

# Notes on *Eubrephulus peloponnesicus* (E. Gittenberger, 1984) (Gastropoda, Enidae)

FRANK WALTHER

Center of Natural History, Zoological Museum, University of Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany;  
fw.walther@gmail.com [corresponding author]

INGA GRYL

University of Duisburg-Essen, Schützenbahn 70, 45127 Essen, Germany;  
inga.gryl@uni-due.de



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New data on the shell and the genital anatomy as well as on distribution and ecology of *Eubrephulus peloponnesicus* (E. Gittenberger, 1984) are presented. The morphology of genitalia and shell confirm the classification as *Eubrephulus*. Differences to the genera *Chondrula* and *Mastus* are discussed.

Key words: *Eubrephulus*, *Chondrula*, *Mastus*, Greece, Peloponnes, land snail, genital anatomy.

## INTRODUCTION

*Eubrephulus peloponnesicus* (E. Gittenberger, 1984) is a virtually unknown member of family Enidae from the western part of Peloponnes Peninsula, Greece. It has been described based on a single intact but bleached shell (Gittenberger, 1984). Since its description no further information concerning this species has been published, except for the picture of a less bleached shell from a second locality (Welter-Schultes, 2012).

Originally, the species was assigned to *Eubrephulus* A.J. Wagner, 1928 based on shell similarities. *Eubrephulus* is usually listed as a subgenus of *Chondrula* (e.g. Gittenberger, 1984; Schütt, 2010; Welter-Schultes, 2012) or as an independent genus (e.g. Gümüş & Neubert, 2012; Irikov & Eröss, 2008; Páll-Gergely & Bank, 2016) with two additional species, the type species *E. bicallosus* (L. Pfeiffer, 1847) and *E. orientalis* (L. Pfeiffer, 1848). However, the assumption that *E. peloponnesicus* shares the anatomical characteristics

with the two other *Eubrephulus* has not been verified so far. In the Red Book of endangered animals of Greece (Vardinoyannis et al., 2009) the species is listed twice, first as *Chondrula peloponnesica* and a second time as *Mastus peloponnesicus*. It is also listed as *Mastus* in the taxonomic web databases Fauna Europaea (Bank, 2013) and MolluscaBase (Bank & Neubert, 2017). No arguments for a placement in *Mastus* have been published, but we suppose that the absence of palatal teeth led to this placement. Palatal teeth are a key character for *Chondrula* but are missing in *Mastus*.

Here, we present the first record of live collected specimens of *E. peloponnesicus* along with data on its shell variation, genital anatomy, habitat requirements, and distribution.

## MATERIALS AND METHODS

Shells were collected by hand in spring 2019. Living specimens were killed in boiling water as described by Fukuda et al. (2008) and immediately transferred to 70% ethanol for anatomical studies. We studied more than 70 specimens from three localities (see below). The material is deposited in the collection of the authors (FW) and in the collection of H.-J. Hirschfelder. Additional voucher specimens and tissue material suitable for molecular biological studies are stored in the collection of the Zoological Museum Hamburg (ZMH). Shell dimensions were measured under a stereo microscope (magnification 6-40 ×) with an ocular micrometer. The counting of whorls with an accuracy of 0.25 whorl follows Kerney & Cameron (1979). The genitalia of two specimens were examined. The terms proximal and distal in the description of the genitalia refer to the position in relation to the gonad.



**Figs 1-4.** Shells of *Eubrephulus peloponnesicus* (E. Gittenberger, 1984). 1-2. Moni Loukous (FW 14612). 3-4. Agios Andreas towards Oreino Korakovouni (coll. Hirschfelder) (Figs 3b, 4 slightly inclined to illustrate the presence respectively absence of a palatal tooth). Scale bar 2 mm.

## SYSTEMATIC PART

Superfamily Pupilloidea Turton, 1831

Family Enidae B.B. Woodward, 1903 (1880)

Subfamily Eninae B.B. Woodward, 1903 (1880)

Tribe Chondrulini Wenz, 1923

Genus *Eubrephulus* A.J. Wagner, 1928

*Eubrephulus* A.J. Wagner, 1928: 310. Type species (selected by Forcart, 1940: 250): *Bulimus bicallus* L. Pfeiffer, 1847.

*Eubrephulus peloponnesicus* (E. Gittenberger, 1984)

*Chondrula* (*Eubrephulus*) *peloponnesica* Gittenberger, 1984: 330-332, figs 1 (shell), 4 (distribution).

*Chondrula peloponnesica* – Vardinoyannis, Giokas & Mylonas, 2009: 445.

*Mastus peloponnesicus* – Vardinoyannis, Giokas & Mylonas, 2009: 446.

*Chondrula peloponnesica* – Welter-Schultes, 2012: 176.

Shell (Figs 1-4). — Shell dextral, fusiform, thin-shelled, with 8.5-11 very slightly convex whorls and shallow suture;

slightly translucent, light corneous. Teleoconch with irregular, fine, radial striae. Peristome reflected, particularly on the parietal side. Palatal callus well developed except for the upper third of the palatal wall; an indistinctly to strongly developed denticle marks the uppermost end of the parietal callus. Subangularis stretching as a sharp crest over the entire parietal area, connected with the columellar insertion of the peristome, often with an oblique thickening at the angular edge and a second oblique thickening near the columellar edge. Columellaris very prominent, oblique, reaching deep inside the shell. Umbilicus narrow, slit-like, usually obscured by the columellar margin.

The shell description above is essentially the same as the detailed original description (Gittenberger, 1984). However, in the holotype the palatal denticle is hardly recognizable. In the majority of our specimens, the denticle is present as a clearly pronounced, sometimes even tooth-like swelling. Individuals with a well-marked palatal denticle have also a prominent parietal crest and high columellaris, whereas these apertural structures are much lower in individuals without a palatal swelling.

When comparing the shell dimensions of the three populations (Table 1) we noticed differences in shell height and the number of whorls. Other shell characters do not differ between the populations. A single specimen from Agios

	H (mm)	D (mm)	HA (mm)	WA (mm)	W
Moni Loukos ( $n = 20$ )	13.7-16.1	3.5-4.3	3.5-4.3	2.7-3.3	9.25-11.0
Agios Andreas 8.9 km towards Tiros ( $n = 20$ )	11.0-14.0	3.6-4.0	3.5-4.0	2.5-2.8	8.5-10.0
Agios Andreas, road towards Oreino Korakovouni ( $n = 16$ )	12.2-15.0	3.5-4.0	3.2-3.8	2.3-3.8	9.25-10.5

**Table 1.** Shell dimensions of *Eubrephulus peloponnesicus* (E. Gittenberger, 1984). Abbreviations: H: shell height, D: shell diameter, HA: height of aperture, WA: width of aperture, W: number of whorls.

Andreas towards Oreino Korakovouni (Fig. 3) differs significantly from all other shells in the presence of a well developed parietalis. This shell is also thicker and has fewer whorls than all the other shells of the same population.

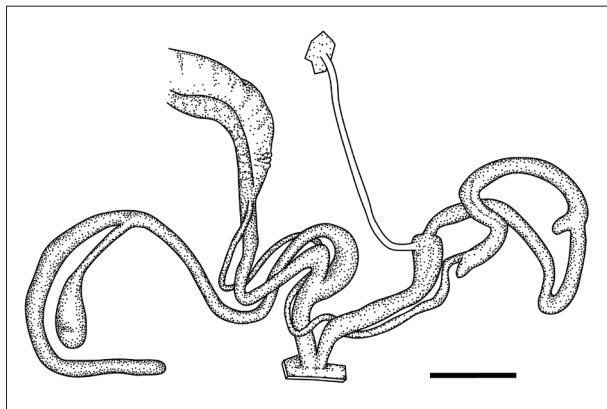
Genitalia (Fig. 5). — Penis elongated, almost cylindrical, proximal part somewhat thicker, no penial appendices; penial retractor attaches nearly at proximal end of penis next to insertion of epiphallus; epiphallus 2.75 times longer than penis and slightly thinner; epiphallus caecum before middle of epiphallus; short flagellum at the end of epiphallus. Vagina and oviduct cylindrical; oviduct 2.4 times longer than vagina. Bursa copulatrix elongated ovate; pediculus of bursa copulatrix much longer than oviduct, near its insertion to the vagina thicker than vagina or oviduct; a long, relatively thick diverticulum inserts at the last quarter of the pediculus; diverticulum 2 times longer than bursa copulatrix and proximal part of the pediculus together. Right ommatophoral retractor crossing between penis and vagina.

The genitalia of *E. peloponnesicus* largely agree with the drawings of the genitalia of *E. bicallosa* (Wagner 1928: pl. 18 figs 154-155; Pintér & Pintér, 1970: fig. 2; Hudec & Vašátko, 1973: text-fig. 2; Schileyko, 1978: fig. 4) and *E. orientalis* (Forcart 1940: text-fig. 13). In *E. peloponnesicus*, the diverticulum of the bursa copulatrix is shorter than in the other

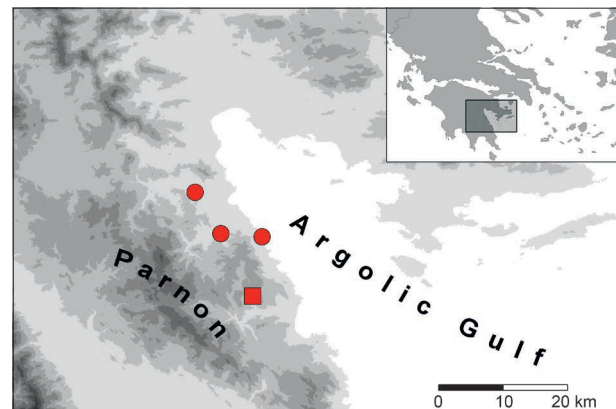
species and the epiphallus caecum is slightly more distal. We assume that the differences fall within the variability of these characters because a comparison of the four figures of the genitalia of *E. bicallosa* shows also several minor differences.

Distribution (Fig. 6). — *Eubrephulus peloponnesicus* lives in a small part of the coastal area of Arcadia (Peloponnese peninsula) from Astros southwards to Leonidio. So far, the species is known from the following four localities:

- 15 km NW of Leonidion along the main road (type locality).
- Moni Loukous (Welter-Schultes 2012); Moni Loukous, parking area (4 shells, FW 15173, ex coll. Hemmen); Moni Loukous, 37.4132°N 22.6846°E, 160 m a.s.l., leg. F. Walther & E.M. Gryl (21 shells & 4 specimens in 70% ethanol; FW 14612, ZMH 147427).
- Agios Andreas 8.9 km towards Tiros (N of Krioneri), 37.3201°N 22.8247°E, 40 m a.s.l., leg. F. Walther (25 shells; FW 14613, ZMH 147428).
- Agios Andreas, along road towards Oreino Korakovouni approximately 1.3 km from the main road Agios Andreas-Kastanitsa, 37.3267°N 22.7384°E, leg. H.-J. Hirschfelder & K. Kittel (17 shells, FW 15484, coll. Hirschfelder).



**Fig. 5.** Genitalia of *Eubrephulus peloponnesicus* (E. Gittenberger, 1984) from Moni Loukous (FW 14612). Scale bar 1 mm.



**Fig. 6.** Type locality (square) and further localities (dots) of *Eubrephulus peloponnesicus* (E. Gittenberger, 1984).

Habitat. — All localities of *E. peloponnesicus* are in karstic environment with phrygana vegetation. Living specimens were found in vegetation debris and soil under layers of small stones which had accumulated between the limestone rocks. One living specimen was found attached directly to the limestone rock deep in a crevice. At the two localities surveyed by us, *E. peloponnesicus* is the snail species with the highest abundance, although living specimens are much rarer than dead shells. Associated species are *Albinaria petrosa astrosensis* H. Nordsieck, 2007, *Lindholmiola lens* (A. Férussac, 1832), *Orculella critica* (L. Pfeiffer, 1856) and *Zonites parnonensis* A. Riedel, 1985 at Moni Loukou and *Albinaria spec.*, *Cochlostoma parnonis* Schütt, 1981 and *Lindholmiola lens* (A. Férussac, 1832) at Agios Andreas 8.9 km towards Tiros.

## DISCUSSION

The conformity of the genitalia shows that *E. peloponnesicus* is indeed closely related to *E. bicallosus* (L. Pfeiffer, 1847) and *E. orientalis*. This is corroborated by the common occurrence of a palatal denticle and further shell characters already mentioned by Gittenberger (1984), namely the fusiform shell form and the strong columellaris. Unfortunately, these characters do not allow a justified statement on the phylogenetic position of the group in relation to the genera *Chondrula* and *Mastus*. According to Schileyko (1998) the attachment point of the penial retractor is the most meaningful character in the genitalia. In *Eubrephulus* it attaches at the proximal part of the penis, whereas in *Chondrula* the attachment point is in the middle of the penis. In *Mastus*, however, both character states occur. The *Mastus* species with a proximal attachment point (inferred from Maassen, 1995) do not cluster together in molecular biological studies (Parmakelis et al., 2003). The attachment point of the penial retractor is therefore of little value for a separation of groups within *Mastus* and probably also for an assessment of its relationship to other groups. So far, molecular genetic studies focused solely on radiations within the genera *Chondrula* and *Mastus* (e.g. Parmakelis et al., 2003, 2005; Snegin et al., 2017) but did not deal on their relationship to each other or to other groups of the Enidae.

As demonstrated above, there is no reason to assume that *Eubrephulus* is closer related to *Mastus*. However, the fact that *Eubrephulus* and *Chondrula* have apertural teeth is also no argument for a close relationship as the teeth are developed differently. Neither the prominent columellaris nor the long, crest-like subangularis are found in *Chondrula*. Only the exceptional occurrence of a well-developed parietalis in a single specimen could indicate a relationship to *Chondrula*.

We would like to emphasize that the members of *Eubrephulus* and particularly *E. peloponnesicus* are similar in anatomy and shell characters to the species of the East Aegean genus *Meijeriella* Bank, 1985, although the missing columellaris in *Meijeriella* is a good distinguishing character. *Eubrephulus* might be more closely related to *Meijeriella* than to *Mastus* or *Chondrula*.

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