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Three new species of the family Bithyniidae from Greece (Gastropoda: Bithyniidae)

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> Abstract

Maassen's and Gittenberger's collections of the Bithyniidae from Greece have been studied thoroughly and revealed two apparently new *Pseudobithynia* species: *P. gittenbergeri* n. sp., *P. hemmeni* n. sp. In addition a newly collected sample from Crete consists of a new *Bithynia* spec., named as *Bithynia cretensis* n. sp. These new species are described here as new. Additionally, we discuss the distinctness from other *Bithynia* and *Pseudobithynia* species of this region known so far. Interesting was the occurrence of a new *Pseudobithynia* sp. in the Lake Pamvotis, i.e. there are three distinct *Pseudobithynia* spp. that live in this ancient lake. Additionally Gittenberger's collection of the Bithyniidae revealed many samples from Corfu, by which we could identify the species described by Letourneux in 1887. All these described taxa belong in our opinion to one species: *Pseudobithynia renei* (Letourneux, 1887).

> Kurzfassung

Drei neue Arten der Familie Bithyniidae aus Griechenland (Gastropoda: Bithyniidae). – Die *Bithynia*-Sammlungen von Maassen und Gittenberger wurden intensiv bearbeitet und ergaben zwei offensichtlich neue *Pseudobithynia*-Arten: *P. gittenbergeri* n. sp., *P. hemmeni* n. sp. Zusätzlich enthielt eine neue Aufsammlung von Wim Maassen von Kreta eine neue *Bithynia*-Art, benannt als *Bithynia cretensis* n. sp. Diese Arten werden hier neu beschrieben. Zusätzlich diskutieren wir die Unterschiede zu anderen *Bithynia*- und *Pseudobithynia*-Arten der Region, soweit sie bisher bekannt sind. Interessant war das Auftreten einer neuen *Pseudobithynia* sp. im See Pamvotis, womit drei unterschiedliche *Pseudobithynia*-Arten in diesem Langzeitsee leben. Zusätzlich fanden wir in Gittenbergers Sammlung zahlreiche Proben von Korfu, die wir Arten zuordnen konnten, die von Letourneux 1887 beschrieben wurden. Alle diese beschriebenen Arten gehören unserer Meinung nach einer Art an: *Pseudobithynia renei* (Letourneux, 1887).

> Key words

Gastropoda, Bithyniidae, *Pseudobithynia*, *Bithynia*, taxonomy, Greece.

Introduction

Recent research activities carried out by Glöer & Pešić (2006) as well as by Glöer, Albrecht & Wilke (2007) showed that the species richness in Greece is even greater than was believed in the 19th Century and that many *Pseudobithynia* spp. are strictly restricted in their distribution.

Maassen's and Gittenberger's dry collections revealed some additional, apparently new, *Pseudobithynia* species: *P. gittenbergeri* n. sp., and *P. hemmeni* n. sp. from Greece.

To describe new bithynioid species by only regarding the shells, we have to consider the shell shape, the umbilicus, the operculum, sex dimorphism, and zoogeographical aspects. On regarding only the shell shape and the operculum a problem arises because very similar looking shells are not necessarily conspecifical, e.g. *Bithynia tentaculata* (Linnaeus, 1758) vs. *Pseudobithynia kirka* Glöer, Albrecht & Wilke, 2007. Sex dimorphism without consideration of the anatomy can be misinterpreted as being distinct species because in some lakes in the Balkans up to three *Bithynia* species can occur (Glöer & Pešić 2007). Although only all arguments taken together can define a species, our experience with the Bithyniidae from the Balkans made

Fig. 1. The sampling sites of the here discussed *Pseudobithynia* spp. **1**: Korfu, **2**: Ioannina, **3**: Samos, **4**: Crete.

us decide to treat some species from the Maassen's and Gittenberger's collections as new and describe the species only after conchological characters.
New samples from Greece carried out in 2008 by Wim Maassen revealed *Bithynia cretensis* n. sp., which lives syntopically with *B. candiota* Westerlund, 1886, thus we can describe this species as new here, too. The purpose of this paper is to increase the knowledge of the Greek Bithyniidae and to describe the three new species mentioned above.

Material and methods

The snails were collected with a sieve, and the samples were preserved in 75% ethanol. The dissections and measurements of the genital organs and the shells were carried out by means of a Zeiss stereo microscope with an eyepiece-micrometer; the photographs were made with a Leica R8 camera system with a digital adapter. The type material is stored in the RMNH, Nationaal Natuurhistorisch Museum Naturalis, Leiden (The Netherlands) (formerly: Rijksmuseum van Natuurlijke Historie).

Results

We had to compare the new species exclusively with the formerly known species *Bithynia graeca* (Westerlund, 1879) as well as *Bithynia candiota* Westerlund, 1886 from Crete, and only the latter species could be identified in Maassen's collection. In addition LETOURNEUX described in 1887 many *Bithynia* spp. (originally as *Digyreidum*) from Corfu, which could be found in Gittenberger's collection. The other species that are mentioned in the literature of the last two centuries do not live in Greece (see GLÖER et al. 2007: 15). The recently described species by GLÖER & PEŠIĆ (2006) as well as GLÖER et al. (2007) had to be taken into consideration, too.

As we could study only shell material, except of *Bithynia cretensis* n. sp., and as most of the small species of the Bithyniidae in Greece belong to the genus *Pseudobithynia*, we decided to use this genus name in order to describe our new species.

Family: Bithyniidae Gray, 1857

Genus: *Bithynia* Leach, 1818

Type species: *Helix tentaculata* Linnaeus, 1758

Bithynia candiota (Westerlund, 1886)

figs. 2.1–2.4

Bythinia badiella var. *candiota* Westerlund, 1886

Material examined: Isle of Crete, nomos Lassithi, Kato Metochi; nomos Rethimnon, valley along river Petres, 9 km W of Rethimnon; – in debris of river Petres, 9 km W of Rethimnon, UTM KV61; – nomos Iraklion, small river near river Gerapotamos near bridge at Phaistos.
Remarks: WESTERLUND (1886: 22) described this species as a var. of *Bithynia badiella* Küster, 1853 (loc. typ.: Beirut). KÜSTER (1853: 62, pl. 11, Figs. 25–28) described *B. badiella* as having a sphaerical-conical translucent shell the whorls of which are flattened at the suture. This flattening does not exist in Westerlund's species and, however, not in the specimens studied by us, as well, so we state that his var. *candiota* does not belong to *B. badiella* but represent an independent species.

Bithynia cretensis n. sp.

figs. 3.1–3.6

Material examined: 100 specimens in ethanol from type locality.
Holotype: Shell height 6.5 mm, width = 4.5 mm (male), RMNH 112033.
Paratypes: RMNH 112034/4, 89 ex collection Maassen, 10 ex. collection Glöer.

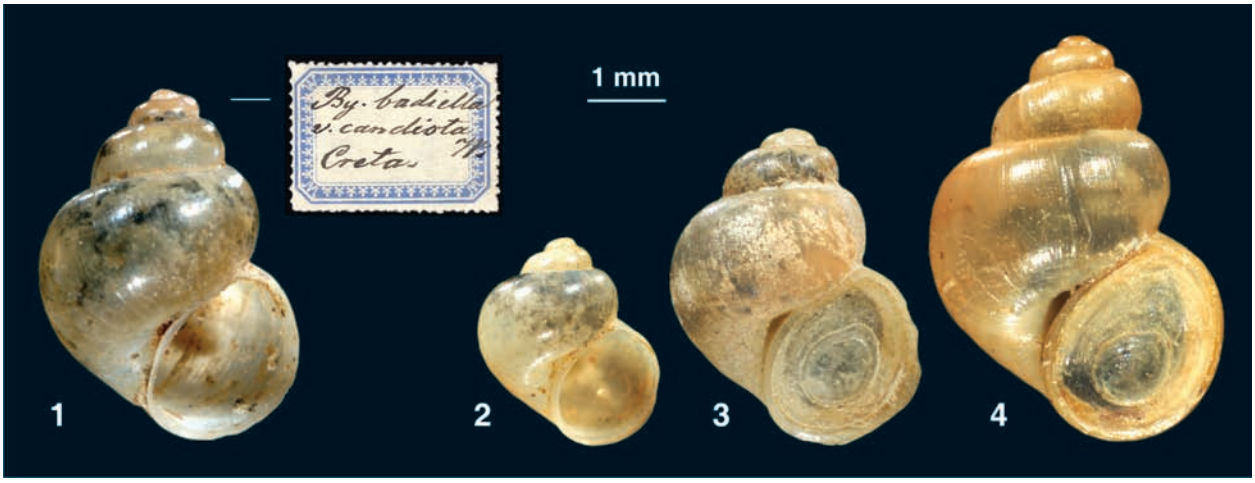

Fig. 2. The shells of *Bithynia candiota*. – **1:** Syntype of *P. candiota* with original label, **2–4**: Topotypes of *P. candiota* from Maassen's collection: **2:** Nomos Rethimnon, debris of Petres river, 9 km W of Rethimnon (X.1991), **3, 4**: branch of river Gerapotamos near the bridge of the street Kalivia-Phaistos (8.VII.1975, leg. F. Seidl).

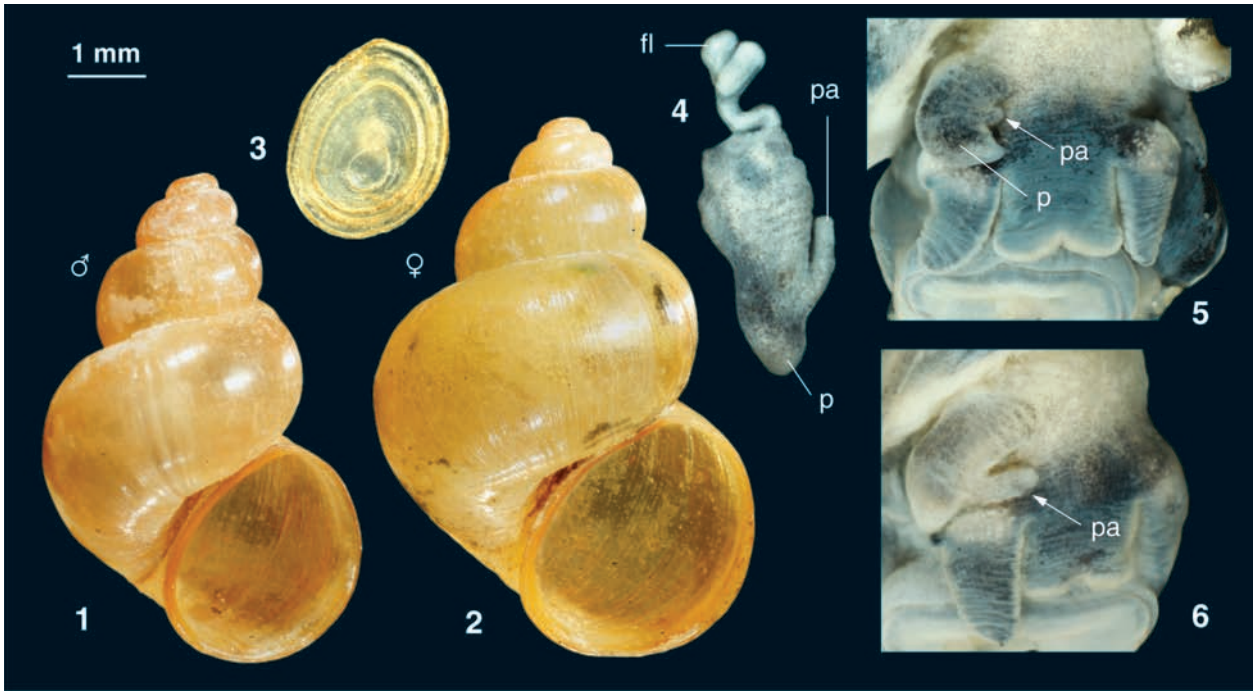

Fig. 3. *Bithynia cretensis* n. sp. – **1–2**: shells, **1**: male, **2**: female; **3**: operculum, **4**: penis with flagellum, **5–6**: head with penis: **5**: short penial appendix, **6**: characteristic penial appendix. – **fl** = flagellum, **p** = penis, **pa** = penial appendix.

Locus typicus: Greece, Crete, nomos Lasithiou, Kato Metohi, near entrance to big cave and along small streamlet, 0.5 km E of village, 800 m alt. 35°11.505'N 25°25.925' E (leg. 2008 W. J. M. Maassen).

Etymology: Named after the island Crete where the species lives.

Description: The reddish horn-coloured shell has 4.5 whorls with a deep suture, the surface is glossy and finely striated, umbilicus slit-like, the aperture is oval with an oval rounded operculum, a sexual dimorphism is visible: the males are slimmer and slightly smaller than the females. Dimensions: females: height 6.8–7.8 mm, width 5.0–5.4 mm, males: height 6.5–6.8 mm, width 4.4–4.5 mm.

Anatomy: Distal part of the penis short and obtuse, penial appendix slim and as long as the distal penis part. The flagellum is short and thick. Sometimes the penial appendix is very short and hardly visible (Fig. 3.5).

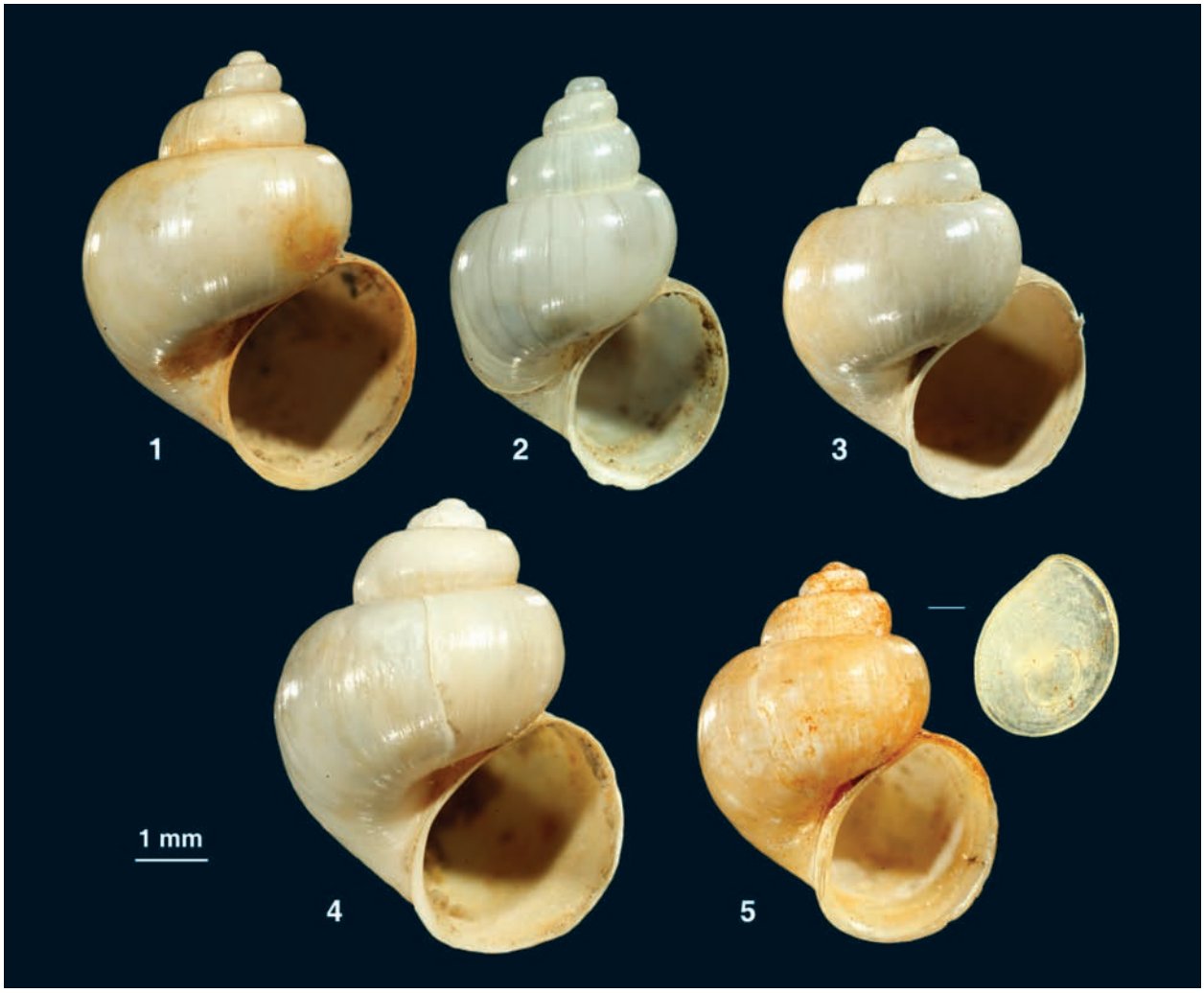

Fig. 4. *Pseudobithynia renei*. Regarding LETOURNEUX (1887) **1, 3**: *Pseudobithynia* cf. *P. renei*, **2**: *Pseudobithynia* cf. *P. viridis*, **3**: *Pseudobithynia* cf. *P. renei*, **4**: *Pseudobithynia* cf. *P. servainiana*, **5**: *Pseudobithynia* cf. *P. corcyrense*.

Genus: *Pseudobithynia* Glöer & Pešić, 2006

Type species: *Pseudobithynia irana* Glöer & Pešić, 2006

Pseudobithynia renei Letourneux, 1887

figs. 4.1–4.5

Digyreidum renei LETOURNEUX (1887: 70)

Syn.: *Digyreidum corcyrense* Letourneux, 1887 – *D. servainianum* Letourneux, 1887 – *D. viride* Letourneux, 1887 – *Bythinia phaeacina* Locard, 1894 – *Bythinia stossichiana* Locard, 1894.

Material examined: 7 lots with numerous specimens from Gittenberger's collection, all collected in Corfu: Manatades, Dassia, Ermones, SE Ropa, Perama, Messonghi, Agios Mattheos**.**

Remark: We do not know if this is a *Pseudobithynia* in fact, because we could only study dried materials, but most of the species of the Bithyniidae in Greece belong to this genus.

The two latter species mentioned above as synonyms have been found by Locard in Bourguignat's collection. The names were given by Letourneux in 1879, which are only manuscript names, because they have never been published by him, so the author of these species is Locard. These species could not be indentitfied with the materials of Gittenberger's collection because Locard gave no description and only non-specific drawings (LOCARD 1894: Pl. V, fig. 7 and fig. 19).

We tried to borrow the syntypes of the mentioned species descripbed by Letourneux from Corfu, but they could not be found at present in Paris (Virginie Héros, Muséum d'Histoire Naturelle Paris, in litt.) nor in Toulouse (collection Letourneux, Gisèle Claverie, Muséum d'Histoire Naturelle Toulouse, in litt.). But the given descriptions by LETOURNEUX (1887: 70–72) are suitable for identification.

Fig. 5. *Pseudobithynia gittenbergeri* n. sp. (holotype).

Fig. 6. *Pseudobithynia hemmeni* n. sp. (holotype).

However, we believe that all these specimens represent the same species, for which we use the name *P. renei*, because this was the first name Letourneux mentioned in his descriptions of the Bithyniidae from Corfu, and he gave this species name in honour to his friend Bourguignat. This species seems to be slightly plastic, but the swollen, prominent body whorl, the stepped whorls, the deep suture, and the shape of the aperture are similar in all specimens, which have been found syntopically on many sampling sites in Corfu. Only one of the depicted specimens (Fig. 4.2, *P. viridis*) looks a little distinct from the others, but this is possibly a male specimen, the form of which occured in all samples. If *P.* cf. *servainiana* (Fig. 4.4) with its broader spire is distinct from the other species described by Letourneux, cannot be said definitely, because it occured also in many samples from Corfu together with *P. renei*.

Pseudobithynia gittenbergeri n. sp.

fig. 5

Material examined: 5 ex. from type the locality.
Holotype: Shell height 5.5 mm, width = 4.0 mm, RMNH 109075.
Paratypes: 3 ex. collection Maassen, 1 ex. collection Glöer.
Locus typicus: Greece, Samos Island, 1 km W of Psili Ammos (E of Pythagorio) near freshwater-lake, V.1993.
Etymology: The species is named after Edmund Gittenberger.
Description: The 4.5–5 whorls are slightly convex with a deep suture. The glossy shell is elongated conical and of a dark horn colour, the umbilicus is slit-like. The ovate aperture is slightly rounded. Shell height 5.0–5.5 mm, shell width 3.5–4.0 mm.
Differential diagnosis: The shells of *Pseudobithynia gittenbergeri* look a little similar to *P. panetolis*, but the shells of *P. gittenbergeri* are smaller than the others, the whorls are less swollen, and the suture is less deep (see also discussion below).

Pseudobithynia hemmeni n. sp.

fig. 6

Material examined: 18 ex. from the type locality.
Holotype: Shell height 7.3 mm, shell width 5.4 mm; RMNH 109076.
Paratypes: 2 ex. HW, 11 ex. MD, 4 ex. collection Glöer.
Locus typicus: Greece, nomos Joannina, springs near monastery Velas, SSW of Konitsa, 8.IV.1995, leg. J. Hemmen.
Etymology: The species is named after Mr Jens Hemmen, Wiesbaden (Germany), who collected these and other samples of Bithyniidae in Greece.
Description: The 4–4.5 whorls are stepped and at the suture flattened. The shell is conical and horn-coloured. The umbilicus is open. The ovate aperture is slightly angled at the top, the operculum is slightly spiral shaped at the nucleus. The males are possibly slimmer and slightly smaller in shell height. Shell height 6.0–7.3, shell width 4.3–5.4 mm.
Differential diagnosis: This species looks somewhat similar concerning the stepped whorls to *Bithynia graeca* (Westerlund, 1879), but the aperture in *Pseudobithynia hemmeni* is less rounded, and the whorls are flattened at the suture, in *B. graeca* they are regularly convex.
Remarks: This species was already found by Mousson in Lake Pamvotis and depicted by Frogley & Preece (2007: 279, fig. 5c, 5d). Thus there are three possible *Pseudobithynia* species that live in this ancient lake,

similar to the three *Pseudobithynia* spp. in Lake Trichonis (GLÖER et al. 2007) or three *Bithynia* species in Lake Skadar (GLÖER & PESIC 2007). The material that we investigated was found ca. 50 km north of Ioannina, thus this species is not endemic to Lake Pamvotis.

Discussion

All species of Greece described in the 19th Century could be indentified, except *B. hellenica* (Kobelt, 1892). But *B. hellenica* could be found in Falniowski's collection and a redescription will be published in a distinct paper. None of the species mentioned here corresponds to *B. hellenica*, so we can ignore this species in the following discussion.

At last 13 species of the Bithyniidae are known up to now from Greece and can be indentified by the following identification keys, which shows the distinctness of all these species.

It is not known if *B. graeca* belongs to the genus *Bithynia* or *Pseudobithynia* but in every case it can be distinguished from all other species of both genus by the large shell, the convex whorls, and the very deep suture. Only *P. gittenbergeri*, *P. panetolis*, and *P. hemmeni* are similar in their shell shapes. But the investigations of many samples from all regions of Greece showed us that most of the species are endemic to ancient lakes or are restricted in their distribution to a small region. *P. panetolis* lives in the ancient lake Trichonis together with *P. trichonis* and *P. falniowskii*, of which every species occurs on distinct shore sides of this lake and none of these species could be found outside this lake. The sampling sites of *P. gittenbergeri* (Samos) and *P. hemmeni* (Lake Pamvotis) are about 600 km afar. *P. hemmeni* is not endemic to Lake Pamvotis because it could be found in waters N of the lake, too, but it could not be found far apart from this lake. From the zoogeographical point of view the three species mentioned above are very probably distinct species.

Identification key: Bithyniidae

However, it is not possible to identify the genus by shell features, so the genus groups can only be distinguished by the absence or presence of the penial appendix.

1. Penis with penial appendix ..... ***Bithynia***
1'. Penial appendix missing ..... ***Pseudobithynia***

Identification key: *Bithynia*

1. Shell height about 9–11 mm, convex whorls with a deep suture, operculu rounded, (Lake Pamvotis) ..... ***B. graeca***
1'. Shell smaller **2**
2. Shell small, height up to 5 mm, whorls stepped, operculum angled, umbilicus closed, (Lake Prespa) ..... ***B. prespensis***
2'. Shell larger, umbilicus not closed **3**
3. Shell conical with a prominent body whorl, umbilicus opened, deep suture, operculum angled (Corfu) ..... ***B. renei***
3'. Body whorl not prominent, operculum rounded .. **4**
4. Shell elongated conical, about 7 mm (male)–8 mm (female), convex whorls, with a deep suture (Crete) ..... ***B. cretensis***
4. Shell smaller about 5–6 mm **5**
5. Shell oval conical, umbilicus opened to slit-like, suture clear, whorls rounded, (Crete) ..... ***B. candiota***
5'. Shell elongated conical, umbilicus opened to slit-like, whorls convex, shell height up to 6.5 mm, (Lake Kastorias) ..... ***B. kastorias***

Identification key: *Pseudobithynia*

1. Margin of the aperture sinuated (side view) **2**
1'. Margin of the aperture straight (side view) **5**
2. Males are slimmer and smaller than the females: about 7 mm : 4 mm or 6 mm : 4.5 mm **3**
2'. Males are slimmer than the females and only slightly smaller **4**
3. Female: H:W = 1.55, male: H:W = 1.46, umbilicus opened, oviductual loop coiled, (Lake Trichonis, NW-shore) ..... ***P. panetolis***
3'. Female: H:W = 1.45, male: H:W = 1.60, umbilicus slit-like, oviductual loop not coiled, (Lake Trichonis, S-shore) ..... ***P. falniowskii***
4. Umbilicus opened, whorls slightly convex with a clear suture (Lake Trichonis, NE shore) ..... ***P. trichonis***
4'. Umbilicus closed, whorls slightly convex with a clear suture, (Samos) ..... ***P. gittenbergeri***
5. Shell elongated conical, umbilicus closed, slightly rounded whorls with a flat suture, body whorl not prominent, (Lake Pamvotis) ..... ***P. westerlundi***
5'. Body whorl prominent, umbilicus opened, deep suture **6**
6. Body whorl prominent, umbilicus opened, stepped whorls (Corfu) ..... ***P. renei***
6'. Body whorl prominent, umbilicus opened, rounded whorls (Lake Pamvotis and vicinity) ..... ***P. hemmeni***

In addition to the species mentioned above, Beriozkina et al. (1995) listed more species and genus groups of the Bithyniidae that live in the Balkans. These new descriptions have been published in 1995 by Anistratenko & Stadnichenko (1995) under the authorship of Beriozkina & Starobogatov. Therefore the authors of these new species are quoted as "Beriozkina et Starobogatov in Anistratenko & Stadnichenko, 1995" (Kantor & Sysoev 2005: 74). The authors devided the European genera of the Bithyniidae into five groups, distinguished by shell characters: the size, the shape of the shell, the umbilicus, the inflation of whorls, size of spiral nucleus. As Beriozkina et al. (1995) listed some species from Corfu that, in their opinion, belong to the genus *Paraelona* Beriozkina et Starobogatov, 1995, in our opinion, however, to the genus *Pseudobithynia* Glöer & Pešić, 2006, the latter genus would be a junior synonym of *Paraelona*.

The type species of the genus *Paraelona* is *Bithynia majewsky* Frauenfeld, 1862. The syntypes of this species have been studied by Schütt (1988), and this species has never been depicted (Schütt 1988: 37). Schütt designated a lectotype: 4.5 whorls, shell height 4.6 mm, shell width 3.1 mm, and identified this species with a juvenile of *Bithynia tentaculata*. Beriozkina et al. (1995: 36, Fig. 5a) depicted *Bithynia majewskyi* from the Rostov Region with these measures: shell height 6.6 mm, width 4.6 mm, while Anistratenko & Stadnichenko (1995: 150) depicted quite a different looking species with the measurements: shell height 5.3 mm and width 4.2 mm but in their description they gave the measurements: shell height 4–4.5 mm, width 3–3.5 mm. We do not know which species Beriozkina et al. (1995) used for their description of *B. majesky*, and how they could state a distribution range for this species from "Sicily, Balkan peninsula, shores of northern part of the Black and Azov seas and Caspian Sea". In addition Beriozkina et al. (1995: 35) mentioned *Bythinia hellenica* Kobelt, 1892 as a younger synonym of *B. majewskyi*, but the syntypes of *B. hellenica*, studied by the senior author, look distinct from *B. majewskyi*. Because the name *B. majewskyi* is a younger synonym of *B. tentaculata*, the genus *Paraelona* has no type species and is not a valid genus name.

In addition Beriozkina et al. (1995: 35) mentioned the species "*P. orsini* (Küster, 1852) = *Digyreidum servainianum* Letourneux, 1887 = *Bithynia graeca* Locard, 1894; *Bithynia narentana* Locard, 1874; *Digyreidum viride* Letourneux, 1887 = *Bithynia gracilis* Locard, 1894" as belonging to the genus *Paraelona*. *Paraelona orsini* (Küster, 1852) has been described as *Paludina orsinii* and belongs to the genus *Pseudamnicola* (Falkner & Boeters 2003).

The name *Bithynia graeca* Locard, 1894, is preoccupied by *Bithynia graeca* Westerlund, 1879, a species that lives endemically in the Lake Pamvotis.

Bithynia narentana has been described by Locard (1874: 82, pl. 5, Fig. 25) as belonging to the group of *Bithynia tentaculata*. The depicted species looks similar to *Bithynia mostarensis* Möllendorff, 1873 and seems to be a junior synonym tp the latter species.

The species *Digyreidum servainianum* Letourneux, 1887, and *Digyreidum viride* Letourneux, 1887, are in our opinion synonyms to *Pseudobithynia renei*.

The species' name *Bithynia gracilis* (Locard, 1894) is preoccupied by *Bithynia gracilis* (Sandberger, 1863).

The species of the genus *Paraelona* mentioned above are not described by Beriozkina & Starobogatov (1995), but the authors added descriptions of the species *Paraelona boissieri* (Küster, 1852) (= *Bythinia ilysaeca* Locard, 1894) as well as *P. socialis* (Westerlund, 1886) (= *Digyreidum renei* Letourneux, 1887). *Paludina boissieri* Küster, 1852, has been described to have the region of Rome (Küster 1852: 36) as its type locality, and not Sicily, as mentioned by Beriozkina & Starobogatov (1995: 36). Topotypes, studied by the senior author, revealed that *Paludina boissieri* belongs to the genus *Bithynia* because it has a penial appendix and a flagellum. As this species could not be found in the many samples from the Balkans, that have been studied, it seems to be endemical to Italy. *Bythinia ilysaeca*, which should be a synonym of *Paludina boissieri* (see above), is, according to the drawing given by Locard (1894: pl. VI, Fig. 5), distinct from the topotypes of *B. boissieri* as well as from the specimen depicted by Beriozkina & Starobogatov (1995: Fig. 5C).

Bythinia socialis Westerlund, 1886, described and depicted also by Kobelt (1892: p. 68-69, icon. 863) looks distinct from the drawing in Beriozkina & Starobogatov (1995: 36, Fig. 5D), and in addition the topotypes of *Digyreidum renei* (Fig. 4.1–4.5) look distinct, too.

Summarising, we can say that it is not possible to revise on the Bithyniidae from the Mediterranean without a study of the syntypes or topotypes of the species. In addition zoogeographical aspects should be taken under consideration because in the Balkans most of the Bithyniidae are restricted in their distribution to ancient lakes or mountainous regions, only some species that live in the lowlands have a larger range of distribution.

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