A new high-altitude *Metafruticicola* species from Türkiye (Gastropoda, Pulmonata, Hygromiidae)

Aydin Örstan
Research Associate, Section of Mollusks, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA; anothersnail@hotmail.com [corresponding author]

M. Zeki Yildirim
Mehmet Akif Ersoy Üniversitesi, Bucak Sağlık Yüksek Okulu, Burdur, Türkiye

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Abstract

A land snail from an altitude of 2300 m on Tahtalı Mountain in southern Türkiye is described as a new species, *Metafruticicola diva* Örstan & Yıldırım spec. nov. The new species is distinguished from the previously known high-altitude *Metafruticicola* species by its unbanded shell with short hairs and anatomical characteristics.

Key words. Land snail, montane, genitalia, radula.

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Introduction

The land snail genus *Metafruticicola* contains 23 species distributed in Greece, Türkiye, Cyprus, Lebanon, Israel and the coastal areas of Syria (Bank et al., 2013; MolluscaBase, 2022). Altitudinal distributions of the *Metafruticicola* species extend from almost sea level to above 2500 m. Four conchologically similar species that form a zoogeographic group live in habitats restricted to altitudes above 1000 m in mountainous areas of central-south Türkiye. Here we describe a new *Metafruticicola* species belonging to the same group from an altitude of 2300 m on Tahtalı Mountain in southern Türkiye.

Materials and Methods

Shell diameters and heights were measured using calipers. Umbilicus diameters and diameters of very small juvenile shells consisting of only protoconch whorls were measured under a stereomicroscope. The latter measurements are presented here as protoconch diameters. Whorls were counted as in Kerney & Cameron (1979). The radula was extracted by macerating the buccal tissues in 10% KOH, cleaned in dilute household bleach, mounted in dilute glycerine and photographed using a compound microscope. Photographs taken at different focus levels were stacked using Helicon Focus (Helicon Soft). Individual parts of the genitalia were measured on photographs using ImageJ (https://imagej.nih.gov/ij/). In the description of the genitalia, distal and proximal are with respect to the ovotestis. In addition to hand collecting of large shells at the type locality, a small amount of soil was also taken, which yielded protoconchs of the new species and the specimens of the smaller species. Collections were done under a permit issued by the Doğa Koruma ve Milli Parklar Genel Müdürlüğü (General Directorate of Nature Conservation and National Parks, Republic of Türkiye).

Systematics

Family Hygromiidae Tryon, 1866
Genus *Metafruticicola* Ihering, 1892

Metafruticicola diva Örstan & Yıldırım spec. nov.
Figures 2–5

ZooBank registration. urn:lsid:zoobank.org:act:FA98665D-9DB0-495B-9F80-FE32A80D5221

Type series. The holotype (shell) (CM 152530), 37 paratypes (36 shells and one specimen in alcohol) (CM 152531) have been deposited in the Carnegie Museum of Natural History, Pittsburgh, PA, USA; 14 paratypes (shells) have been deposited in the Naturhistorisches Museum Bern, Bern, Switzerland (NMBE 573356). Thirty-seven paratypes (36 shells, including 10 protoconchs, and one dissected specimen in alcohol) are in the collection of the first author and six paratypes (shells) are in the collection of the second author at Mehmet Akif Ersoy Üniversitesi.

Figure 1. Habitat at the type locality of *Metafruticicola diva* spec. nov. The handle of the pick in the foreground was ~30 cm long.

Type locality. Calcareous rocks along a ~325 m transect (between coordinates 36.5370°N, 30.4411°E and 36.5392°N, 30.4387°E) following the hiking trail in a northwest direction on slopes below the cable-car station (Olympos Teleferik) at the peak of Tahtalı Mountain, northwest of Tekirova, Antalya, Türkiye (Fig. 1). Elevation: 2270–2325 m. Collected on 15 May 2022.

Diagnosis. Shell moderately flat with low, dense, broken ribs and short hairs, not banded; epiphallus and flagellum considerably longer than penis.

Description of shell. Adult shells (diameter larger than ~11 mm) with flat body whorl and moderately raised spire (Fig. 2A–C). Teleoconch light brown, shiny, not banded; sculptured with closely spaced, low ribs of uneven lengths; extremely faint wavy spirals visible on some shells. Hairs, straight or slightly curved and 0.10–0.18 mm long, or distinct hair pits present on shells with intact periostracum (Figs 2, 3). Body whorl descends slightly at aperture; aperture slightly wider than high; lip not reflected, but forms slightly thickened rim surrounding aperture; white rib present inside. Umbilicus widens during last whorl; slightly obstructed by columellar edge of aperture on some shells. At aperture, body whorl ~1.4 times wider than penultimate whorl. Body whorl rounded in frontal view in adult shells, slightly shouldered in juvenile shells (diameter less than ~7 mm). Protoconch (~1.5 whorls) same color as teleoconch; initial quarter whorl smooth at magnifications up to 50×, subsequent whorls with indistinct radial ribs. End of protoconch marked by thin varix, afterwards ribs become more distinct and hairs appear (Fig. 3).

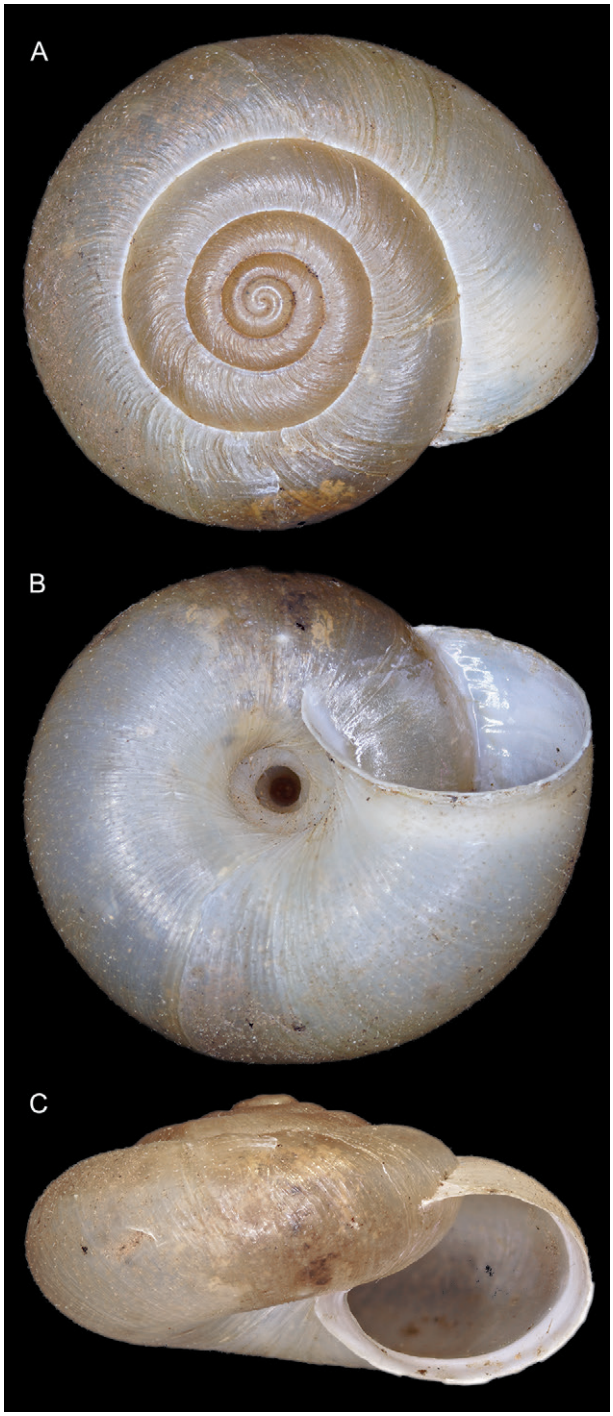

Figure 2. Holotype of *Metafruticicola diva* spec. nov.; diameter, 14.6 mm.

Dimensions. Holotype: diameter, 14.6 mm; height, 7.8 mm; whorls, 4.8; ratio of shell diameter to umbilicus, 5.1.

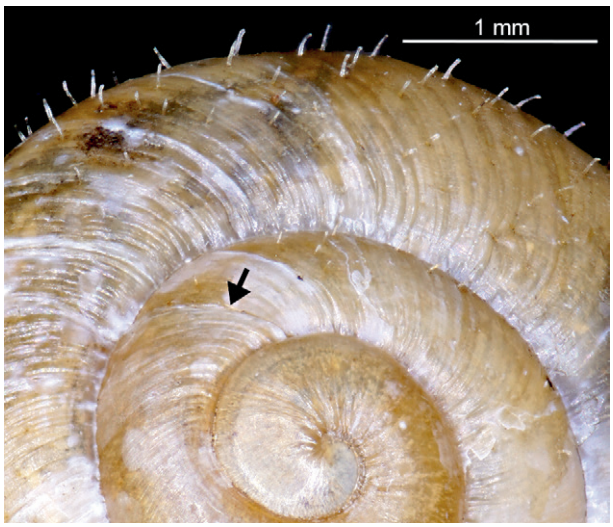

Figure 3. Close-up of a juvenile shell of *Metafruticicola diva* spec. nov. showing the end of the protoconch (arrow), microsculpture and hairs.

Five largest paratypes (diameter, height): 14.4, 7.1; 14.9, 8.0; 15.2, 8.9; 15.3, 8.0; 15.9, 8.5 mm. Protoconch diameter (n = 4), 2.0 mm.

Anatomy. Foot, light gray; dorsal head and tentacles, dark gray. Mantle with irregularly shaped black spots visible through shell (Fig. 4A). Penis much shorter than epiphallus and flagellum; flagellum 1.8 times longer than epiphallus, 1.3 times longer than duct of bursa copulatrix. Retractor muscle short, attaches to epiphallus within distal third of its length. Free oviduct slightly longer than vagina (Fig. 4B). Inside walls of penis with few longitudinal folds; papilla short single lobe (~1 mm) with longitudinal groove (Fig. 4C).

Radula and jaw. Each row with ~60 teeth. Central tooth tricuspid with long mesocone and very small side cusps; on each side of central tooth 11 bicuspid laterals with one small ectocone followed by about 18 lateromarginals with mesocones divided into two cusps and large triangular ectocones; marginals not examined (Fig. 5A, B). Jaw horseshoe-shaped with wrinkled, transversely striated surface divided into low ridges (Fig. 5C).

Comparison with other species. We examined 95 adult and juvenile shells of *M. diva* spec. nov. during the preparation of its description. This relatively large sample enabled us to estimate the range of the conchological variation of the new species. We assumed the thickened rim surrounding the aperture represented maturity although it was present on some shells with diameters as small as 11.3 mm, but absent on a few much larger shells.

Metafruticicola diva spec. nov. is the fifth member of a zoogeographic group that is made up of conchologically similar species from altitudes above 1000 m in mountainous areas of central-south Türkiye. The shell of *M. diva* spec. nov. differs clearly from the shells of the other high-altitude *Metafruticicola* species. The shell of *M. dedegoelensis* Hausdorf et al., 2004 has a distinct keel and ribs more prominent than those on the shells of *M. diva* spec. nov. and apparently lacks hairs (Hausdorf et al., 2004). The shell of *M. oerstani* Hausdorf et al., 2004 also has hairs, but differs from the shell of *M. diva* spec. nov. in the presence of a white and a brown band on the body whorl (clearly visible in color photos in Bank et al., 2013: fig. 67). *Metafruticicola kizildagensis* Gümüş & Neubert, 2012 is larger (holotype diameter, 20.4 mm) and it too has a white and a brown band on its body whorl (Gümüş & Neubert, 2012). Finally, the shells of *M. monticola* Bank et al., 2013 are much larger (up to 27.9 mm in diameter), lack hairs

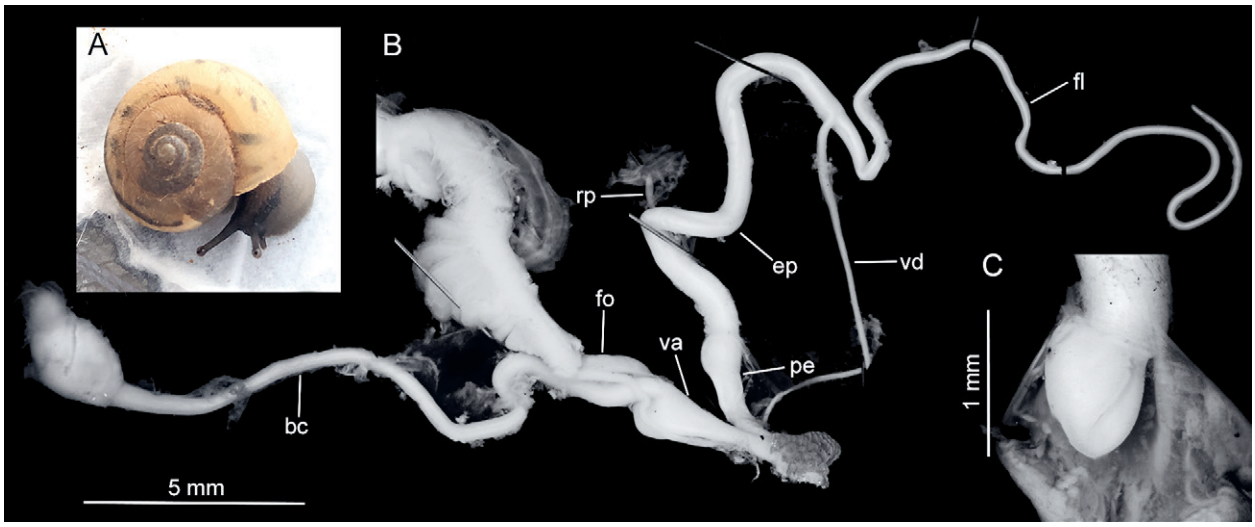

Figure 4. Anatomy of *Metafruticicola diva* spec. nov. **A.** Live snail. **B.** Genitalia. **C.** Papilla inside the penis. Abbreviations: bc: bursa copulatrix, ep: epiphallus, fl: flagellum, fo: free oviduct, pe: penis, rp: retractor of penis, va: vagina, vd: vas deferens.

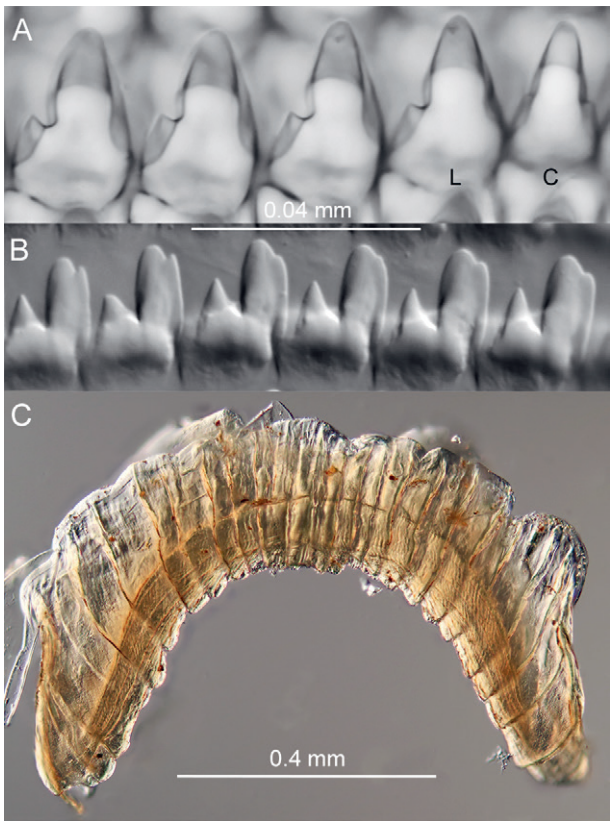

Figure 5. Radula and jaw of *Metafruticicola diva* spec. nov. **A.** Tricuspid central (C) and four bicuspid laterals (L). **B.** Lateromarginals with bicuspid mesocones and large triangular ectocones. **C.** Jaw.

and have reflected and strongly descending lips (Bank et al., 2013).

Among the previously described species, the genitalia of only *M. dedegoelensis* and *M. oerstani* are known (Hausdorf et al., 2004). The length ratios of various parts of the genitalia of *M. diva* spec. nov. differ from the length ratios calculated from the published descriptions of both of those species. The epiphallus to penis ratio of *M. diva* spec. nov. (4.2) is larger than those of both *M. dedegoelensis* (1.4) and *M. oerstani* (1.9). Likewise, the flagellum to penis ratio of *M. diva* spec. nov. (7.7) is much larger than those of both *M. dedegoelensis* (1.9) and *M. oerstani* (2.4). In addition, in both *M. dedegoelensis* and *M. oerstani* the free oviduct is more than twice as long as the vagina with length ratios of 2.3 and 2.9, respectively; while in *M. diva* spec. nov. the lengths of the free oviduct and the vagina are closer to each other with a ratio of 1.3.

Etymology. The specific name of the new species is from Latin *diva* (goddess) on account of Tahtalı Mountain being one of the several mountains that were named Olympus (and where gods were believed to have resided) in antiquity (Bean, 1968: 165). The gender of the name *Metafruticicola* is feminine (Welter-Schultes, 2007).

Figure 6. Juvenile shell of *Metafruticicola diva* spec. nov. that was peeled probably by a predator.

Discussion

Using only on shell characteristics, Bank et al. (2013) separated the *Metafruticicola* species into four subgenera as *Metafruticicola* s. str., *Cretigena*, *Rothifruticicola* and *Westerlundia*. The shell characteristics of *M. diva* spec. nov. would place it in the subgenus *Rothifruticicola* where the other four high-altitude species have also been placed (Bank et al., 2013). Schileyko & Fehér (2017) argued that the anatomy of the penile papilla was also specific enough to distinguish among these subgenera. But they also noted that the distribution of the species between the subgenera using either conchological characters or the anatomy of the penile papilla did not always conform to each other. In the anatomical scheme of Schileyko & Fehér (2017), the subgenus *Rothifruticicola* was distinguished from the other subgenera by its bilobed penile papilla. However, *M. diva* spec. nov. does not fit into that definition of *Rothifruticicola*, because its penile papilla consists of a single lobe (Fig. 4C). We note that the penile papilla of *Metafruticicola schuberti* (J.R. Roth, 1839) placed in the subgenus *Rothifruticicola* by Bank et al. (2013), also has a single lobe (Örstan & Yıldırım, 2022). Clearly, further research is needed to understand the within genus phylogeny of *Metafruticicola*. Therefore, until additional anatomical or molecular information becomes available, we have decided not to place *M. diva* spec. nov. in a subgenus.

Very little information is available about the natural history of these high-altitude species. It has been suggested that their relatively flat shells might be an adaptation to live in narrow crevices in rocks (Hausdorf et al., 2004). On Tahtalı Mountain the habitat of *M. diva* spec. nov. is under snow for about six months from near the end of October through most of April; during our survey on 15 May 2022

there were still large patches of snow covering the slopes at the type locality and even at slightly lower altitudes below it. Therefore, *M. diva* spec. nov. would be expected to be active during the late spring and the summer when the soil in its habitat would be wet from melted snow. It is not known what animals may be preying on these snails. One small *M. diva* spec. nov. shell we collected had a spiraling opening with jagged edges on the ventral side of its body whorl (Fig. 6). A small mammal or a large predatory beetle may have peeled the body whorl open and consumed the snail.

At the type locality of *M. diva* spec. nov. we also found *Oligolimax annularis* (S. Studer, 1820) and a few mostly juvenile shells tentatively identified as *Pyramidula pusilla* (Vallot, 1801). Time constraints prevented us from surveying at lower altitudes below the peak. But at five localities between the altitudes of 80 m and 730 m we found *M. schuberti* (the slopes of Tahtalı Mountain above about 800 m are difficult to access). The range of *M. diva* spec. nov. is probably restricted to areas above the treeline, which is located at about 1500 m on the slopes of Tahtalı Mountain (estimated in Google Earth). The other high-altitude *Metafruticicola* species have also never been collected at locations below about 1000 m. Therefore, the populations of these species that are separated from each other by uninhabited lower altitudes would be expected to have been isolated from each other genetically. Because such populations may have been evolving as independent lineages, they may be considered to be separate species (de Queiroz, 2007) even when the conchological and anatomical differences between them are slight.

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