

New data on the genus *Guadiella* Boeters, 2003 (Gastropoda: Hydrobiidae) from the northern half of the Iberian Peninsula, with the description of a new species

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A new species of the *Guadiella* genus of springsnails is described from Calanda (Teruel province, Aragón, Spain). The status of the previously described *Alzoniella murita* is reviewed, placing it also in the genus *Guadiella*. Additional data on *Guadiella arconadae* and *Guadiella ballesterosi* are also provided with new material collected from their type localities.

This new species is the eighth known of its genus, all of them in the Iberian Peninsula, and the second stygobiont mollusc found at the same locality, after *Hadziella forneri*.

Keywords: freshwater, springs, *Guadiella*, *Alzoniella murita*, new species, stygobiont.

Noves dades sobre el gènere *Guadiella* Boeters, 2003 (Gastropoda: Hydrobiidae) de la meitat nord de la península Ibèrica, amb la descripció d'una nova espècie

En aquest estudi es descriu una nova espècie del gènere de caragols aquàtics *Guadiella* per Calanda (província de Terol, Aragó, Espanya). S'hi revisa l'estatus de l'anteriorment descrita *Alzoniella murita*, que també es passa al gènere *Guadiella*, i es proporcionen noves dades de *Guadiella arconadae* i *Guadiella ballesterosi* a partir de material recollit de les seves respectives localitats tipus.

Amb aquesta nova espècie, serien vuit les espècies descrites per aquest gènere, totes elles a la península Ibèrica, tractant-se a més del segon mol·lusc estigobi trobat a la mateixa localitat, juntament amb *Hadziella forneri*.

Paraules clau: aigua dolça, fonts, *Guadiella*, *Alzoniella murita*, nova espècie, estigobi.

The stygobiont fauna, which inhabits interstitial underground waters, is probably one of the least known of the whole planet. Recently, however, many new taxa have been described, thus revealing the unexpected richness of these ecosystems. The recent episodes of drought in many places, particularly in the Mediterranean basin, the overexploitation of underground waters, and climate change, will drive these species to extinction if no rational use of water is implemented. Thus, knowledge of biodiversity in these ecosystems appears as a major priority and concern for conservation.

In the Iberian Peninsula, over the last two decades, many new species of stygobiont molluscs, belonging to

the families Moitessieridae and Hydrobiidae, have been described. From only 7 described species known at the end of 20th century, their number has skyrocketed to an astonishing 75 (manuscript in preparation by the authors), while many other species await description.

Within the Hydrobiidae family of freshwater snails, the genus *Guadiella* Boeters, 2003 includes strict stygobiont species of small size, conical/cylindrical and elongated shape. At present, only six species are known in this genus, all distributed in different parts of Spain: *Guadiella andalucensis* (Boeters, 1983), the type species of the genus, is present in the Guadalquivir River basin, in the provinces of Jaén and Sevilla; *Guadiella*

ramosae Boeters, 2003, only known from a spring in the province of Jaén; *Guadiella arconadae* Boeters, 2003, whose generic status is still unresolved (see Arconada *et al.*, 2007), known from a single locality in the province of Burgos; *Guadiella ballesterosi* Alba, Tarruella, Prats, Corbella & Guillén, 2009, from a single spring in the province of Tarragona; *Guadiella pilelongata* Quiñonero-Salgado, Martín-Álvarez, López-Soriano & Rolán, 2018 from a single spring in the province of Huelva, in the Guadiana River basin; and *Guadiella algarvensis* Martín-Álvarez, Quiñonero-Salgado, López-Soriano, Raven, Alonso & Glöer, 2024 from the south of Portugal.

The genus *Guadiella* was erected to include a few species that did not fit well with representatives of the genus *Alzoniella* Fo. Giusti & Bodon, 1984. Originally, the two species that matched best with the description of the new genus, anatomically and conchologically, were from the Guadalquivir River basin (leading to the name of the genus). Indeed, Boeters himself (2003) only provisionally included *G. arconadae* in the genus, and not within *Alzoniella*, as its distribution did not match that of the other two known species of *Guadiella*. However, the discovery of a new species in Catalonia, and later on another two in the Guadiana River basin, substantially enlarged the distribution range of the genus, suggesting it could be much more widespread, possibly throughout the Iberian Peninsula. Similarly, contrary to *Guadiella*, all *Alzoniella* species were supposed to be crenobiont, with the exception of *Alzoniella murita* Boeters, 2003, which was provisionally placed within this genus, although with some doubt whether it might rather be part of *Guadiella* (Boeters, 2003).

In this paper the knowledge on this poorly studied genus is expanded through a revision of the generic adscription for *Alzoniella murita*, the description of a new species of *Guadiella* from Aragón (NE Spain), and the provision of new data regarding some of the least known species of the genus, *G. arconadae* from Burgos, and *G. ballesterosi* from Tarragona, thus reviewing all the species from the northern half of the Peninsula.

Materials and methods

The type locality for the new species was visited in October 2021. Various stones were turned over and sediment was collected from the spring and later washed using sieves of different mesh size (2.0, 1.0 and 0.25 mm). The sediment was then dried and, under a

stereomicroscope, shells were separated with a fine brush and then cleaned with tap water.

New material from the type localities of *A. murita*, *G. arconadae* and *G. ballesterosi* was obtained between 2020 and 2022 by the first author, by sieving sediment in the same way.

All the shells were measured under stereomicroscope with the help of a scale with 0.01 mm precision. Specimens were photographed through a trinocular Nexius Zoom NM1903-S stereomicroscope, with a Euromex CMEX-10PRO camera adapted. Some empty shells were mounted on an aluminium stub for scanning electronic microscopy images, obtained without coating in a JEOL JSM-6480 LV using low vacuum, 10KV voltage and 30 Pa pressure, to reveal their microsculpture.

Abbreviations: Naturalis: Naturalis Biodiversity Center (Leiden); SEM: Scanning Electron Microscopy; s: shell; a.s.l.: above sea level.

Results

Systematics

Family Hydrobiidae Stimpson, 1865

Genus *Guadiella* Boeters, 2003

Type species: *Belgrandiella andalucensis* Boeters, 1983 by original designation

Redefinition (modified from Arconada *et al.*, 2007): Shell narrow, long, cylindrical to slightly conical. Surface smooth or with microsculpture of fine, irregularly shaped pits, best seen on the protoconch. The edge of the aperture is sharp; only its columellar border may be slightly broadened. Horny operculum of yellowish colour. The animal lacks pigmentation, has no eyes, gill with 7–15 leaflets, rectum forms two z-like loops, penis simple (only *G. arconadae* has a small lateral appendix), female genital tract with bursa and single receptaculum.

The genus comprises the following eight species: *G. algarvensis*, *G. andalucensis*, *G. arconadae*, *G. ballesterosi*, *G. kolendaensis* sp. nov.; *G. murita* (Boeters, 2003) comb. nov., *G. pilelongata*, and *G. ramosae*. All are stygobionts from the Iberian Peninsula.

Guadiella kolendaensis sp. nov.

(Figs. 1, 2, 4A)

Material: Holotype RMNH.MOL.350854 (Naturalis) (Fig. 2); Paratypes: 3s. RMNH.MOL.350855 (Naturalis).

Other material examined: 40 shells in SQS collection, from the type locality.

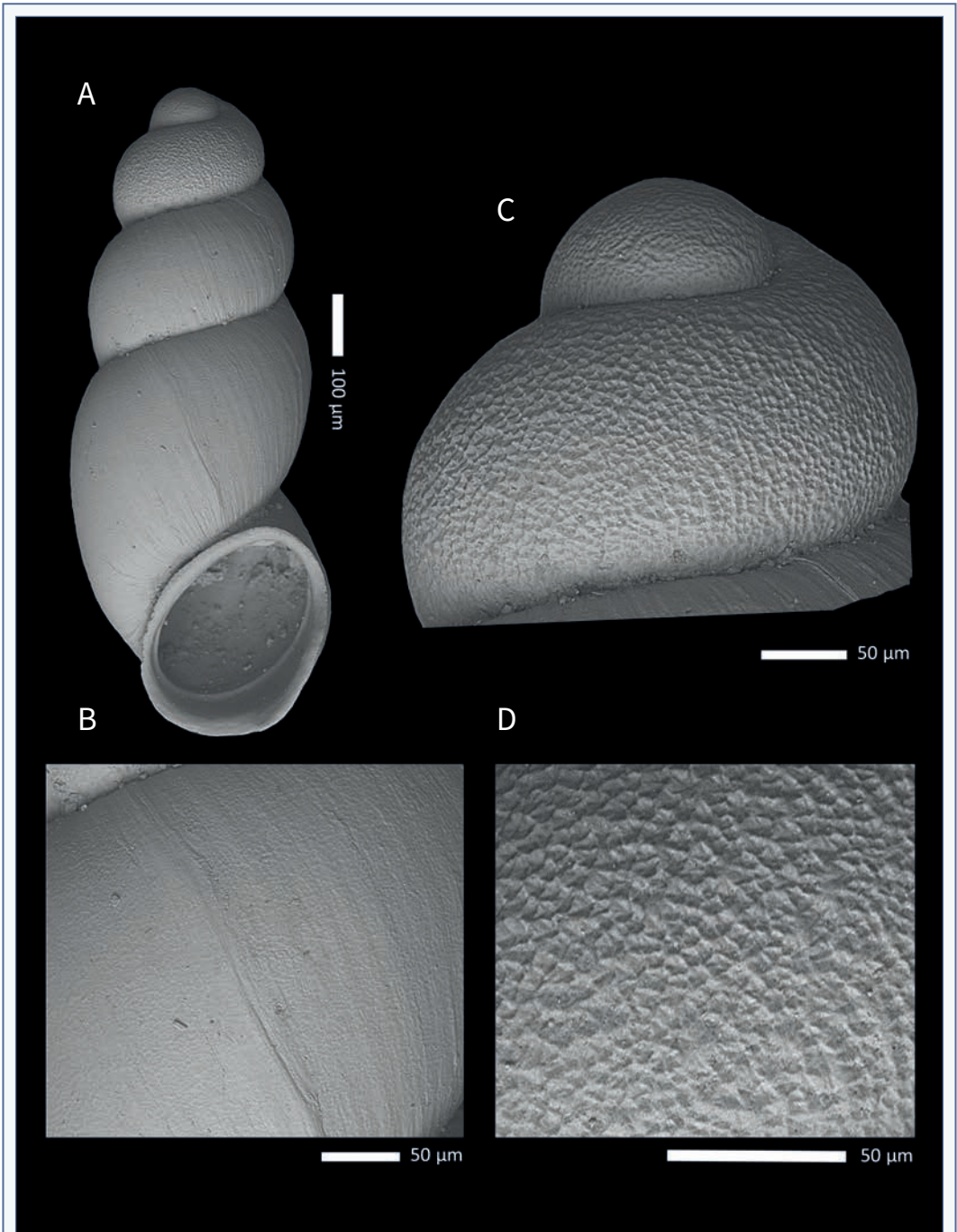


FIGURA 1. SEM images of *Guadiella kolendaensis* sp. nov. **A:** Shell; **B:** Detail of the microsculpture of the teleoconch; **C:** Protoconch; **D:** Detail of microsculpture of the protoconch.

Fotografies de microscòpia electrònica de *Guadiella kolendaensis* sp. nov. **A:** Conquilla; **B:** Detall de la microescultura de la teleoconquilla; **C:** Protoconquilla; **D:** Detall de la microescultura de la protoconquilla.

Type locality: Fuente de Morales, Calanda (Teruel province), Spain. [30TYL370357]. 381 m a.s.l. (Fig. 6A). This is a spring with abundant and permanent water flow, which rises in a small cavity and is channelized with a rubber pipe. It is hard to localize and to access, due to its abandoned state, and the amount of vegetation around. It is located in a slope close to the Guadape River, a tributary of Ebro River. This is also the type locality of *Hadziella forneri* Quiñonero-Salgado, López-Soriano & Rolán, 2023.

Etymology: The specific name derives from the Celtiberian village of Kolenda, origin of the present village of Calanda.

Description: The shell is elongate, slender, with inflated whorls and a deep, well-defined suture (Fig. 1A). The last whorl is much higher and therewith flatter. Protoconch of 1–1.5 whorls with a marked microsculpture of fine, irregularly shaped pits (most pits have grooves in the shape of a 6-pointed star in the centre and a more or less hexagonal outline, but the number of points varies from 5 to 8) (Fig. 1D). Teleoconch of 3 whorls, surface with poorly defined, low, irregular radial ribs with microsculpture of irregular, very fine and shallow pits (Fig. 1B). Aperture with slanted ovoid outline, slightly wider at base, edge reflected. A narrow ridge inside the aperture, close to the edge, supports the operculum. The final part of the

last whorl is very slightly decollated, forming a narrow umbilical groove between aperture and penultimate whorl (Figs. 1, 2, 4A).

As only empty shells were found, no operculum has been seen. It is assumed to be horny, as in other species of the genus.

Dimensions: Shell height 0.87–1.16 mm, and width 0.34–0.50 mm. The aperture/last whorl has dimensions of 0.26–0.34 mm. See Table 1 and Fig. 5.

Habitat: Stygobitic. Shells were washed out from their habitat, likely after sudden rises of the subterranean water levels. Shells had a mainly fresh appearance, given their transparent colour.

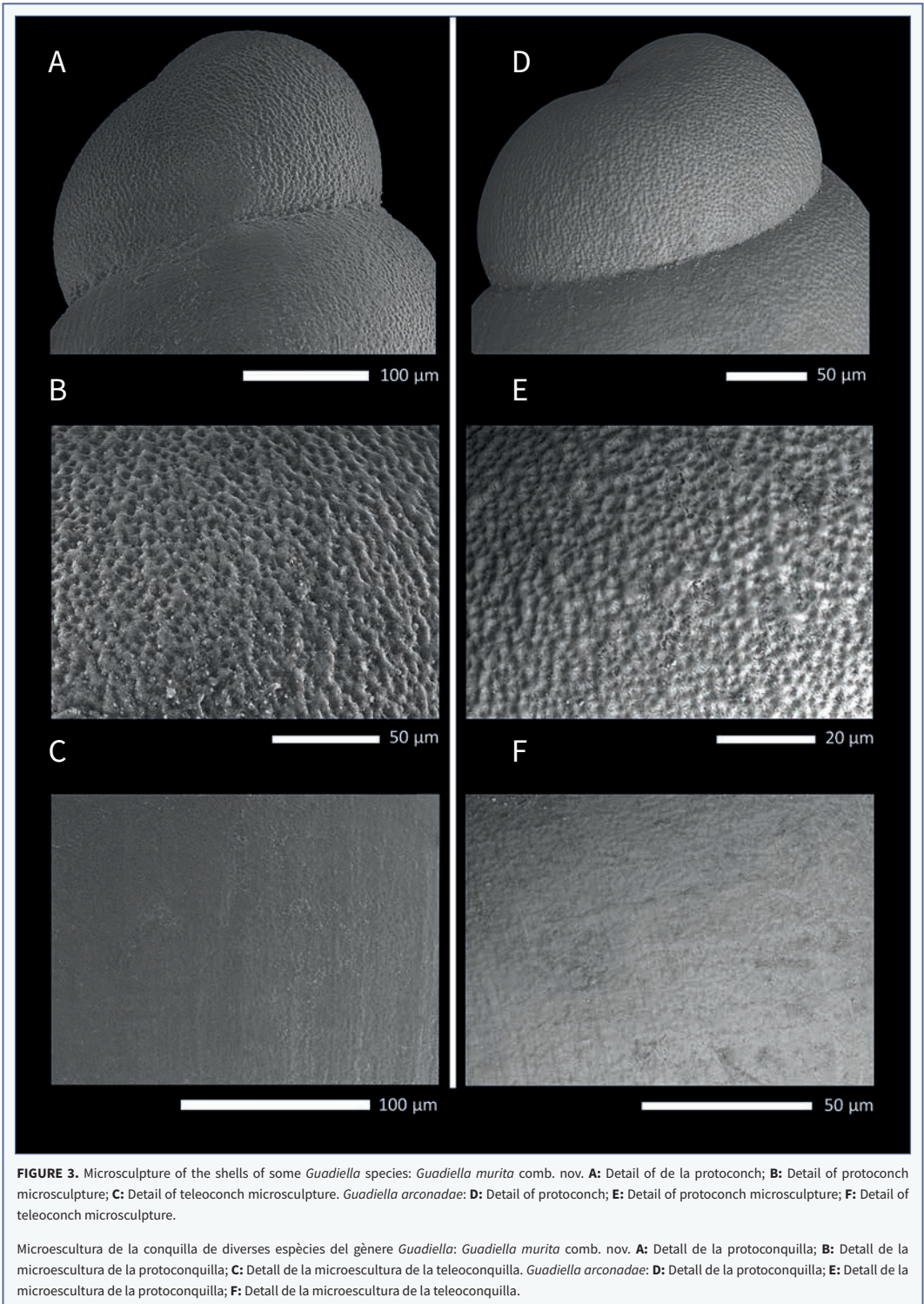
Distribution: Only known from the type locality.

Differentiating characters: *Guadiella kolendaensis* sp. nov. is similar to *G. arconadae* regarding microsculpture, but the latter has a wider apex, more inflated whorls, and the narrow ridge inside the aperture is much closer to the edge. The apex of *Guadiella murita* comb. nov. is slenderer, resulting in an inverted conical shape, whereas the microsculpture of the protoconch differs in having a dense pattern of irregularly arranged micropunctures. *Guadiella pilelongata* also has a slender apex, deep sutures with a narrow subsutural ramp and a protoconch with a fine microsculpture of variable shaped polygonal micropits. Like *G. kolendaensis* sp. nov., *G. ballesterosi* has a suboval and



FIGURE 2. Holotype of *Guadiella kolendaensis* sp. nov. Scale: 1 mm

Holotip de *Guadiella kolendaensis* sp. nov. Escala: 1 mm.



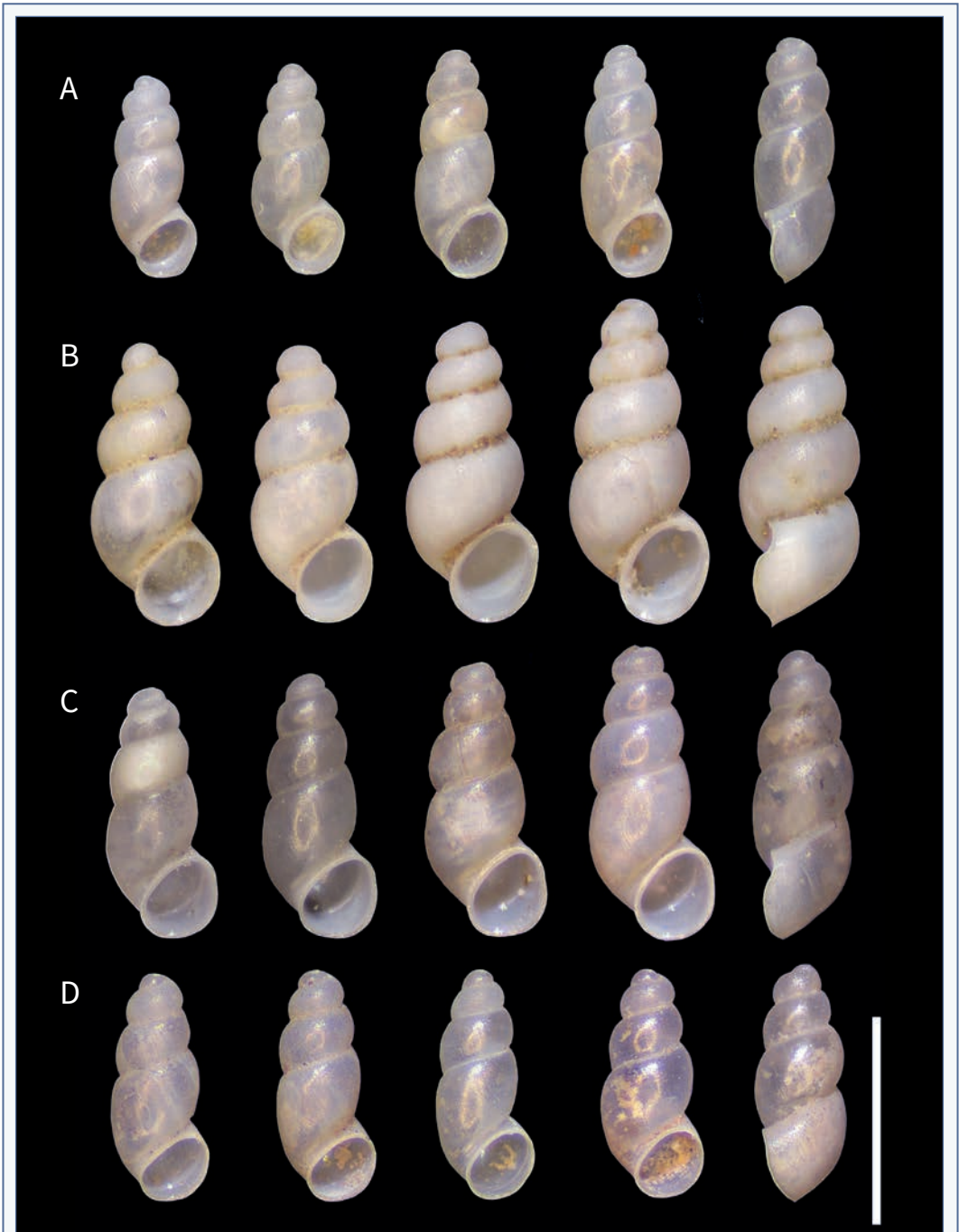


FIGURE 4. Specimens of the different *Guadiella* species considered in this work: **A:** *Guadiella kolendaensis* sp. nov.; **B:** *Guadiella murita* comb. nov.; **C:** *Guadiella arconadae*; **D:** *Guadiella ballesterosi*. All specimens from their respective type localities. Scale: 1 mm.

Exemplars de les diferents espècies de *Guadiella* considerades en aquest estudi: **A:** *Guadiella kolendaensis* sp. nov.; **B:** *Guadiella murita* comb. nov.; **C:** *Guadiella arconadae*; **D:** *Guadiella ballesterosi*. Tots els exemplars obtinguts de les seves respectives localitats tipus. Escala: 1 mm.

inclined aperture, but the sutures are deeper and it has very fine polygonal depressions on the protoconch and irregular spiral lines on the teleoconch, in addition to be larger in size. *Guadiella andalucensis* has lower upper whorls and a much broader final whorl, resulting in a much plumper shell. *Guadiella ramosae* is very similar in outline to *G. kolendaensis* sp. nov., but the whorls are more compressed whereas the apex is wider. *Guadiella algarvensis* has a substantially larger shell, with one additional whorl, is relatively narrower, and it narrows towards the apex; the microsculpture of the protoconch is much finer, formed by very dense and irregularly displayed micropunctures.

***Guadiella murita* (Boeters, 2003) comb. nov.**

(Fig. 3A-C, 4B)

Type locality: Cueva de Murita, Berberana, Burgos province, 620 m a.s.l. (Fig. 6B).

Material examined: 40 shells in SQS collection from the type locality, collected in 2023 (SQS leg.)

Remarks: In the original description by Boeters

(2003), *A. murita* was provisionally placed in the genus *Alzoniella*, but the author himself proposed that it could rather belong to *Guadiella*. The geographic distance from all the other known species of this second genus at that time, while having much more proximity with the first one, was the main reason for that decision, since no anatomical data were available. Similarly, Arconada et al. (2007), in their revision of the genus *Alzoniella*, also expressed their doubts, since *A. arconadae*, at that time already described in Burgos province, did not have a satisfactory generic attribution either.

Guadiella murita comb. nov. was originally found in an outflow from a cave, thus suggesting it is a stygobiont mollusc, in opposition to all other known species of the genus *Alzoniella*, which are crenobiont and live in surface waters. Our field data confirm this fact. Type locality was visited by the first author, and at that time it was completely dried out. The cave is flooded temporarily only after heavy rains, when shells are washed out, accumulating amongst vegetal debris outside.

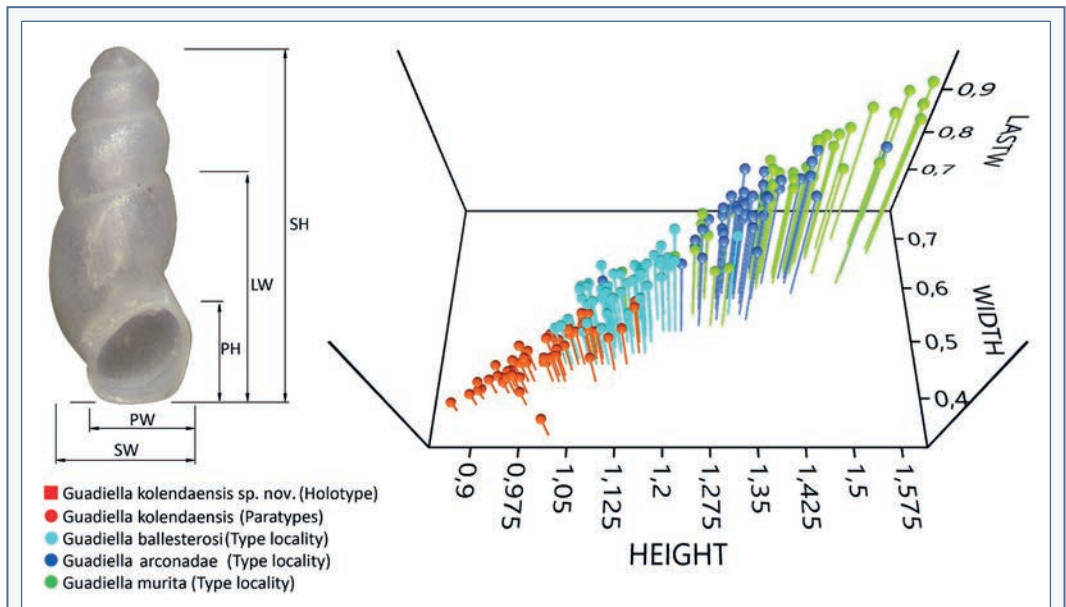


FIGURE 5. *Guadiella kolendaensis* sp. nov. shell profile (left) and measurements (in mm) from the different specimens studied (right): *Guadiella kolendaensis* sp. nov., *G. murita* comb. nov., *G. arconadae*, and *G. ballesterosi*. All specimens from their type localities. SH: shell height; SW: shell width; PH: aperture height; PW: aperture diameter; LW: body whorl height.

Guadiella kolendaensis sp. nov., aspecte de la conquilla (esquerra), i mesures (en mm) dels exemplars estudiats (dreta): *Guadiella kolendaensis* sp. nov., *G. murita* comb. nov., *G. arconadae*, i *G. ballesterosi*. Tots els exemplars procedents de les seves localitats tipus. SH: alçada de la conquilla; SW: amplada de la conquilla; PH: alçada de l'obertura; PW: diàmetre de l'obertura; LW: alçada de la última volta.

The ecological aspects (stygobiont and not crenobiont), the presence of a shell conchologically much more related to *Guadiella* (cylindrical with prominently convex whorls, separated by a deeper suture), and the fact that this latter genus now appears to have a wide geographical range in Spain (including western Andalusia, Catalonia and Aragón), prompt us to classify it with a new generic adscription, where it fits better.

This species was described on the basis of a single shell, which was illustrated only by a drawing, without any description whatsoever of its microsculpture (Boeters, 2003). In this article, we provide a set of specimens with complete shell measurements, in addition to the first SEM images of its shell, which show a protoconch formed by dense micropunctures irregularly arranged, and a teleoconch showing growth lines and a rough surface (Figs. 3A-C, 4B).

***Guadiella arconadae* Boeters, 2003**

(Figs. 3D-F, 4C)

Type locality: Merindad de Río Ubierna, spring at north side of San Martín de Ubierna, Burgos province, 900 m a.s.l. (Fig. 6C).

Material examined: 43 shells in SQS collection from the type locality, collected in 2023 (SQS leg.)

Remarks: Based on anatomical traits and the stygobitic habitat, in the original description the species was provisionally assigned to *Guadiella*. A single SEM image of the shell was provided, but no data related to its microsculpture. The type locality was visited by the first author of this note, which allowed the gathering of fresh, new material. New SEM images reveal a protoconch microsculpture formed by small undulations or excavations (Figs. 3D-E), irregularly displayed, and a rough surface of the teleoconch, with few growth lines



FIGURE 6. Type localities of the *Guadiella* species considered in this study. **A:** Fuente de Morales, Calanda (Teruel province); **B:** Cueva de Murita, Berberana (Burgos province); **C:** Spring at the north of San Martín de Ubierna (Burgos province); **D:** Font del Racó de la Pastera, Ulldemolins (Tarragona province).

Localitats tipus de les espècies de *Guadiella* considerades en aquest estudi. **A:** Fuente de Morales, Calanda (provincia de Terol); **B:** Cueva de Murita, Berberana (provincia de Burgos); **C:** Brollador al nord de San Martín de Ubierna (provincia de Burgos); **D:** Font del Racó de la Pastera, Ulldemolins (provincia de Tarragona).

(Fig. 3F). A number of shells from this new material were measured, allowing description of shell variability (Figs. 3D-F, 4C, 5 and Table 1).

***Guadiella ballesterosi* Alba, Tarruella,
Prats, Guillén & Corbella, 2009**
(Fig. 4D)

Type locality: Font del Racó de la Pastera (Ulldemolins, Tarragona province). [31TCF1976], 510 m a. s. l. (Fig. 6D).

Material examined: 50 shells in SQS collection from the type locality, collected in 2024 (SQS leg.).

Remarks: This species has a very small shell, showing deep sutures and polygonal scars in the protoconch. Only known from the type locality, where the authors of its description measured up to 13 specimens. Our new measurements (Table 1) enlarge the size ranges of the species, after including a much larger set of individuals.

Discussion

In the present paper, two additional species are included in the genus *Guadiella*, raising the total number of species in the genus to eight. First, *Alzoniella murita* is now placed into *Guadiella*, given its conchological traits and stygobitic habitat. In addition, a new species is described for Aragón, also adding a new autonomous community where the genus is present. Remarkably, the newly described species, which is only the second stygobiont Hydrobiidae for Aragón, was located at the same place as *H. forneri* which points to a high biodiversity of Iberian underground water systems that has been underestimated in the past.

New material of the two *Guadiella* species present in Burgos was also collected in their type localities, based on which detailed pictures of their microsculpture are made. Complete shell measurements are also provided, with at least 40 shells measured for each species, which can be helpful for future comparisons with even-

		SH	SW	LW	PH	PW
<i>G. kolendaensis</i> sp. nov. Fuente de Morales Calanda (Teruel) (n=50)	HOLOTYPE	1.02	0.43	0.66	0.29	0.30
	min	0.87	0.34	0.59	0.27	0.26
	max	1.16	0.50	0.74	0.34	0.34
	mean	1.02	0.44	0.67	0.30	0.30
	st. dev.	0.071	0.030	0.037	0.020	0.018
<i>G. arconadae</i> San Martín de Ubierna, Merindad de Río Ubierna (Burgos) (n=43)	min	1.11	0.52	0.73	0.34	0.33
	max	1.51	0.64	0.93	0.48	0.44
	mean	1.32	0.59	0.84	0.42	0.39
	st. dev.	0.063	0.030	0.039	0.025	0.026
<i>G. ballesterosi</i> Font del Racó de la Pastera, Ulldemolins (Tarragona) (n=50)	min	1.04	0.46	0.70	0.29	0.26
	max	1.31	0.56	0.83	0.38	0.37
	mean	1.14	0.51	0.76	0.33	0.33
	st. dev.	0.054	0.026	0.032	0.019	0.024
<i>G. murita</i> comb. nov. Cueva de Murita, Berberana (Burgos) (n=40)	min	1.14	0.53	0.74	0.37	0.34
	max	1.58	0.74	0.96	0.51	0.47
	mean	1.39	0.63	0.86	0.46	0.41
	st. dev.	0.102	0.049	0.060	0.037	0.031

TABLE 1. Measurements (in mm) of *Guadiella kolendaensis* sp. nov. shells, in comparison with shells of *G. murita* comb. nov., *G. arconadae* and *G. ballesterosi*, all from their respective type localities. SH: shell height; SW: shell width; LW: last whorl height; PH: aperture height; PW: aperture width.

Mesures (en mm) de la conquilla de *Guadiella kolendaensis* sp. nov. en comparació amb conquilles de *G. murita* comb. nov., *G. arconadae* i *G. ballesterosi*, totes de les seves respectives localitats tipus. SH: alçada de la conquilla; SW: amplada de la conquilla; LW: alçada de la última volta; PH: alçada de l'obertura; PW: amplada de l'obertura.

tual new species in the genus. The same applies for *G. ballesterosi*, for which we also provide a measurement of a much larger set of specimens than in the original description, providing new data on shell ranges, more representative of the species. With all these measurements, a clearer picture of the four species of the genus present in the northern half of the Peninsula is given. A future work on the southern half will be dedicated to the other four species present in the Guadiana and Guadalquivir River basins (in preparation).

As no genetic data are yet available, little is known regarding the precise placement of this genus of stygobiont snails. The rapid increase in the number of stygobiont molluscs known from the Iberian Peninsula, at a present pace of about 2.5 new species described per year, correlates quite well with the fact that most of the species in this genus (seven out of eight) have only been described in the present century. Its widespread distribution in the Iberian Peninsula makes it possible that many new species of this genus could be discovered in the coming years, as more exhaustive research is undertaken in new springs and river basins. Their very small size and the narrow distribution for each species make them difficult to find, so exhaustive searches are usually needed before finding the right sediment in the different springs where the species could appear, and with a representative number of specimens for their study. However, given the distribution range presently known of the genus *Guadiella*, it is easy to speculate that it may have a much larger geographic range. Preliminary, unpublished results of the authors of this article seem to confirm this point, so future new species could be described in the coming years for still unexplored areas.

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