

New species of freshwater molluscs from Gökçeada (northeastern Aegean Sea), Turkey (Gastropoda: Hydrobiidae, Bythinellidae)

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Abstract. For centuries, scientists have been inspired by island ecosystems in terms of their biodiversity and physical environment. Because freshwater and terrestrial ecosystems of the Aegean Islands have undergone processes of formation and geographical isolation differentiating them from the adjacent mainland, they have attracted many scientists. Although several papers describing the freshwater molluscs of these islands have been published, there is no such study about the Turkish islands of Gökçeada and Bozcaada located in the northern Aegean Sea. This study describes the diversity of the freshwater mollusc fauna of Gökçeada. Sampling of freshwater snails by kick-net and hand-collection was carried out throughout the island, covering diverse habitats including fountains, streams, and artificial ponds. The findings include the first records of *Dreissena polymorpha* and *Pisidium subtruncatum* from Gökçeada and the invasive gastropod *Physella acuta*. Furthermore, we present descriptions of the anatomy and shells of four new species of freshwater snails: *Pseudamnicola cirikorum* sp. n., *Pseudamnicola radeae* sp. n., *Grossuana kayrae* sp. n., and *Bythinella gokceadaensis* sp. n. We compare these new species (except *G. kayrae* sp. n.) with previously described congeners from the Sporades, mainland Greece, and western Turkey. Because *Grossuana* had previously not been recorded from Turkey, *G. kayrae* is compared with Greek and Balkan (southwestern Thrace) *Grossuana* species.

Key words. *Bythinella*, *Grossuana*, *Pseudamnicola*, new records, distribution, island endemics.

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Introduction

Investigations of the freshwater gastropods of Turkey have increased in number, especially within the last 2 decades. Substantial contributions have been made from various regions of Turkey (SCHÜTT & YILDIRIM 2003, GLÖER & GEORGIEV 2012, KEBAPÇI et al. 2012, KOŞAL-ŞAHİN et al. 2012, GLÖER et al. 2014, 2015, ODABAŞI & GEORGIEV 2014, GLÖER et al. 2015, GLÖER & PEŠIČ 2015, GÜRLEK 2017, 2019a, b, YILDIRIM et al. 2017), revealing a striking biodiversity of freshwater gastropods in Asia Minor. Nevertheless, more research is needed to describe the biodiversity and zoogeography effectively. Most research effort has largely been focused on the freshwater ecosystems of the Turkish mainland, while information regarding the islands in the northern Aegean Sea, especially Bozcaada and Gökçeada, has been completely lacking. Freshwater gastropods from the Greek islands in the Aegean Sea have been recorded since

the 19th century (CLESSIN 1878a, b, BOETTGER 1889, SCHÜTT 1980, REISCHÜTZ et al. 2008). Recent studies, including descriptions of new species, have contributed to our knowledge of the distributions of freshwater molluscs from insular Greece (GLÖER et al. 2010, 2018, ALBRECHT et al. 2012, FALNIOWSKI et al. 2012, GLÖER & GEORGIEV 2012, RADEA et al. 2013a, b, SZAROWSKA et al. 2014, 2016a, b, GEORGOPOULOU et al. 2016).

Most Aegean islands are of continental origin, but some belong to the South Aegean Volcanic Arc (KOUGIOUMOUTZIS et al. 2017). In the Aegean basin, some of the islands attained their present configuration c. 8 ka ago, including the island of Gökçeada (KOUGIOUMOUTZIS et al. 2017 and references therein).

Gökçeada, also called İmbros or İmroz, is located in the northeastern Aegean Sea, north-west of the opening to the Çanakkale Boğazı (the Dardanelles). With a coastline of 92 km and an area of 289 km², Gökçeada is the largest island in Turkey. The island has important

potential as a source of freshwater due to its relatively high precipitation. The average annual rainfall on the island over the last 3 decades is 740 mm (CENGİZ et al. 2013), while the adjacent mainland receives considerably less, 574 mm per year over the last decade (<https://www.mgm.gov.tr/veridegerlendirme/yillik-toplam-yagis-verileri.aspx>, accessed 26.iii.2019).

Recent scientific publications reported several freshwater gastropod species from the Aegean islands. *Pseudamnicola negropontina* (Clessin, 1878), *P. brachia* (Westerlund, 1886), *P. pieperi* Schütt, 1980, and *P. chia* (E. von Martens, 1889) are known from the islands of Evvoia, Crete, Karpathos, and Chios, respectively (SCHÜTT 1980, BANK 2004). RADEA et al. (2016), added *P. ianthe* and *P. ilione* from Rhodes. *Pseudamnicola limnosensis* Glöer, Stefanov & Georgiev, 2018, *P. magdalenae* Falniowski, 2016, and *P. occulta* Glöer & Hirschfelder, 2019 were recorded from Limnos, Kithira, and Crete, respectively (FALNIOWSKI 2016, RADEA et al. 2016, SZAROWSKA et al. 2016b, GLÖER et al. 2018, GLÖER & HIRSCHFELDER 2019). In Turkey, 13 species of *Pseudamnicola* have been recorded. SCHÜTT & BILGİN (1970) described *P. natolica smyrnensis* from the province of İzmir and *P. geldiyana* from the province of Denizli (the most western records of the genus in Turkey). *Pseudorientalia* sp. and *Islamia bendidis* Reischütz, 1988 were the only representatives of their genera on the islands of Samos (SZAROWSKA et al. 2014) and Samothrace, respectively (REISCHÜTZ 1988).

Additionally, 6 *Bythinella* species were recorded from various islands: *B. kosensis* Schütt, 1980, *B. cretensis* Schütt, 1980, *B. charpentieri* (Roth, 1855), *B. walensae* Falniowski, Hofman & Rysiewska, 2016, *B. magdalenae* Glöer & Hirschfelder, 2019, and *B. sitiensis* Glöer & Hirschfelder, 2019 (SCHÜTT 1980, FALNIOWSKI et al. 2016, GLÖER & HIRSCHFELDER 2019). Until now, 8 species of *Bythinella* were recorded from Turkey. These species mostly occur in provinces of western Anatolia: *Bythinella turca* Radoman, 1976 from Isparta (YILDIRIM, 1999), *B. occasiuncula* Boeters & Falkner, 2001 from İzmir (YILDIRIM et al. 2015), *B. kazdagensis* Odabaşı & Georgiev, 2014 from Çanakkale (Odabaşı & Georgiev, 2014), and the recently described *B. anatolica*, *B. istanbulensis*, *B. magdalenae*, and *B. wilkei* Yıldırım, Kebapçı, Bahadır Koca & Yüce, 2015 from Manisa, İstanbul, Aydın, and Kocaeli, respectively (YILDIRIM et al. 2015). Additionally, *B. yerlii* Gürlek, 2017 was also recorded from the vicinity of Dursunbey in Balıkesir (GÜRLEK 2017).

Although there have been several records of *Grossuana* from the Balkans, including from Bulgaria and continental and insular Greece, there has been no record from Turkey. *Grossuana avandasensis*, *G. stenaensis*, *G. sidironerensis* Glöer, Reuselaars & Papavasileiou, 2018, and *G. marginata* (Westerlund, 1881) were recorded from southwestern Thrace (Greece), central Greece and the island of Evvoia, respectively (GLÖER et al. 2018).

Grossuana thracica and *G. angelskovi* Glöer & Georgiev, 2009 were recorded from southern Bulgaria (GLÖER & GEORGIEV 2009, GEORGIEV & GLÖER 2013, GEORGIEV et al. 2015).

In this study some accessible groundwater fountains and surface water bodies, including ponds and streams, were sampled to investigate the freshwater mollusc diversity on the island of Gökçeada. Four new species, belonging to the genera *Bythinella*, *Grossuana*, and *Pseudamnicola*, are described.

Materials and Methods

In order to record the freshwater mollusc fauna of the island of Gökçeada, we investigated a variety of freshwater bodies such as springs, fountains, brooks, and reservoirs between May 2016 and September 2018. The island has 4 small ponds and 1 reservoir, which supply drinking water to the island's residents. In addition, some temporary streams occur on the island, such as Marmaros Deresi and the weakly flowing Ayatodoro Manastır Seep, which are located at the northern and western sides of the island, respectively. Fountains are very common all over the island and provide drinking water for human use and wildlife.

Freshwater snails were collected by hand or using a sieve (500 µm) and forceps at 18 pre-selected sampling stations (Sta. 1–18: Fig. 1, Table 1). The sampling stations are scattered over the island and comprise ponds, reservoirs, and fountains, and some ephemeral water bodies such as brooks and a seep. Stations numbered from 1 to 10 (Table 1) are fountains. Fountains made to supply drinking water for humans and animals are generally located along roads and are currently in use, while fountains which had formerly been used for washing clothes (the old laundries) are visited only by tourists nowadays. Some of these fountains harbour other macro-invertebrates co-occurring with molluscs, for instance gammariids, asellids, turbellarians, and hirudineas. Our still-water stations on the island are Aydıncık Göleti (Sta. 11), Gökçeada Barajı (12), Şahinkaya Göleti (13), Uğurlu Göleti (14), and Uğurlu Barajı (15). Only the littoral zone was sampled at these stations. Running-water stations are Marmaros Deresi (16), Marmaros Şelalesi (17), and Ayatodoro Manastır Seep (18). In the dry season, water levels at these stations are very low or they are dried up, and only dipterans were observed at stations 16 and 17. Station 18 is a seep from a fracture on a cliff above the Ayatodoro Manastır (monastery), which is located on the eastern side of the island.

The snails were picked up individually with forceps and put into plastic tubes filled with 80% ethanol. Shell height (SH), shell diameter (SW), aperture height (AH), aperture width (AW) (Fig. 2) were measured on 8–24 shells of each species and site using a stereomicroscope (Zeiss Stemi 508) equipped with an imaging

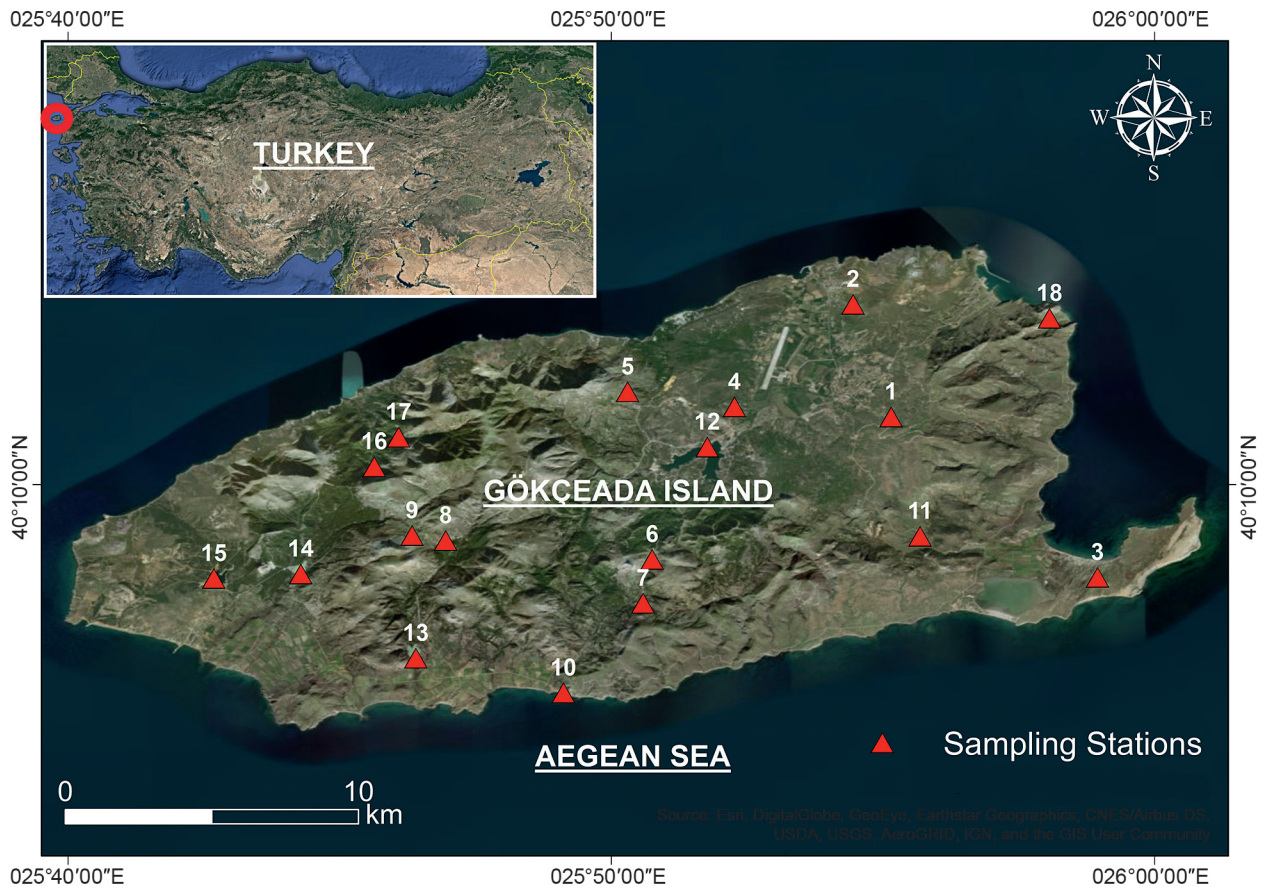


Figure 1. Sampling stations on Gökçeada (see also Table 1).

Table 1. Sampling stations with coordinates. Abbreviations of species collected: Bg = *Bythinella gokceadaensis*, Gk = *Grossuana kayrae*, Pc = *Pseudamnicola cirikarum*, Pr = *Pseudamnicola radeae*, Dp = *Dreissena polymorpha*, Pa = *Physella acuta*, Af = *Ancylus fluviatilis*, Ps = *Pisidium subtruncatum*.

No.	Name	Latitude (N)	Longitude (E)	Species collected
1	Börekçi Cafer Çeşmesi (fountain)	40°11'14.6"	025°55'09.0"	Bg
2	Bademli Çamaşırhanesi (laundry)	40°13'18.7"	025°54'27.5"	Gk
3	Aydıncık Burnu Çeşmesi (fountain)	40°08'17.7"	025°58'56.7"	Pr
4	Papaz Çeşmesi (fountain)	40°11'25.5"	025°52'15.5"	Pc
5	Pınarbaşı Çeşmesi (fountain)	40°11'42.3"	025°50'17.7"	Bg
6	Karayolları Çeşmesi (fountain)	40°08'37.4"	025°50'45.0"	Gk, Bg
7	Cugura Çeşmesi (fountain)	40°07'49.1"	025°50'35.2"	Bg
8	Fehim Akdemir Çeşmesi (fountain)	40°08'58.2"	025°46'56.9"	Bg
9	Dereköy Çamaşırhanesi (laundry)	40°09'03.7"	025°46'19.7"	Bg
10	Karakol Çeşmesi (fountain)	40°06'10.2"	025°49'06.6"	Bg, Gk
11	Aydıncık Göleti (pond)	40°09'03.1"	025°55'40.9"	—
12	Gökçeada Barajı (reservoir)	40°10'41.4"	025°51'46.3"	Dp, Pa
13	Şahinkaya Göleti (pond)	40°06'48.5"	025°46'23.7"	Dp, Pa
14	Uğurlu Göleti (pond)	40°08'21.3"	025°44'16.5"	—
15	Uğurlu Barajı (reservoir)	40°08'16.5"	025°42'41.3"	—
16	Marmaros Deresi (brook)	40°10'19.7"	025°45'38.3"	—
17	Marmaros Şelalesi (waterfall)	40°10'52.3"	025°46'04.6"	—
18	Ayatodoro Manastır Seep	40°13'03.4"	025°58'03.6"	Af, Ps

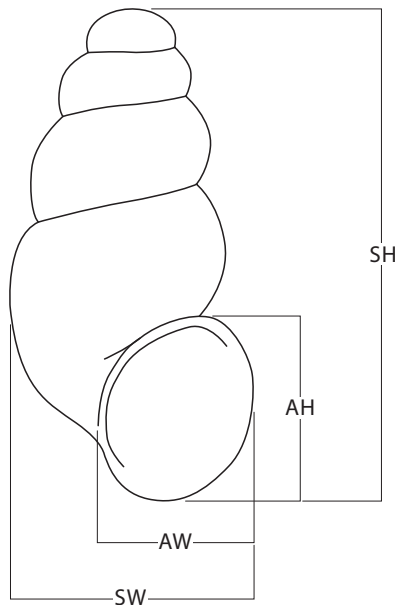


Figure 2. Shell measurements: SH = shell height, SW = shell width, AH = aperture height, AW = aperture width.

system (Axiocam 105 Color). The ratio SW/SH was also calculated. Whorls were counted following the method in GLÖER (2015: 24). For the anatomical investigations, at least 5 specimens were dissected for each species. Dissections of the male and female genital organs were made using a micro-dissecting needle under the stereomicroscope; photographs were taken with a digital camera system and processed with the focus-stacking technique using Adobe Photoshop CS6.

The material, including holotypes and paratypes, is deposited at the following museums in Turkey: Limnology Museum of Çanakkale Onsekiz Mart University, Çanakkale (COMULM), İstanbul University, Science Faculty, Hydrobiology Museum, İstanbul (IUSHM), and Faculty of Fisheries Museum of Ege University, İzmir (ESFM). All other material is deposited in the private collection of the second author (PCD).

Results

We collected *Bythinella gokceadaensis* at 7 stations (1, 5–10; Fig. 1, Table 1). *Pseudamnicola cirikorum* was collected at station 4, and *Pseudamnicola radeae* at station

3 (Fig. 1, Table 1). Specimens of *Grossuana kayrae* were collected at stations 2, 6 and 10 (Fig. 1, Table 1), which represent the first records for Turkey. *Dreissena polymorpha* and *Physella acuta* were sampled from the still waters of stations 12 and 13. Sampling station 18, seepage water generating a small aquatic habitat mostly covered with phytobenthic and organic material, is home for *Ancylus fluviatilis*, *Pisidium subtruncatum*, and some dipterans.

Taxonomic descriptions

Family Hydrobiidae Stimpson, 1865

Genus *Pseudamnicola* Paulucci, 1878

Type species: *Paludina macrostoma* Küster, 1853.

Pseudamnicola cirikorum sp. n. D.A. Odabaşı

Figure 3A–D

Type materials. All specimens from type locality, leg. Serpil Odabaşı & Deniz Anıl Odabaşı, 13.vii.2016.

Holotype: COMULM G0077. SH = 3.30 mm, SW = 2.64 mm, AH = 1.94 mm, AW = 1.55 mm.

Paratypes: All specimens dissected and deposited as fragmented parts: IUSHM 20191015-01 (2 specimens), ESFM GASI/2016-3 (2 specimens), PCD 20160713/3 (3 specimens).

Type locality. Turkey, Gökçeada, from Papaz Çeşmesi in Zeytinli village (Sta. 4, Table 1), in front of the house of the late Dr Foko.

Etymology. The species name is in honor of Prof. Dr Semra Cirik and Prof. Dr Şükran Cirik, who have made many significant contributions to the limnology and marine biology in Turkey.

Description. Shell conical, with 4½ whorls, and pale horn-colored; surface usually corroded. Suture shallow. Apex blunt. Aperture ovate, angled above. Umbilicus slit-like. Operculum orange, concentric. SH = 2.33–4.26 mm and SW = 1.93–3.01 mm ($n = 8$) (Table 2). Mantle black. Face black. Tentacles white, with eyes at their bases. Penis white, massive, triangular, blunt at its distal end, and without outgrowth, but bearing folds. Female genitalia not detected (Fig. 3A–D).

Differential diagnosis. *Pseudamnicola limnosensis* has a slightly smaller (SH to 3.0 mm), ovate-conical to globular

Table 2. Conchological statistics of *Pseudamnicola cirikorum* sp. n.

	SH (mm)	SW (mm)	AH (mm)	AW (mm)	SW/SH
Holotype	3.30	2.64	1.94	1.55	0.80
Mean ($n = 8$)	3.14	2.35	1.76	1.45	0.76
Min.	2.33	1.93	1.46	1.14	0.63
Max.	4.26	3.01	2.01	1.75	0.85

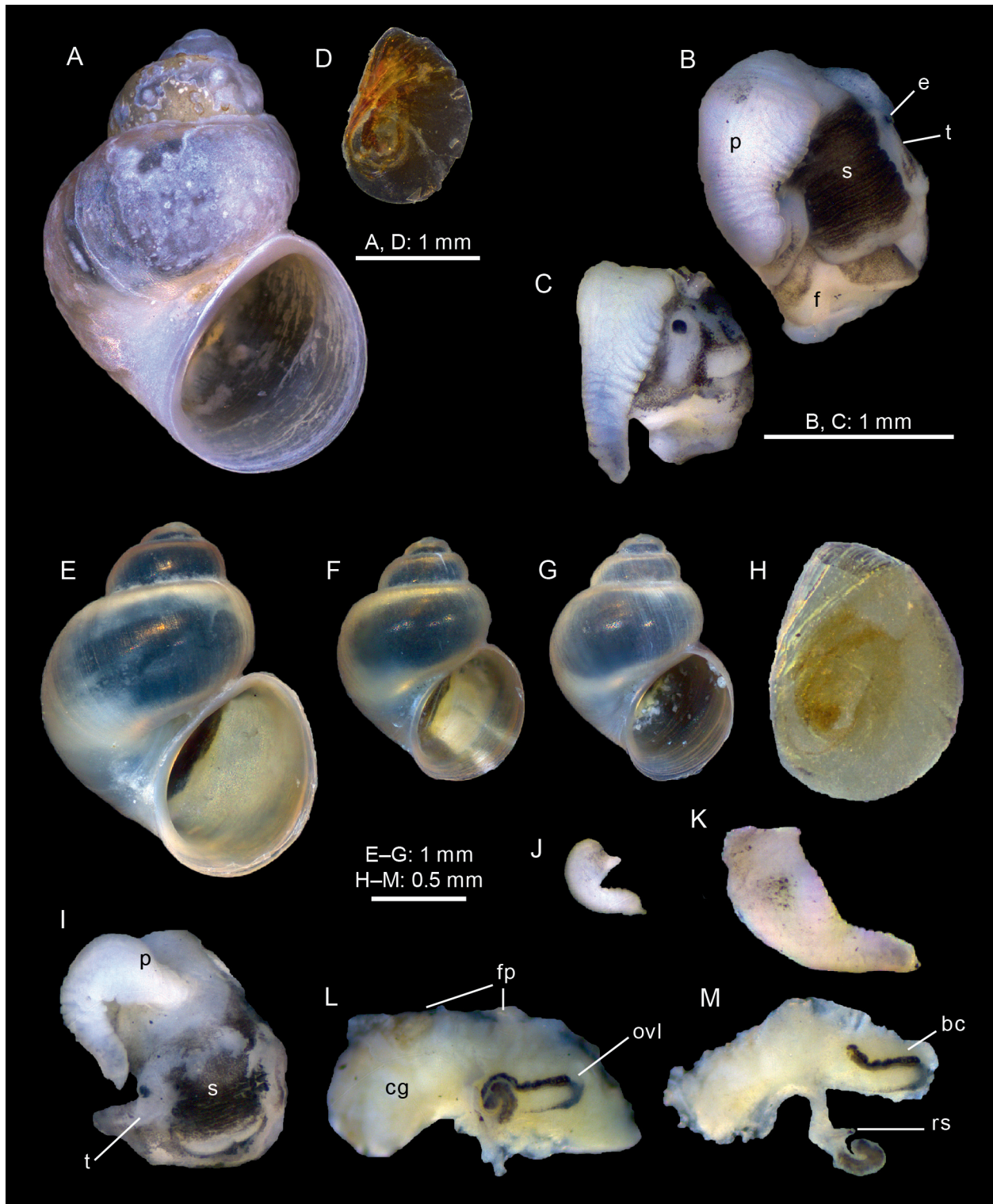


Figure 3. *Pseudamnicola cirikorum* sp. n. and *Pseudamnicola radeae* sp. n. **A–D.** *P. cirikorum*, from Sta. 4: **(A)** holotype shell (COMULM G0077); **(B, C)** paratypes (PCD 20160713/3), penis and face; **(D)** paratype (PCD 20160713/3), operculum. **E–M.** *P. radeae*: **(E)** holotype shell (COMULM G0078); **(F–M)** paratypes (PCD-20170424/34): **(F, G)** shells; **(H)** operculum; **(I)** penis and face; **(J, K)** penes; **(L, M)** female genitalia; (bc = bursa copulatrix; cg = capsule gland; e = eye; f = foot; fp = fecal pellets; ovl = oviductal loop; p = penis; rs = receptaculum seminis; s = snout; t = tentacle).

shell with fewer (up to 4), slightly more convex whorls than *P. cirikorum*. *Pseudamnicola chia* from the island of Chios also has a smaller, more globular shell than *P. cirikorum*. *Pseudamnicola pieperi* and *P. ilione* from the islands of Karpathos and Rhodes, respectively, have up

to 4 whorls, separated by a deep suture. *Pseudamnicola ianthe* from Rhodes has 5 whorls, the massive penis has grey pigment patches, and the penial duct is strongly undulating. *Pseudamnicola geldiyana* is the only species of its genus recorded in western Anatolia, where it is

known from the province of Denizli. This species has a slenderer shell than *P. cirikorum*, and the penis is worm-shaped with a rounded tip and no folds.

***Pseudamnicola radeae* sp. n. D.A. Odabaşı**

Figure 3E–M

Type materials. All specimens from type locality, leg. Serpil Odabaşı, 24.iv.2017.

Holotype: COMULM G0078. SH = 3.71 mm, SW = 2.90 mm, AH = 2.16 mm, AW = 1.72 mm.

Paratypes: 44 specimens: IUSHM 20191015-02 (5 specimens), ESFM GASI/2017-1 (5 specimens), PCD 20170424/34 (34 specimens).

Type locality. Turkey, Gökçeada, Aydıncık Burnu Çeşmesi (Sta. 3, Table 1), near the village of Eşelek. The spring is used for watering a trough for sheep.

Etymology. This species is named after Dr Canella Radea, an outstanding ecologist and freshwater malacologist.

Description. Shell ovoid-conical, with 3½–4 prominent whorls, translucent; surface with a silky sheen. Suture deep. Apex blunt. Aperture ovate. Umbilicus slit-like. Operculum concentric, horn-colored but orange at its centre. SH = 2.33–2.97 mm and SW = 1.97–2.39 mm ($n = 9$) (Table 3). Mantle black with white stripes at margins. Face black with white tentacles. Eyes at bases of tentacles. Penis white, broader at its base, and tapering toward

its bluntly tipped distal end. Rectum U-shaped in pallial cavity. Oviduct loop black-pigmented, of the S-type, and curled with a seminal receptacle. Bursa copulatrix elongate and lying under oviduct (Fig. 3E–M).

Differential diagnosis. *Pseudamnicola radeae* sp. n. is smaller than *P. cirikorum* sp. n. and *P. limnosensis* in both height and diameter. *Pseudamnicola pieperi*, *P. ilione*, and *P. ianthe* have larger shells, with higher whorls, than *P. radeae*. In addition, *P. radeae* has the distal end of the penis slender, while *P. limnosensis*, *P. cirikorum*, *P. pieperi*, *P. ilione*, and *P. ianthe* have massive, triangular penes with folds along their length. *Pseudamnicola geldiyana*, from western Anatolia, has a slimmer shell with a pointed apex. *Pseudamnicola radeae* has fewer, more convex whorls than all other *Pseudamnicola* spp. occurring in the Mediterranean region of Turkey.

Genus *Grossuana* Radoman, 1973

Type species: *Grossuana serbica* Radoman, 1973.

***Grossuana kayrae* sp. n. D.A. Odabaşı**

Figure 4

Type materials. All specimens from type locality, leg. Kayra Odabaşı, 12.vii.2016.

Holotype: COMULM G0079. SH = 1.48 mm, SW = 1.14 mm, AH = 0.8 mm, AW = 0.71 mm.

Paratypes: 23 specimens: IUSHM 20191015-03 (5

Table 3. Conchological statistics of *Pseudamnicola radeae* sp. n.

	SH (mm)	SW (mm)	AH (mm)	AW (mm)	SW/SH
Holotype	2.64	2.06	1.54	1.24	0.82
Mean ($n = 9$)	2.69	2.20	1.57	1.27	0.82
Min.	2.33	1.94	1.35	1.14	0.78
Max.	3.71	2.90	2.16	1.72	0.87

Table 4. Conchological statistics of *Grossuana kayrae* sp. n.

	SH (mm)	SW (mm)	AH (mm)	AW (mm)	SW/SH
Holotype	1.48	1.14	0.80	0.71	0.77
Karayolları Çeşmesi (type locality)					
Mean ($n = 24$)	1.50	1.16	0.84	0.70	0.77
Min.	1.35	1.03	0.79	0.62	0.71
Max.	1.71	1.26	0.90	0.75	0.87
Karakol Çeşmesi					
Mean ($n = 13$)	2.34	1.38	1.04	0.86	0.81
Min.	0.97	0.88	0.49	0.56	0.77
Max.	1.52	1.22	0.84	0.79	0.91
Bademli Çamaşırvhanesi					
Mean ($n = 8$)	1.33	1.01	0.73	0.61	0.76
Min.	1.14	0.91	0.65	0.55	0.69
Max.	1.45	1.07	0.79	0.64	0.80

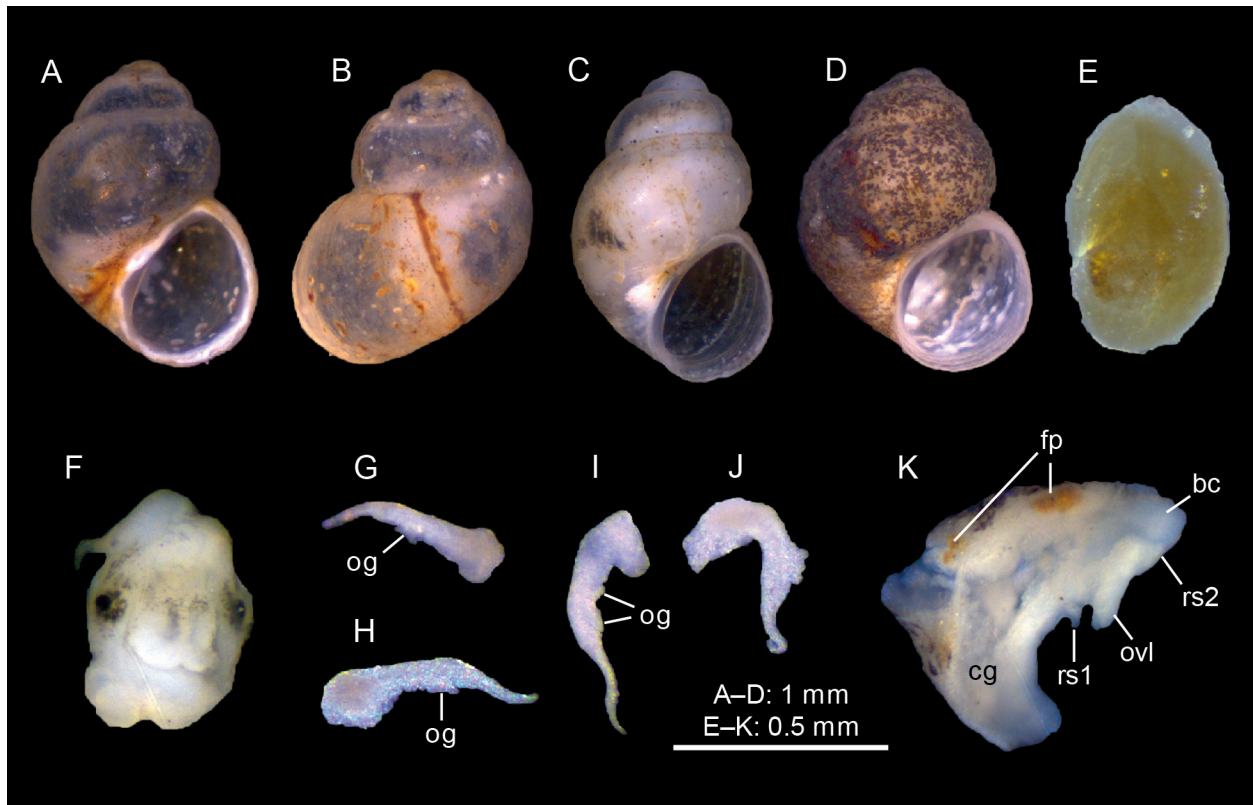


Figure 4. *Grossuana kayrae* sp. n. **A, B.** Holotype shell from Sta. 6 (COMULM G0079). **C, D, I, J.** Non-type material: **(C)** shell from Sta. 2 (PCD 20160712/8); **(D)** shell from Sta. 10 (PCD 20160714/13); **(I)** penis from Sta. 2 (PCD 20160712/8); **(J)** penis from Sta. 10 (PCD 20160714/13). **E–H, K.** Paratypes, from Sta. 6 (PCD 20170427/13): **(E)** operculum; **(F)** face and penis; **(G, H)** penes; **(K)** female genitalia; (bc = bursa copulatrix; cg = capsule gland; og = outgrowth on penis; ovl = oviductal loop; rs1–2 = receptaculum seminis; fp = fecal pellets).

specimens), ESFM GASI/2016-2 (5 specimens), PCD 20170427/13 (13 specimens).

Additional materials. 13 specimens from Sta. 10 (PCD 20160714/13), 8 specimens from Sta. 2 (PCD 20160712/8), leg. Serpil Odabaşı and Deniz Anıl Odabaşı, 12.vii.2016 and 14.vii.2016.

Type locality. Turkey, Gökçeada, Karayolları Çeşmesi (Sta. 6, Table 1), located along the road to Kapıkaya. Found together with *Bythinella gokceadaensis* sp. n.

Etymology. This species is dedicated to Miss Kayra Odabaşı, who loves science and works with her parents in nature.

Description. Shell ovoid, with $3\frac{1}{2}$ slightly convex whorls, translucent, and pale, with brownish striae on the strongly developed last whorl. Aperture ovoid. SH = 0.97–1.71 mm and SW = 0.88–1.26 mm ($n = 45$) (Table 4). Operculum orange to reddish. Mantle black with a whitish stripe at margins. Face pale to dark grey, but tips of tentacles and snout unpigmented. Tentacles each with a grey stripe. Eyes at base of tentacles. Penis unpigmented, elongate, tapering at distal part, and with a weakly bifurcated outgrowth on its left margin. Bursa copulatrix elongate; seminal receptacle 2 more developed than seminal receptacle 1 (Fig. 4).

Differential diagnosis. *Grossuana kayrae* sp. n. has fewer whorls and a shorter shell height than *G. avandasensis*, *G. stenaensis*, and *G. sidironerensis* from southwestern Thrace (northern Greece); *G. kayrae* also differs from these species anatomically: the penis of *G. kayrae* has no pigmentation, and the bifid outgrowths are apparent, while no bifid structure is visible in these 3 Greek species. *Grossuana thracica* and *G. angelskovi*, from southern Bulgaria, differ from the new species in their larger shells; the penes in these species have black pigmentation on the distal part in contrast to the unpigmented penis of *G. kayrae*.

Remarks. *Grossuana kayrae* is the first species of the genus recorded both from the island of Gökçeada and from mainland Turkey.

Family Bythinellidae Locard, 1893

Genus *Bythinella* Moquin-Tandon, 1856

Type species: *Bulimus viridis* Poiret, 1801.

Bythinella gokceadaensis sp. n. D.A. Odabaşı Figure 5

Type materials. All specimens from type locality, leg. S. Odabaşı, D.A. Odabaşı & S. Acar, 13.vii.2016.

Holotype: COMULM G0080. SH = 2.44 mm, SW = 1.42 mm, AH = 1.08 mm, AW = 0.90 mm.

Paratypes: 32 specimens of which 12 were measured (Table 5) and 9 dissected: IUSHM 20191015-04 (5 specimens), ESFM GASI/2016-1 (5 specimens), COMULM

G0081 (10 specimens), COMULM G0082 (2, as soft parts), PCD 20161120/10 (10 specimens).

Additional materials. 8 specimens from Sta. 1 (PCD 20161120/8), 10 from Sta. 5 (PCD 20160713/10), 2 from Sta. 6 (PCD 20161120/2), 15 from Sta. 7 (PCD

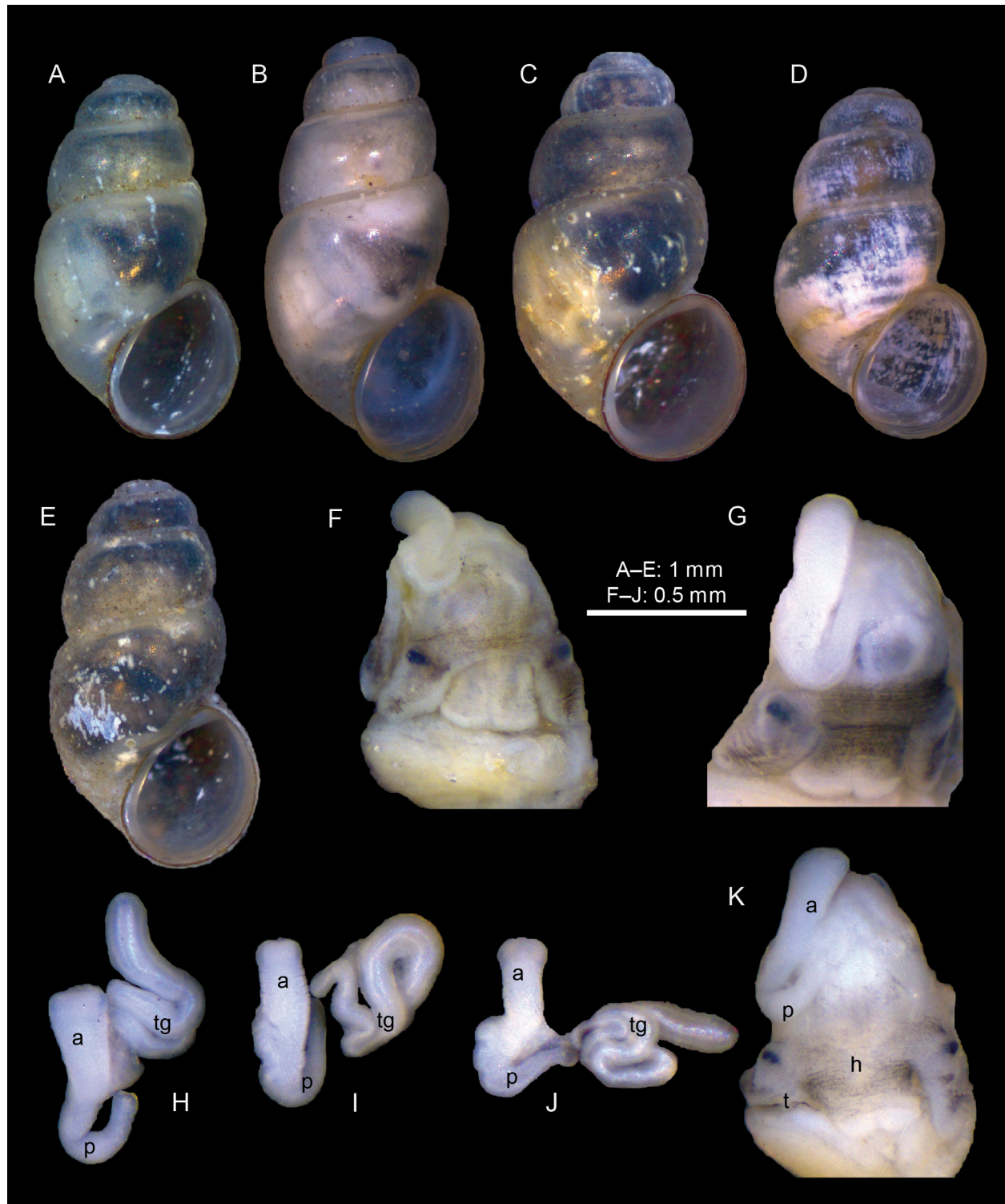


Figure 5. *Bythinella gokceadaensis* sp. n. **A.** Holotype shell from Sta. 8 (COMULM G0080). **B–E, G, I–K.** Non-type materials: (**B**) shell from Sta. 9 (PCD 20160713/15); (**C**) shell from Sta. 1 (PCD 20161120/8); (**D**) shell from Sta. 7 (PCD 20160714/15); (**E**) shell from Sta. 5 (PCD 20160713/10); (**G**) face and penis from Sta. 5 (PCD 20160713/10); (**I**) penis and tubular gland from Sta. 9 (PCD 20160713/15); (**J**) penis and tubular gland from Sta. 5 (PCD 20160713/10); (**K**) face and penis from Sta. 9 (PCD 20160713/15). **F, H.** Paratypes (COMULM G0082): (**F**) face and penis; (**H**) penis and tubular gland; (a = appendix, h = head, p = penis, t = tentacle, tg = tubular gland).

20160714/15), 15 from Sta. 9 (PCD 20160713/15), and 4 from Sta. 10 (PCD 20160714/4), leg. Serpil Odabaşı & Deniz A. Odabaşı, 13.vii.2016, 14.vii.2016 & 20.xi.2016.

Type locality. Turkey: Gökçeada, Fehim Akdemir Çesmesi (Sta. 8, Table 1) located along the road to Şahinkaya village.

Etymology. This species is named after the island of Gökçeada.

Description. Shell cylindrical, with $4\frac{1}{2}$ slightly convex whorls, and translucent. Apex blunt. Suture deep. Aperture ovoid, angled above. Umbilicus slit-like. SH = 1.63–2.92 mm and SW = 0.99–1.66 mm ($n = 46$) (Table 5). Mantle black, white at edges. Face and tentacles grey but with margins of snout unpigmented. Tentacles tapering, tips of tentacles extending to end of snout. Eyes at bases of tentacles. Penis is shorter and slimmer than the appendix. Tubular gland proximally narrowed and equal in length to penis and appendix combined (Fig. 5).

Differential diagnosis. *Bythinella charpentieri cabirius* Reischütz, 1988, which occurs on the Greek island of Samothrake, has similar shell dimensions to *B. gokceadaensis*, but the apex is broader in the latter species. The penis of *B. charpentieri cabirius*, as described by GLÖER & GEORGIEV (2012), is longer than that of *B. gokceadaensis*. The tubular gland of *B. charpentieri cabirius* is proximally broader and distally slimmer, which is opposite to *B. gokceadaensis*. *Bythinella walensae*, from the island of Naxos, has an ovate-conical, larger shell (SH to 3.16 mm) than *B. gokceadaensis*, which is cylindrical and smaller (SH to 2.92 mm). The penial structure of *B.*

walensae is also different from that in *B. gokceadaensis*. *Bythinella kosensis* differs from *B. gokceadaensis* in its smaller shell and blunter, wider apex. *Bythinella charpentieri* from mainland Greece is separated by its bigger shell (SCHÜTT 1980), and it has also a longer appendix and tubular gland than does *B. gokceadaensis*. *Bythinella kazdagensis* Odabaşı & Georgiev, 2014, described from Mount Kazdağı, is the only Turkish species of its genus from near Gökçeada. It can be separated from *B. gokceadaensis* by its narrower apex and its characteristic penis, which is as long as the appendix. *Bythinella yerlii* also occurs relatively close to the type locality of *B. gokceadaensis*, but the maximum shell height of *B. yerlii* is less than 2 mm (1.96 mm; Gürlek 2017: 996), its whorls are more convex, and the aperture is rounded, while in *B. gokceadaensis* shell height is up to 2.92 mm, whorls are slightly less convex, and the aperture is angled above. *Bythinella istanbulensis* is distinguished from *B. gokceadaensis* by its nearly cylindrical shell with a broader and blunter apex; the penis of *B. istanbulensis* is also smaller. *Bythinella anatolica* is larger (SH to 3.07 mm) than *B. gokceadaensis*, and the penial appendix is shorter. *Bythinella magdalenae* has an ovate to conical shell with fewer ($3-3\frac{1}{2}$) whorls and a truncate apex. *Bythinella wilkei* is larger (SH to 3.03 mm), with tumid whorls, and a nearly round aperture, which is strongly descending and projected forward. *Bythinella turca* has $3-3\frac{1}{2}$ whorls, separated by a deep suture. *Bythinella turca* has a longer tubular gland, which is sometimes visible without dissection. *Bythinella occasiuncula* has an oval shell, which is smaller (SH to 2.3 mm) than in *B. gokceadaensis*.

Table 5. Conchological statistics of *Bythinella gokceadaensis* sp. n.

	SH (mm)	SW (mm)	AH (mm)	AW (mm)	SW/SH
Holotype	2.79	1.54	1.18	0.99	0.55
Fehim Akdemir Çesmesi (type locality)					
Mean ($n = 13$)	2.46	1.41	1.12	0.92	0.57
Min.	2.21	1.32	0.99	0.84	0.54
Max.	2.79	1.54	1.61	1.09	0.62
Cugura Çesmesi					
Mean ($n = 15$)	2.08	1.24	0.93	0.74	0.60
Min.	1.63	0.99	0.78	0.59	0.52
Max.	2.63	1.51	1.06	1.92	0.77
Börekçi Cafer Çesmesi					
Mean ($n = 8$)	2.22	1.35	1.00	0.83	0.61
Min.	1.86	1.14	0.85	0.73	0.53
Max.	2.48	1.47	1.10	0.95	0.66
Pınarbaşı Çesmesi					
Mean ($n = 10$)	2.61	1.54	1.13	0.94	0.59
Min.	2.35	1.40	1.06	0.86	0.56
Max.	2.92	1.66	1.22	1.01	0.63

Discussion

Studies on *Pseudamnicola* spp. by DELICADO et al. (2012, 2014) from the Iberian Peninsula and the Balearic Islands show that the taxa are morphologically well differentiated when using some taxonomic characters such as female genitalia. These morphological data are also well supported by molecular data. Molecular research by DELICADO et al. (2014) and RADEA et al. (2016) on the *Pseudamnicola* from the Balearic and Aegean islands respectively has revealed new phylogenetic clades distinct from the morphologically described species. These studies suggest that taxonomic studies using molecular data might indicate further taxa. Descriptions of Turkish *Pseudamnicola* spp. (SCHÜTT & BILGIN 1970, SCHÜTT & ŞEŞEN 1993, GLÖER et al. 2014, 2015, GÜRLEK 2019b) have so far only been based on conchological and anatomical morphology. Further research is necessary to elucidate the diversity of the genus in Turkey especially along the west–east axis of the Mediterranean region.

In this study, some morphological findings on the *Pseudamnicola* spp. from Gökçeada Island were compared with the geographically nearest records from the Aegean Islands, mainland Greece, and mainland Turkey. *Pseudamnicola natolica* is the only record of the genus from northwestern Anatolia (Bursa Province), but RADOMAN (1973) later included it in *Pseudorientalia*. Due to this transfer, the status of *Pseudamnicola natolica smyrnensis* (from İzmir, western Turkey) is still unclear. Therefore, this species was excluded from comparison. The only western Anatolian representative of *Pseudamnicola* is *P. geldiyana* Schütt & Bilgin, 1970, which is geographically distant and morphologically different from the *P. cirikorum* and *P. radeae* described here. Other Turkish *Pseudamnicola* spp. records such as *P. elbursensis* Starmühlner & Edlauer, 1957, and *P. lindbergi* Boettger, 1957, *P. intranodosa* Schütt & Şeşen, 1993, *P. bilgini* Schütt & Şeşen, 1993, *P. vinariskii* Glöer & Georgiev, 2012, *P. marashi* Glöer, Gürlek & Kara, 2014, *P. merali* Glöer, Gürlek & Kara, 2014, *P. goksunensis* Glöer, Gürlek & Kara, 2014, *P. gullei* Glöer, Yıldırım & Kebapçı, 2015, *P. kayseriensis* Glöer, Yıldırım & Kebapçı, 2015, and *Pseudamnicola sumbasensis* Gürlek, 2019 (GÜRLEK 2019b) occur far from our study area.

With *Bythinella*, island ecosystems have generated endemism due to their history of isolation. This can be seen in the differentiation of *B. gokceadaensis* from *B. kazdagensis* and *B. charpentieri cabirius*, which were recorded from locations close to Gökçeada.

A remarkable similarity can be seen between the spring-snail fauna of Gökçeada and the faunas of adjacent regions such as the northeastern Greece, the Greek islands, and southern Bulgaria (Rhodope Mountains); this is because 2 genera are common to these regions, *Bythinella* and *Grossuana* (GLÖER & GEORGIEV 2009, GEORGIEV et al. 2015, GLÖER et al. 2018).

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