materials and methods

Field studies were done at three sampling sites in Turkey (Figure 1). All localities are spring waters with a small flow (Table 1; Figure 2). Snails were collected from stones and water plants, then preserved in plastic tubes with 80% ethanol. Dissections and measurements of the shells and genital organs were carried out using a stereomicroscope (Olympus SZX7), and photographs were taken with a digital camera system (Olympus DP26).

The holotype and some paratypes are stored in the Zoological Museum of Hacettepe University (HUZOM), while others are deposited in the private collection of the author (coll. Gürlek, Mehmet Akif Ersoy University, Turkey).

3. Results and discussion

Family: Bithyniidae Gray, 1857

Genus: *Pseudobithynia* Glöer and Pesic, 2006

***Pseudobithynia adiyamanensis* sp. nov.**

Holotype: Shell height 8.5 mm, width 6.4 mm, from type locality in HUZOM-M1103.

Paratypes: 1 specimen from type locality in HUZOM-M1104.

Additional material examined: 8 ex. from type locality, 1 specimen in coll. Gürlek (Mehmet Akif Ersoy University, Turkey).

Type locality: Adıyaman-Çelikhan mirsuyu (Beypınar) spring water, 5 km Çelikhan to Adıyaman. 37°59′56.61″N, 38°13′06.73″E, 1281 m a.s.l., 14.9.2013.

Etymology: Named after the province where the species was found.

Description: Shell horn-colored, conical, with 5–5.5 whorls slightly rounded with deep suture (Figure 3A). Umbilicus closed. Aperture is ovate and angled at the top. Minimum shell height 5.6 mm and shell width 3.72 mm; maximum shell height 8.5 mm and shell width 6.4 mm (Table 2).

Soft parts: Mantle dark-colored and eyes clearly visible. Snout wide, tentacles long and slightly pigmented. Penis dark-colored and wide, simple without flagellum or appendix, with wrinkles on its proximal part (Figure 3B).

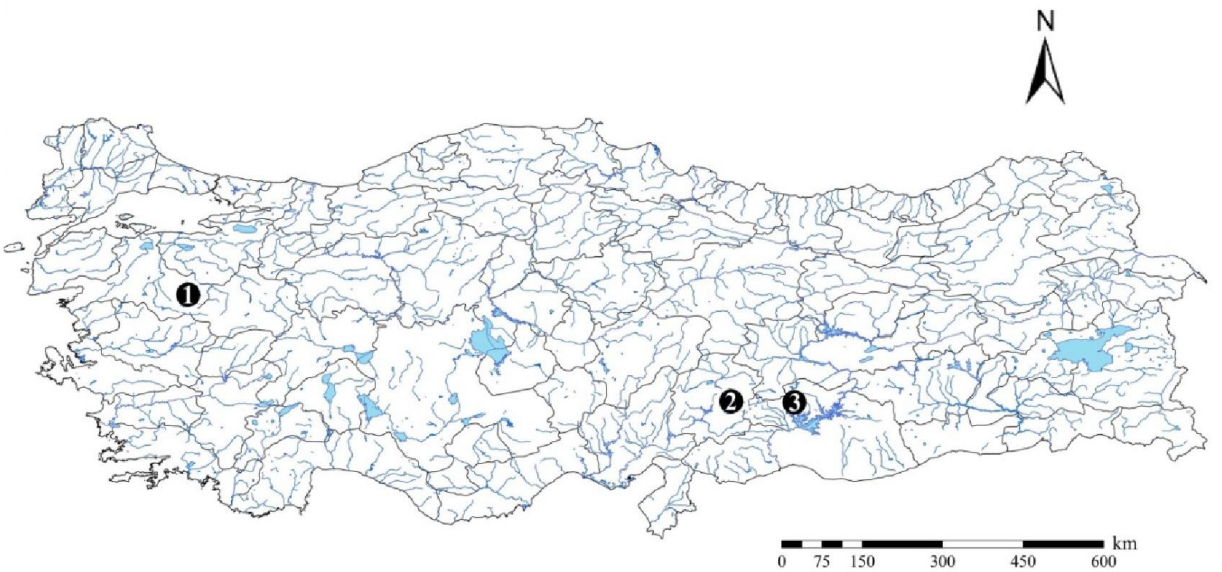

Figure 1. Map of the sampling sites. 1- Balıkesir, Dursunbey, Osmaniye village. 2- Kahramanmaraş, Çağlayancerit. 3- Adıyaman, Çelikhan Mirsuyu.

Table 1. Characteristics of localities.

Site code	Locality name	Habitat types	Coord. X	Coord. Y	Altitude (m)
1	Balıkesir-Dursunbey-Osmaniye village	Natural spring water	39.4520750	28.7051720	613
2	Kahramanmaraş-Çağlayancerit	Natural spring water with channel	37°44′32.56″	37°16′31.62″	1163
3	Adıyaman-Çelikhan	Natural spring water with channel	37°59′56.61″	38°13′06.73″	1281

Figure 2. Habitat of new species. A- *Pseudobithynia adiyamanensis* **sp. nov.** B- *Pseudorientalia ceriti* **sp. nov.** C- *Bythinella yerlii* **sp. nov.**

Table 2. Measurements of some shell characters of *Pseudobithynia adiyamanensis* **sp. nov.**

(mm) N = 4	Shell height (SH)	Shell width (SW)	Aperture height (AH)	Aperture width (AW)
Min	5.6	3.72	3.1	2.6
Max	8.5	6.4	4.26	3.29
Average ± SE	6.45 ± 1.14	4.54 ± 1.26	3.49 ± 0.52	2.84 ± 0.3

Remarks: The sampling site of *Pseudobithynia adiyamanensis* **sp. nov.** was a typical small spring named Mirsu in Adıyaman Province, with sparse vegetation and stony areas. *Pseudobithynia adiyamanensis* **sp. nov.** shares its habitat with *Lymnaea stagnalis*, *Galba truncatula*, *Planorbis planorbis*, *Gyraulus* sp., and *Oxyloma elegans* (Gürlek and Kara, 2016).

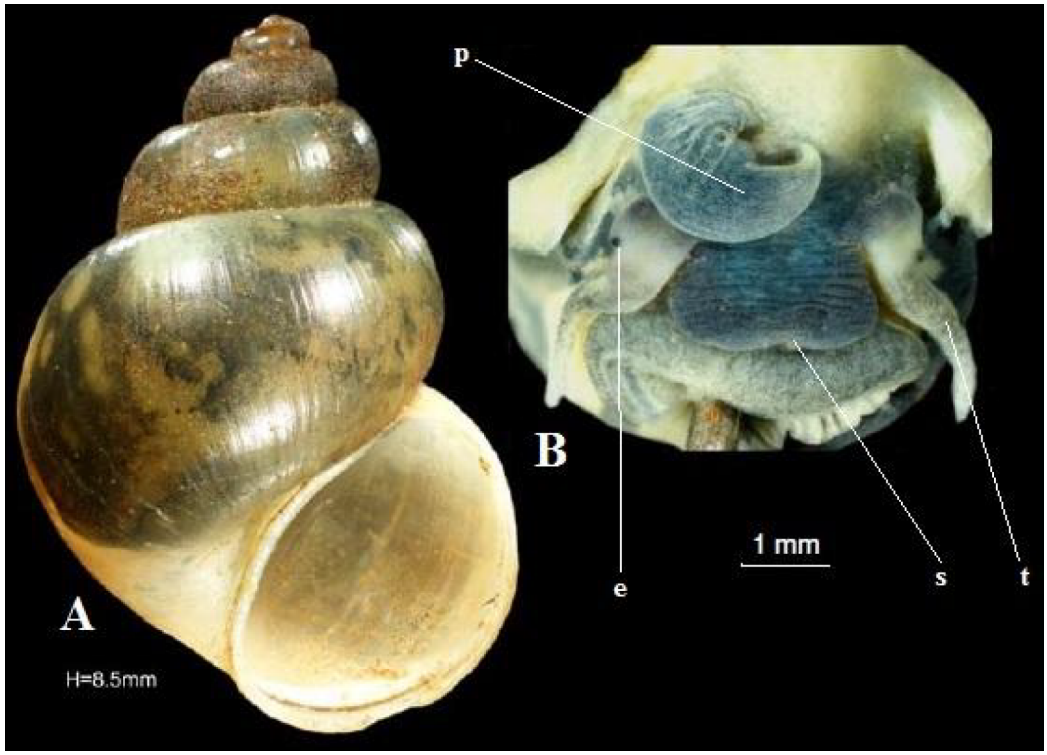

Figure 3. A- Shell of *Pseudobithynia adiyamanensis*. B- Penis in situ. Abbreviations: e = eye spot, p = penis, s = snout, t = tentacle.

Family: Hydrobiidae Stimpson, 1865

Genus: *Pseudorientalia* Radoman, 1973

***Pseudorientalia ceriti* sp. nov.**

Holotype: Shell height 1.54 mm, width 0.72 mm, from type locality. HUZOM-M1105.

Paratypes: 5 specimens from type locality in HUZOM-M1106.

Additional material examined: 24 ex. from type locality, 15 specimens in coll. Gürlek (Mehmet Akif Ersoy University, Turkey).

Type locality: Kahramanmaraş-Çağlayancerit, near 'şelale göz lokantası', 3 km Çağlayancerit to Kahramanmaraş. 37°44′32.56″N, 37°16′31.62″E, 1163 m a.s.l., 8.7.2013.

Etymology: Named after the town (Çağlayancerit = Cerit) where the new species was collected.

Description: Ovoid whitish shell with 4–4.5 whorls, pointed apex, and deep sutures. Aperture high and angular at the top. Umbilicus semiopen and slitlike, outer lip thin and straight (Figure 4A). Operculum orange. Minimum shell height 1.36 mm and shell width 0.85 mm; maximum shell height 1.83 mm and shell width 1.2 mm (Table 3).

Soft parts: Snout dark-colored. Penis long, pointed at the tip, wide at proximal part, and warped to the distal part. The distal part of the penis black (Figure 4B).

Remarks: Natural spring water and small waterfalls. Material collected on the stones and aquatic plants.

Family: Bythinellidae Kobelt, 1878

Genus: *Bythinella* Moquin-Tandon, 1856

***Bythinella yerlii* sp. nov.**

Holotype: Shell height 1.35 mm, width 0.54 mm; from type locality in HUZOM-M1107.

Paratypes: 5 specimens from type locality in HUZOM-M1108.

Additional material examined: 43 ex. from type locality, 5 specimens in coll. Gürlek (Mehmet Akif Ersoy University, Turkey).

Type locality: Balıkesir-Dursunbey to Osmaniye village 28 km (south of Dursunbey). N 39.426192 E 28.723969, 613 m a.s.l., 5.10.2016.

Etymology: Named after Prof Dr Sedat V Yerli (Hydrobiology Department, Hacettepe University, Turkey), an outstanding expert on freshwater fish biology.

Description: Shell cylindrical-conical and having 3–3.5 whorls and changes from yellowish to whitish. Aperture ovoid, sutures deep, apex blunt. Umbilicus slitlike (Figure 5A). Minimum shell height 1.56 mm and shell width 0.9 mm; maximum shell height 1.96 mm and shell width 1.11 mm (Table 4).

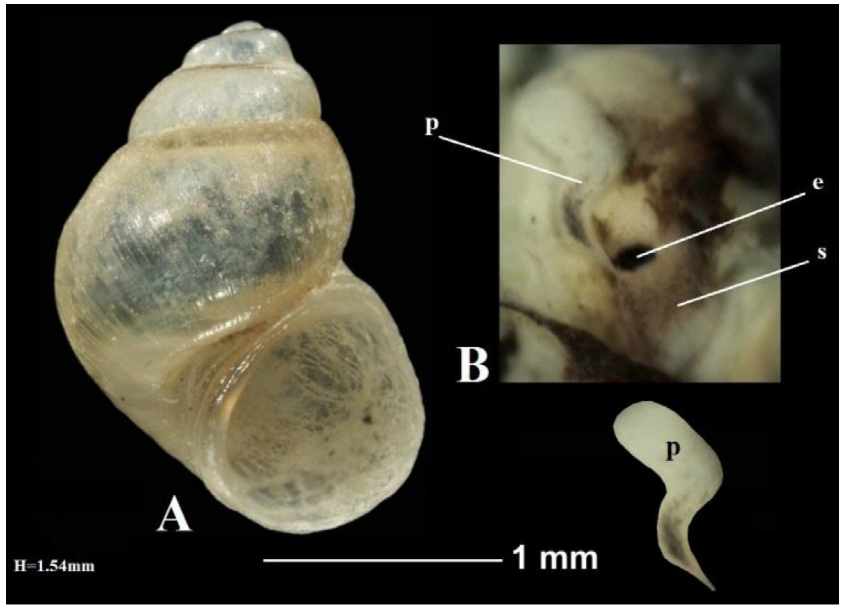

Figure 4. *Pseudorientalia ceriti* **sp. nov.** A- Shell of holotype, B- penis in situ. Abbreviations: p = penis, e = eye spot, s = snout.

Table 3. Measurements of some shell characters of *Pseudorientalia ceriti* **sp. nov.**

(mm) N = 10	Shell height (SH)	Shell width (SW)	Aperture height (AH)	Aperture width (AW)
min	1.36	0.85	0.5	0.32
max	1.83	1.2	0.96	0.78
Average ± SE	1.62 ± 0.16	1.01 ± 0.11	073 ± 0.15	0.54 ± 0.18

Soft parts: Head black, tentacles unpigmented and short. Eyes are clearly visible. Penis unpigmented and shorter than the penial appendix (Figure 5B).

Remarks: Natural spring and small outflow. Material collected on stones and aquatic plants.

The new species, *Pseudobithynia adiyamanensis* **sp. nov.**, differs from the other *Pseudobithynia* species of Turkey. First, it can be distinguished from *P. yildirimi* by its longer shell and number of whorls. The shell is between 2.35 and 5.5 mm high and has 4.5 clearly stepped whorls (Odabaşı et al., 2013). *Pseudobithynia adiyamanensis* **sp. nov.** is more conical than *P. pentheri* and *P. yildirimi* and has a blunter shell apex than *Pseudobithynia adiyamanensis* **sp. nov.** It has 5–5.5 whorls with deep sutures. Both species show a swelling in the middle of the penis. The shell shape of *Pseudobithynia adiyamanensis* **sp. nov.** is similar to *Pseudobithynia hamicensis*, but they are distinguished from each other by penis morphology. The penis of *Pseudobithynia adiyamanensis* **sp. nov.** is darker and wider in the proximal part than that of *P. hamicensis*. The distal part of the *Pseudobithynia adiyamanensis* **sp. nov.** penis is also longer (Glöer et al., 2012).

Pseudorientalia ceriti **sp. nov.** can easily be distinguished by penis shape. Although *Pseudorientalia ceriti* has a warped penis, those of *P. natolica* (Küster, 1852) and *P. tzekovi* (Glöer and Georgiev, 2012b) are more awl-like. The umbilicus of the *Pseudorientalia ceriti* is semiopen and slitlike, while that of *P. tzekovi* is closed. With this study, there is a second new species belonging to this genus described from Turkey. Apart from this species, *P. tzekovi* was described from Greece and Szarowska et al. (2014) recorded the genus from Samos Island, but it has not been confirmed by molecular methods. As mentioned by Glöer and Georgiev (2012a), more species of this genus could be found in both regions.

Bythinella yerlii **sp. nov.** is separated from *Bythinella kazdaghensis*, *Bythinella anatolica*, *Bythinella istanbulensis*, *Bythinella magdalenae*, and *Bythinella wilkei* by its ovoid aperture shape. These five species have more angular apertures. The penises of *B. anatolica*, *B. magdalenae*,

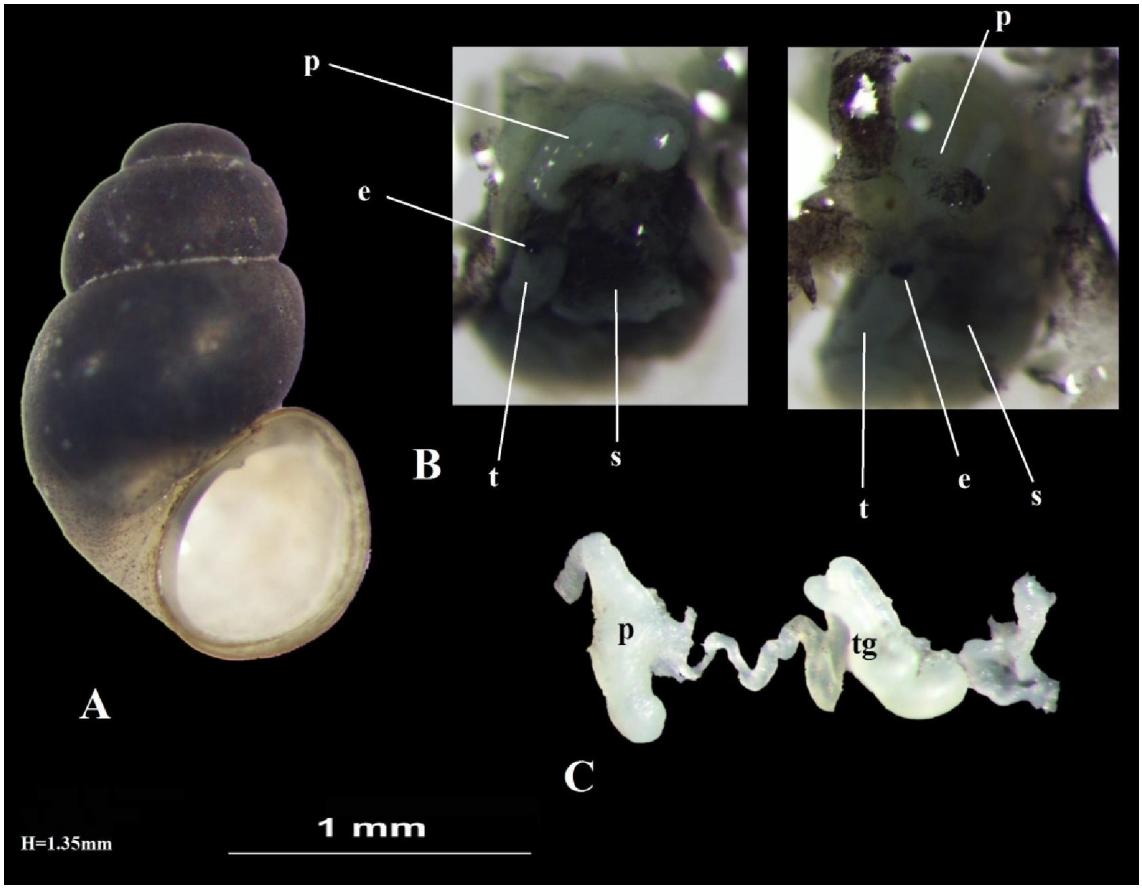

Figure 5. *Bythinella yerlii* **sp. nov.** A- Shell of holotype, B- penis in situ (two types of penis). C- Penis with tubular gland. Abbreviations: p = penis, e = eye spot, s = snout, t= tentacle, tg = tubular gland.

Table 4. Measurements of some shell characters of *Bythinella yerlii* **sp. nov.**

(mm) N = 10	Shell height (SH)	Shell width (SW)	Aperture height (AH)	Aperture width (AW)
min	1.56	0.9	0.69	0.5
max	1.96	1.11	0.97	0.82
Average ± SE	1.76 ± 0.13	0.99 ± 0.07	0.83 ± 0.1	0.64 ± 0.11

and *B. wilkei* get thinner toward the tip, but the penis of *Bythinella yerlii* **sp. nov.** is wide at the tip.

Turkey is one of the main fields of Prosobranchia speciation and the rate of endemism is very high (Yıldırım et al., 2006). Description of new species is very important for conservation of wetland habitats. In particular, when hydrobiids that prefer clean waters are protected, this will ensure the preservation of habitats.

Nomenclatural acts: This work and the nomenclatural acts it contains have been registered in ZooBank. The ZooBank Life Science Identifier (LSID) for this publication is: http://zoobank.org:pub:51A0FCDC-8AA1-4770-AE7E-27EAB961AFA0

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