A new hygromiid for the Iberian malacofauna: *Candidula corbellai* n. sp. (Gastropoda, Pulmonata)

A. Martínez–Ortí

Martínez–Ortí, A., 2011. A new hygromiid for the Iberian malacofauna: *Candidula corbellai* n. sp. (Gastropoda, Pulmonata). *Animal Biodiversity and Conservation*, 34.1: 1–10.

Abstract

A new hygromiid for the Iberian malacofauna: Candidula corbellai *n. sp. (Gastropoda, Pulmonata)*.— We report a new Iberian hygromiid, *Candidula corbellai* n. sp., and describe its conchological and anatomical characteristics. This new species is compared with two other Iberian endemic species, *Candidula camporroblensis* and *C. rocandioi*, which present similarities in the reproductive system, such as the long flagellum. The shell of the new species is compared with specimens of the type series of these taxa. The reproductive system of *C. corbellai* n. sp. is distinguished from *C. camporroblensis* by its longer male part, although the flagellum is shorter than the penis and epiphallus together and it has a long bursa copulatrix with respect to its duct, which is shorter. The epiphallus and the bursa copulatrix duct are longer in *C. rocandioi* than in *C. corbellai* n. sp. A geographical distribution map of the three species in the Iberian peninsula is shown.

Key words: Hygromiidae, *Candidula corbellai* n. sp., *Candidula camporroblensis*, *Candidula rocandioi*, Catalonia, Iberian peninsula.

Resumen

Un nuevo higrómido para la malacofauna ibérica: Candidula corbellai *sp. n. (Gastropoda, Pulmonata)*.— Se se describen las características conquiológicas y anatómicas de un nuevo higrómido ibérico, *Candidula corbellai* sp. n. Se compara con otros dos endemismos ibéricos, *Candidula camporroblensis* y *C. rocandioi*, especies con las que presenta similitud en el aparato reproductor, ya que ambos poseen el flagelo largo. La concha del nuevo taxón se ha comparado con ejemplares de la serie tipo de estos taxones. En cuanto al aparato reproductor *C. corbellai* sp. n. se distingue de *C. camporroblensis* porque la primera posee la porción masculina mucho más larga, aunque el flagelo no lo es tanto como el pene y epifalo juntos y por poseer la bursa copulatrix larga en relación a su conducto, que es corto. Con respecto a *C. rocandioi* el epifalo y el conducto de la bursa copulatrix son mucho más largos que en *C. corbellai* sp. n. Además se aporta un mapa de la distribución geográfica de las tres especies en la península Ibérica.

Palabras clave: Hygromiidae, *Candidula corbellai* sp. n., *Candidula camporroblensis*, *Candidula rocandioi*, Cataluña, Península Ibérica.

(Received: 17 IX 10; Conditional acceptance: 22 X 10; Final acceptance: 15 XI 10)

Alberto Martínez–Ortí, Museu Valencià d'Història Natural and Dept. de Zoologia, Fac. de Ciències Biològiques, Univ. de València, c./ Dr. Moliner 50, 46100 Burjassot, Valencia, España (Spain).

E–mail: amorti@uv.es

ISSN: 1578–665X

Introduction

A series of specimens from a small terrestrial gastropod, collected recently in the north of Catalonia, could not be identified by their shell. These specimens present characteristics of their own and could not be definitively assigned to any of the known taxa in this geographical area. This is common in numerous hygromiid species in which conditions give rise to a morphological convergence that confers high conchological similarity between them (Martínez–Ortí et al., 2000). Samples of the new species described here may have been assigned to another hygromiid in Catalonia. To determine their exact taxonomical status it was necessary to study the anatomical characteristics of the reproductive system. The characteristics of the genitalia allowed us to assign it to the genus *Candidula* Kobelt, 1871. This genus is represented in the Iberian Peninsula by 13 species, ten of which are endemic, while the other three are widely dispersed in central and western Europe (Manga, 1983; Gittenberger, 1993a, 1993b; Altonaga et al., 1994; Puente, 1994; Bragado et al., 2010; Holyoak & Holyoak, 2010).

Results

The reproductive system of *Candidula* is characterized mainly by the presence in its stimulator system of a dart sac on one side with a dart inside, and a second rudimentary sac between this and the vagina that cannot be seen externally (Hausdorf, 1988). The shell morphology, the reproductive system anatomy, the radula, the jaw and their distribution area are described, drawn and compared with the species of *Candidula* that are most similar regarding the reproductive system, *C. camporroblensis* Fez, 1944 and *C. rocandioi* (Ortiz de Zárate, 1950), both of which also have a long flagellum.

The studies used for morpho–anatomical comparison of the three taxa are Fez (1944), where *C. camporroblensis* is described, Ortiz de Zárate (1950, 1991) where the author describes *C. rocandioi* and studies the reproductive system of both species, Aparicio (1982), whose study details the differences between several Iberian hygromiids based on their anatomical characteristics, Manga (1983) who studies *C. rocandioi*, and Faci (1991) and Martínez–Ortí et al. (2000) whose study investigated the conchological and anatomical characteristics of the reproductive system of *C. camporroblensis*. Finally, we provide a map showing the distribution area of the three species in the Iberian Peninsula; it can be seen that *C. corbellai* n. sp. is found in an area away from the other two species.

Family Hygromiidae Tryon, 1866
Genus *Candidula* Kobelt, 1871
Candidula corbellai n. sp.

Type locality
Sierra de Busa (Navés, Lleida), up to 1,375 m altitude, under stones in a calcareous meadow with southern orientation. Collected 11th October 2008 by Jordi Corbella (UTM 31TCG86).

Type material
The type series is constituted by eight specimens in ethanol and 10 shells. The holotype is deposited in the Museu Valencià d'Història Natural (MVHN) with the code MVHN–120609AB00a (ethanol 70%); 10 paratypes (6 shells; 4 in ethanol) deposited in the MVHN with the code 120609AB00b; 2 paratypes in the Museu de Ciències Naturals de Barcelona (Zoologia, MZB) with the codes MZB 2009–4021 (1 shell) and MZB 2010–1152 (1 in ethanol); 2 paratypes (1 shell; 1 in ethanol) in the Museo Nacional de Ciencias Naturales of Madrid (MNCN) with the code MNCN 15.05/53565; 2 paratypes (1 shell; 1 in ethanol) in the Natuurhistorich Museum–Naturalis of Leiden (The Netherlands) with the code RMNH–MOL.125987; 1 paratype (shell) in the Senckenberg Museum of Frankfurt (Germany) with the code SMF–335206.

Etymology
Dedicated to Jordi Corbella Alonso, collector of the specimens.

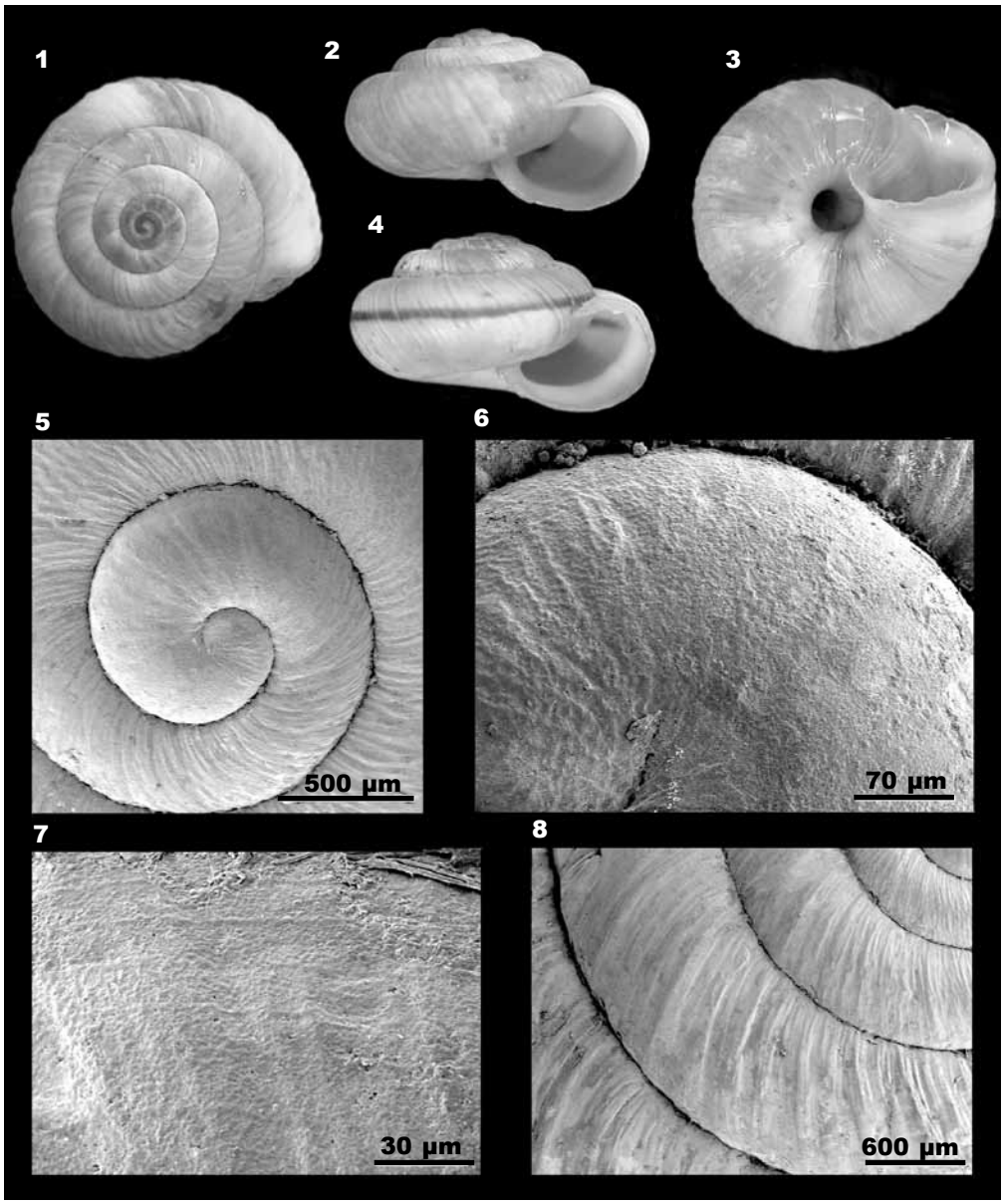
Common name
Small snail of Navés

Diagnosis
Small size shell (6.5–7.9 mm), homogeneous pale grey, it sometimes has a brown spiral band around the last whorl with an internal rib near the aperture, externally visible as a white cretaceous transverse band; sometimes there are two of them. The male portion is very long and the flagellum is also long, but not as long as the penis and the epiphallus together. Bursa copulatrix is well defined and long in relation to its conduct.

Shell (figs. 1–9): for the conchological description 18 specimens of the type series have been used. It is dextral, small in size, from depressed to almost lenticular, low spire, convex, more flattened above and less convex below, solid, opaque, shiny, formed by 4¾ to 5¼ whorls, convex, slow growth, regular and well–marked sutures of grayish–white with brownish apex, highlighting the rest of the shell.

In the first whorl, brownish longitudinal stripes can be seen rather close together, and two shells show a continuous brownish line crosses the periphery of the last whorl and one to 1½ whorls from the suture of the penultimate whorl. There are also some small patches of the same tone scattered in an irregular manner at the top of the shell. The umbilical area is white, occasionally with small isolated patches, but without spiral lines.

The end of the final whorl, near the shell aperture, goes down slightly towards the middle, helping to give this an oval morphology, a little flattened, with maximum size between 2.65 and 3.5 mm in width and from 2.2 and 2.75 mm in height, the opening being larger than 3.5 mm wide x 2.75 mm high, raised in the upper area,



Figs. 1–8. *Candidula corbellai* n. sp.: 1–3. Holotype (nº120609AB00a) (Ø = 6.85 mm); 4. Paratype (Ø = 6.9 mm). 5–7. Protoconch of other paratype: 5. General view; 6–7. Sculpture protoconch details; 8. Teleoconch sculpture.

Figs. 1–8. Candidula corbellai *sp. n.: 1–3. Holotipo (nº120609AB00a) (Ø = 6,85 mm); 4. Paratipo (Ø = 6,9 mm). 5–7. Protoconcha de otro paratipo: 5. Vista general; 6–7. Detalles de la ornamentación; 8. Ornamentación de la teloconcha.*

with the peristome interrupted and sharp. The aperture has an internal callous rib on all specimens except for two youngest that can give the shell surface an easily detectable, well–marked white colour. The internal callous rib can occur several times on the shell, seen externally as white transverse bands. The umbilicus is small, deep, somewhat eccentric, and narrow, from 1.15 to 1.5 mm in diameter, with no completely visible internal spire, barely hidden by the reflection of the peristome. The protoconch is always brownish, consisting of 1⅛ to 1 ½ whorl spires, from 0.7 to 1.0 mm in width, and with a micro–sculpture formed by parallel spiral strips that are visible in the suture zone and with slightly marked ribs, also more or less parallel, possibly giving it a reticulate appearance (fig. 7). This protoconch shows malleolated marks (fig. 5) but there

are no hairs or signs to indicate their presence. The teleoconch has a slight costulation, regular in the first whorls, of wrinkled aspect, but becoming more apparent and irregular in the following whorls and seeming more pronounced in the last whorl that becomes quite angled. Ribs are also visible in the umbilical area; thinner but are well marked. The dimensions of all the shells of the type series range from 6.2 to 7.9 mm in diameter and from 3.7 to 4.7 mm in height. The holotype is 6.85 mm in diameter and 4.3 mm in height.

Reproductive system (figs. 9–15): the reproductive system of three specimens was studied, including the holotype (figs. 9–10). The reproductive system pattern is similar to other species of the genus *Candidula*. The retractor muscle of the right ommatophore is free of penis and vagina. The penis retractor muscle is inserted into the diaphragm. The male portion reaches a maximum length of between 11.15 mm (holotype) and 13.0 mm. The penis has a length of between 3.35 (holotype) and 4.75 mm, the epiphallus between 3.25 (holotype) and 3.7 mm and the flagellum between 4.4 and 4.55 mm (holotype). The penis has a short penial papilla in its interior, measuring 1.05 mm in length, with subapical opening. The vagina is long, between 3.5 (holotype) and 4.75 mm, and the free oviduct is between 0.8 (holotype) and 1.0 mm.

The length of the duct of the bursa copulatrix is shorter than the bursa copulatrix in all specimens, between 1.85 (holotype) and 2.6 mm. The bursa copulatrix, which is well defined, is elongated and somewhat widened in the distal zone, with maximum dimensions between 2.35 x 1.1 mm and 3.35 x 1.15 mm. The proximal portion of the larger dart sac, which lies outside the vagina, is short, measuring between 1.05 and 1.5 mm. The dart is curved. It is 4 mm long and has a circular section ending in a point, without edges. The eight glandulae mucosae are inserted around the vagina, united in 4 trunks that branch from the basal zone, two of which are located laterally, on opposite sides, while the other two are very close, in their middle zone. The atrium measures between 0.9 and 1.25 mm.

Other characters (figs. 16–21): the body is whitish except in the most anterior dorsal zone where it is grey. The odontognate jaw has a few ribs in the central area (fig. 16). The radula of the holotype, 1.6 mm long and 0.55 mm wide, consists of 119 rows. The radular formula is: 6M + 14L + C + 14 + 6M.

Geographical distribution, habitat and conservation
Candidula corbellai n. sp. it is only known from a single locality, Sierra de Busa (Navés, Lleida) (fig. 38). It lives at a high altitude in steppe calcareous meadows, under stones and adhering to the base and /or of the stems of vegetation such as *Santolina chamaecyparissu*s, *Genista* sp. and several gramineous plants.

Due to ongoing taxonomical confusion among the several species of hygromiids in Catalonia, the limits of their geographical distribution need to be determined before some kind of protection for this new species can be proposed.

Discussion

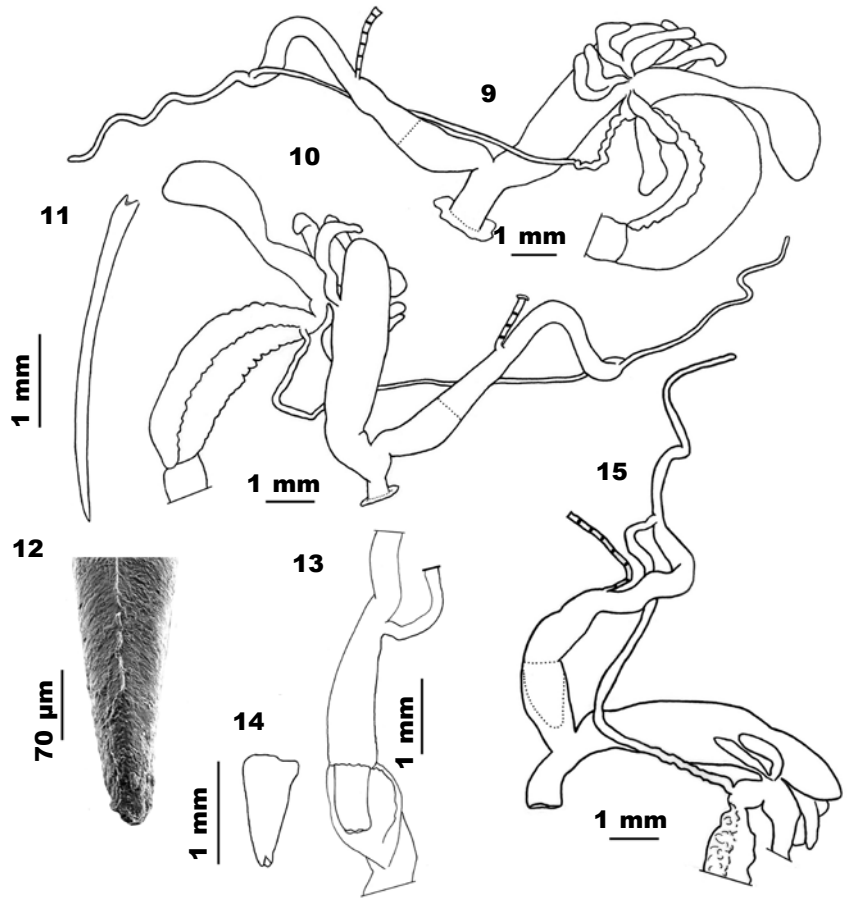
Checking only the shell could lead to errors in differentiating between different genus of hygromiids, such as *Helicella* Férussac, 1821 or *Xerocrassa* Monterosato, 1892, also present in Catalonia, or other *Candidula* species living in areas relatively close to the the Iberian peninsula. To avoid such error, it is necessary to study the reproductive system. The species of *Candidula* found in the Iberian peninsula are the following: *C. arganica* (Servain, 1880), *C. camporroblensis* (Fez, 1944), *C. gigaxii* (Pfeiffer, 1848), *C. intersecta* (Poiret, 1801), *C. najerensis* (Ortiz de Zárate, 1950), *C. rocandioi* (Ortiz de Zárate, 1950) and *C. unifasciata* (Poiret, 1801).

Of all these species, those that are most similar to *C. corbellai* n. sp. in terms of reproductive anatomical characters are *C. camporroblensi*s and *C. rocandioi*. Both have a long flagellum, among other characters, that differentiate them from the others whose flagellum is short (Ortiz de Zárate, 1950; Manga, 1983; Puente, 1994; Gittenberger, 1993a, 1993b). They also have a shell of approximately the same dimensions as *C. corbellai* n. sp., although this latter has a characteristic gray–white colour while the others show a more coloured pattern, with dark brown spiral bands on both sides and brownish spots all over, especially on the apical zone (figs. 22–24).

The maximum diameter of the shell of *C. rocandioi* varies between 5.9 and 7.5 mm and height between 3.5 and 4 mm (Ortiz de Zárate, 1950), very similar to the new taxon. However, the umbilicus of the new taxon is wider and less deep, between 1.6 to 1.7 mm; it occupies about 1/3 or 1/4 of the umbilical area, is not eccentric, and shows all the internal spires in *C. rocandioi*. However, in *C. corbellai* n. sp. the umbilicus is smaller and narrower, and may not be seen around the inner spires, occupying 1/5 or 1/6 part of the total width of the shell. Although Ortiz de Zárate (1950) does not indicate the presence of hair or protoconch or teleoconch in juvenile specimens, these characteristics were later reported by Manga (1983) and Ortiz de Zárate (1991).

No hairs were found in the paralectotypes of *C. rocandioi* deposited in MVHN (Martínez–Ortí & Uribe, 2008), although their marks are visible in the protoconch (figs 26–27), which can be confused with the malleolated marks present in *C. corbellai* n. sp. or *C. camporroblensis*. The aperture is larger in *C. corbellai* n. sp., whose dimensions vary between 2.2 mm high by 2.65 mm wide and 2.75 mm high by 3.5 mm wide, whereas in *C. rocandioi* they vary between 1.7 mm high by 2.2 mm wide and 1.85 mm high by 2.5 mm wide. The top of the aperture in *C. rocandioi* is somewhat more bowed downwards, descending well over the midline of the last whorl, and it has a more marked keel than in *C. corbellai* n. sp.

Based on data about the reproductive system provided by Ortiz de Zárate (1950) and Aparicio (1982), *C. rocandioi* can be distinguished from *C. corbellai* n. sp. for its flagellum that is 1/3 of the total length of the epiphallus and the penis together, while in *C. corbellai* n. sp. the flagellum is double the third of the length of the penis and epiphallus together. The

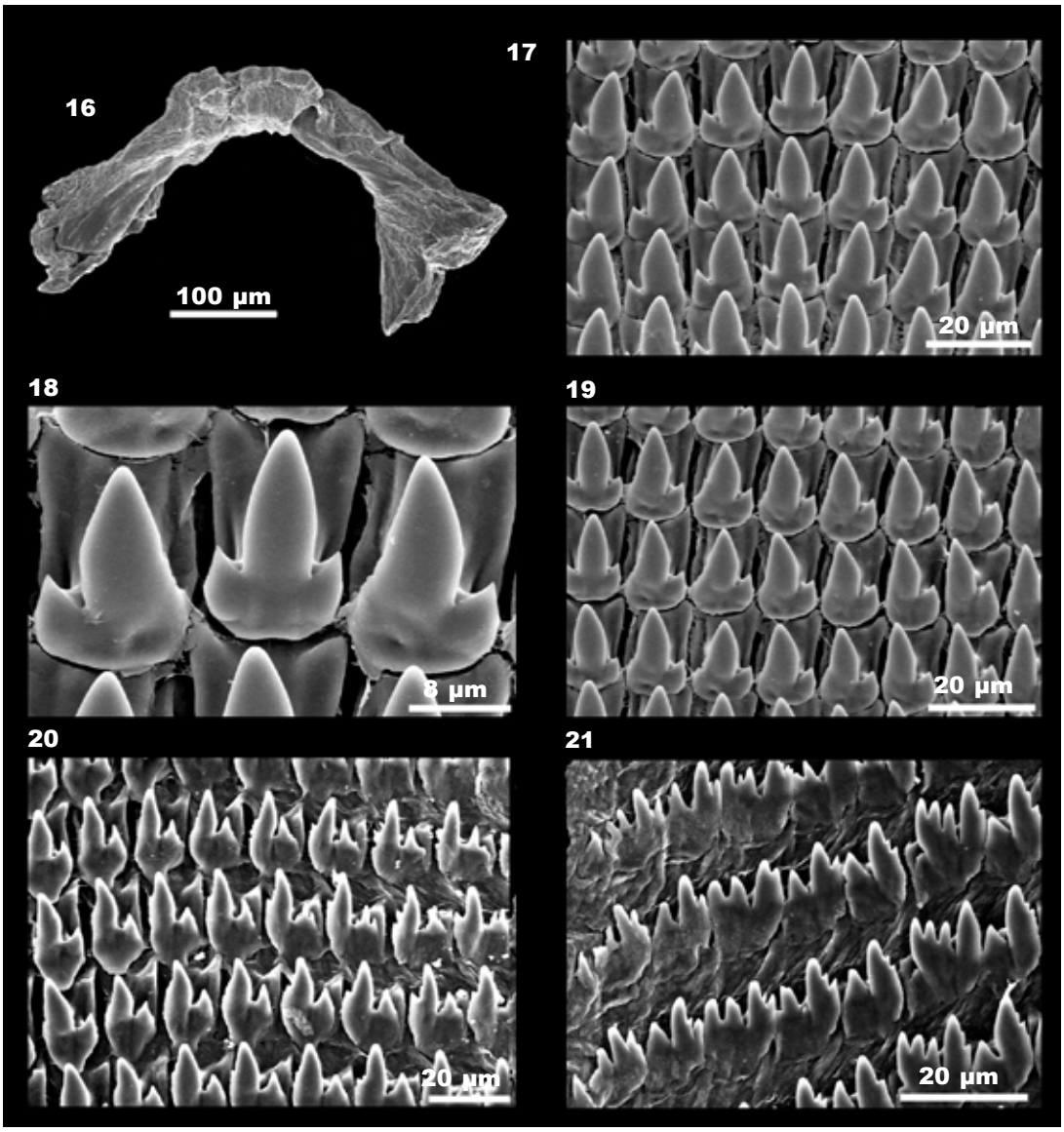


Figs. 9–15. Reproductive system of *Candidula corbellai* n. sp.: 9–10. Holotype; 11. Dart of a paratype; 12. Point detail of dart of one paratype; 13. Penis distal portion; 14. Papilla penial; 15. Genitalia of a paratype.

Figs. 9–15. Aparato reproductor de Candidula corbellai *sp. n.: 9–10. Holotipo; 11. Dardo de un paratipo; 12. Detalle de la punta del dardo de un paratipo; 13. Porción distal del pene; 14. Papila penial; 15. Genitalia del paratipo.*

epiphallus in *C. rocandioi* is very long, almost twice the flagellum, while in *C. corbellai* n. sp. the epiphallus is always smaller than the flagellum. Furthermore, in *C. rocandioi* the penis and epiphallus together can reach 13.5 mm while in *C. corbellai* n. sp. they do not exceed 7.45 mm. Another character mentioned by Ortiz de Zárate (1950: fig. 5), Aparicio (1982: fig. 6), Manga (1983) and Puente (1994: fig. 63) is that in *C. rocandioi* there is no clear difference between the end of the bursa copulatrix duct and the start of the bursa copulatrix itself due to the similar thickness of both. In *C. corbellai* n. sp. there is a clear separation between the two structures (figs. 9–10). Furthermore, the whole duct and bursa copulatrix together reaches 11.5 mm, while this is almost only half as long in *C. corbellai* n. sp., 5.95 mm.

In respect to *C. camporroblensis*, species with great similarities with *C. corbellai* n. sp., Fez (1944) describes shells of 4.0 to 5.0 mm in diameter and 3.0 mm in height, Faci (1991) reports maximum dimensions of 5.25 mm in diameter and 3.0 mm in height for Aragonese populations, Martínez–Ortí (1999) and Martínez–Ortí et al. (2000) mention dimensions of 5.25 mm in diameter and 3.5 mm in height for Valencian populations, and finally, Bragado et al. (2010) describe a diameter of 4.7 and 6.5 mm for the populations in Castilla–La Mancha. In the 18 shells of the new species only one specimen showed a diameter (6.2 mm) less than the maximum diameter known for the species (7.9 mm), while two specimens –somewhat fragmented– showed a larger diameter than that known for *C. camporroblensis*, generally more than 7.0 mm and nearly 8.0 mm *C. corbellai* n. sp. In *C. camporroblensis* the ombilicus has a width of between 0.9 mm (Faci, 1991) and 1.0 mm (Fez, 1944) while in *C. corbellai* n. sp. it is somewhat wider, up to 1.5 mm.

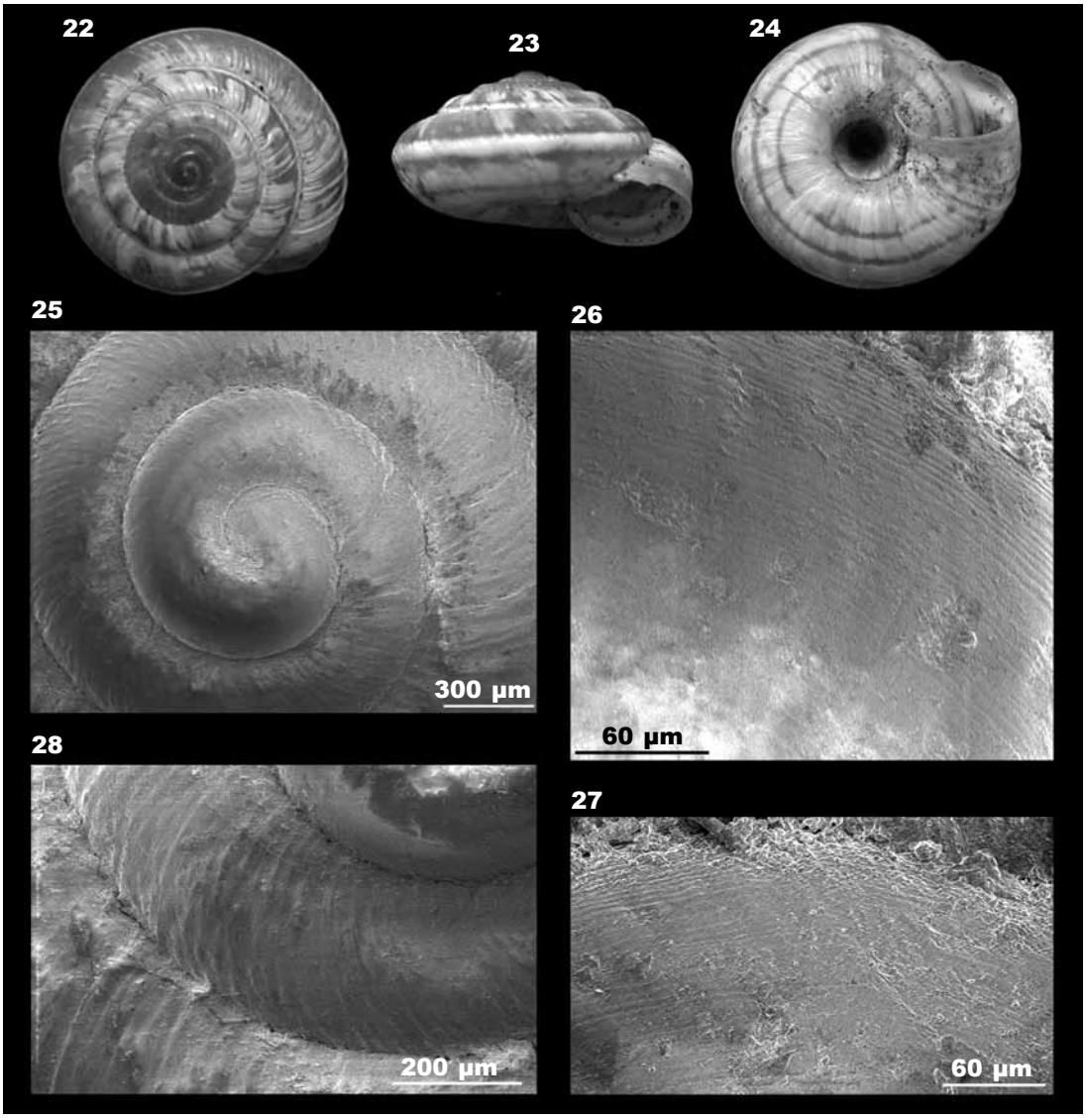


Figs. 16–21. Jaw and radula of *C. corbellai* n. sp.: 16. Jaw; 17. General view of the central and first lateral teeth; 18. Central tooth view; 19. Detail of the transition area between the last lateral teeth and the first marginal teeth; 20. Last marginal teeth; 21. Detail of the marginal teeth.

Figs. 16–21. Mandíbula y rádula de C. corbellai *sp. n.: 16. Mandíbula; 17. Vista general de los dientes central y primeros laterales; 18. Vista del diente central; 19. Detalle de la zona de transición de los últimos dientes laterales y primeros dientes marginales; 20. Últimos dientes marginales; 21. Detalle de los dientes marginales.*

The colour of the apex in *C. corbellai* n. sp. is dark and it stands out from the rest of the shell (fig. 1). In C. *camporroblensis* (fig. 18), on the other hand, the colouring is less varied and is similar to the rest of the shell; in two of 40 shells examined, however, the apex was rather more colourful as was the rest of the shell in both cases. This was not observed in any *C. corbellai* shells which were all a whitish grey. The teleoconch in *C. corbellai* n. sp. is less wrinkled (figs. 1–5, 8) than in *C. camporroblensis* (figs. 18–21, 25–26) and than in *C. rocandioi* (fig. 28).

With regard to the reproductive system the differences between the two taxa are also significant. Aparicio (1982) indicates that the main characteristics of the genitalia of *C. camporroblensis* are the ratio of the length of the bursa copulatrix duct, which is



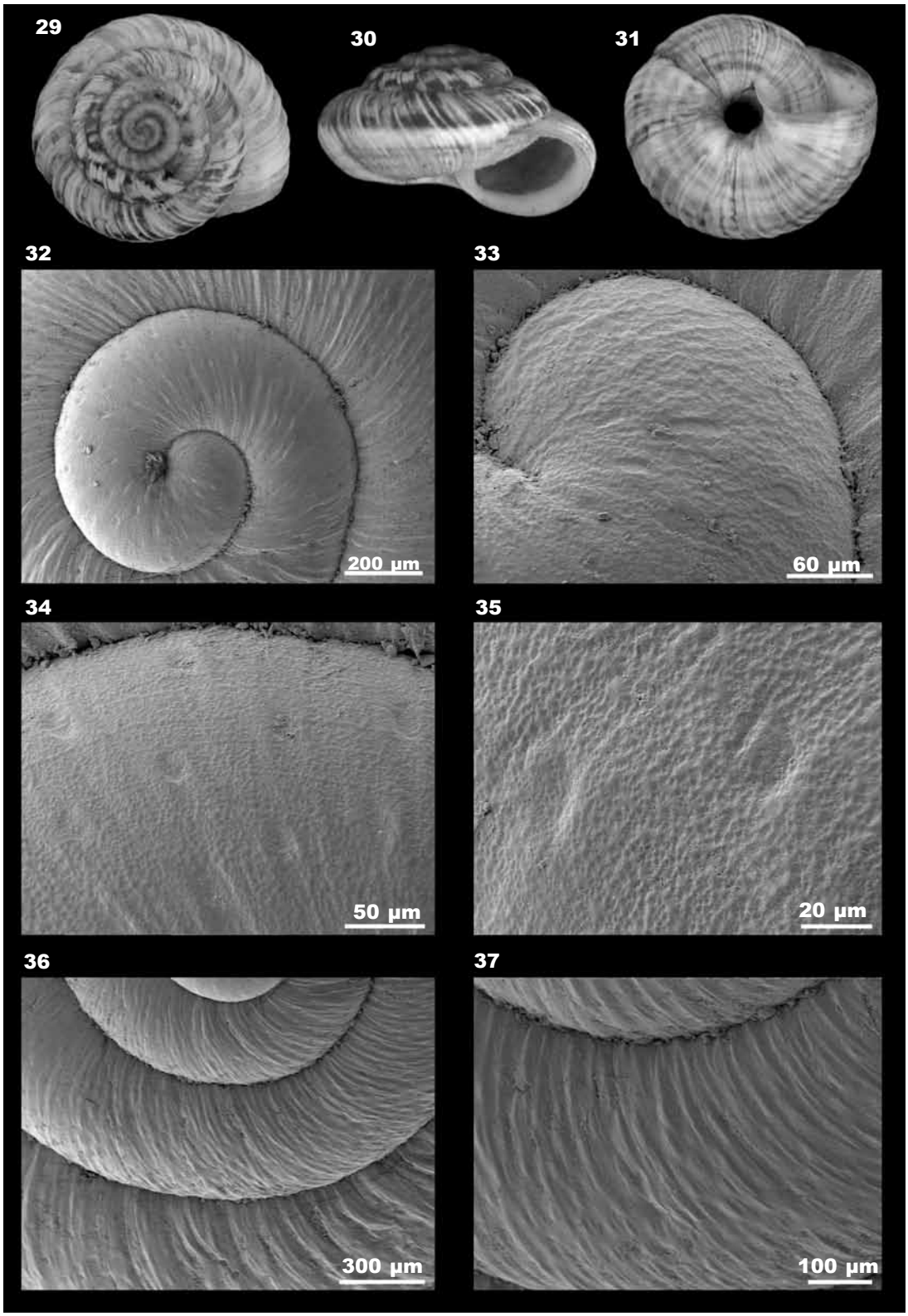
Figs. 22–28. Paralectotypes of *C. rocandioi* (MVHN nº597): 22–24. Shell (Ø = 6.2 mm); 25. Protoconch; 26–27. Protoconch sculpture details; 28. Teleoconch sculpture of the first laps. (The photographs 25–28 were taken without a gold–palladium layer.)

Figs. 22–28. Paralectotipos de C. rocandioi *(MVHN nº597): 22–24. Concha (Ø = 6,2 mm); 25. Protoconcha; 26–27. Detalles de la ornamentación; 28. Ornamentación de la teloconcha. (Las fotografías 25–28 se han realizado sin haber sido cubiertas por una capa de oro–paladio.)*

twice the length of the bursa, and the flagellum has approximately the same length or is slightly longer than half the penis and epiphallus together. Regarding the ratio of the length of the bursa copulatrix duct in *C. corbellai* n. sp., this never exceeds the length of the duct to the bursa copulatrix, rather the contrary, the bursa copulatrix is always a little longer than the duct, allowing us to differentiate it from *C. camporroblensis*.

Moreover, the morphology of the bursa in *C. corbellai* n. sp. is elongated (1.1 to 1.15 mm in width), while in *C. camporroblensis* it is ovoid (Ortiz de Zárate, 1950; Aparicio, 1982; Faci, 1991; Martínez–Ortí, 1999; Martínez–Ortí et al., 2000).

Respect to the length of the flagellum, that of *C. corbellai* n. sp. is longer, between 4.4 and 4.55 mm, while that of *C. camporroblensis* is shorter, reaching a maximum 3.8 mm. Despite being longer, in *C. corbellai* n. sp. the length of the flagellum is always less than the whole of the length of the penis and epiphallus, whereas in *C. camporroblensis* it is equal to or slightly greater than the other two organs



Figs. 29–37. *Candidula camporroblensis:* 29–31. Lectotype (MVHN nº321A) (Ø = 5.1 mm); 32. Protoconch of a paralectotype; 33–35. Protoconch sculpture details; 36–37. Teleoconch sculpture details.

Figs. 29–37. Candidula camporroblensis*: 29–31. Lectotipo (MVHN nº321A) (Ø = 5,1 mm); 32. Protoconcha de un paralectotipo; 33–35. Detalles de la protoconcha; 36–37. Detalles de la ornamentación de la teloconcha.*

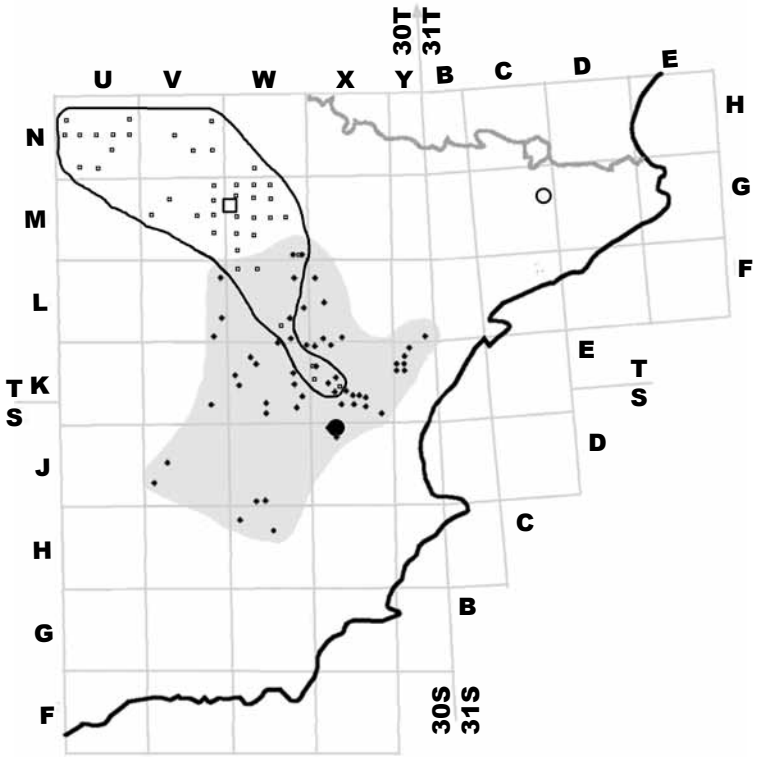


Fig. 38. Geographical distribution of *Candidula corbellai* n. sp. (*locus typicus,* circle), *C. camporroblensis* (area, grey coloured; *locus typicus,* large dot; others localities, small dots) and *C. rocandioi* (area, inside the line; *locus typicus,* square; other localities, small squares) in the Iberian peninsula.

Fig. 38. Distribución geográfica de Candidula corbellai *sp. n. (*locus typicus*, círculo),* C. camporroblensis *(área, sombreada en gris; locus typicus, punto grande; otras localidades, puntos pequeños) y* C. rocandioi *(área, delimitada por la línea;* locus typicus*, cuadrado; otras localidades, cuadrados pequeños) en la península Ibérica.*

together. Other characters of the genitalia clearly differentiate the two taxa. The male portion of *C. corbellai* n. sp. is longer than in *C. camporroblensis*; while the former is between 11.35 and 13.0 mm, the latter only reaches 7.3 mm (Ortiz de Zárate, 1950), 7.95 mm for 17 specimens (Martínez–Ortí et al., 2000), 8.2 mm (Aparicio, 1982) and 7.9 mm (Faci, 1991). In *C. camporroblensis* the penis is between 1.45 and 1.7 mm long (Martínez–Ortí et al., 2000); Faci (1991) indicates 3.2 mm for a single specimen and Aparicio (1982) reports length between 1.7 and 2.5 m, whereas in *C. corbellai* n. sp. it is longer size, ranging between 3.35 mm in the holotype and 4.75 mm in one of the two paratypes studied. The total length of the penis and epiphallus together for *C. camporroblensis* ranges between 5.0 mm (Ortiz de Zárate, 1950), 5.4 mm (Aparicio, 1986), 4.3 mm (Faci, 1991) and 3.95 (Martínez–Ortí et al., 2000), while in *C. corbellai* n. sp. it ranges between 6.55 mm in the holotype and 8.45 mm in one of the paratypes. The dart in *C. corbellai* n. sp. is longer than in *C. camporroblensis*, reaching 4 mm, while the latter ranges between 1.8 and 3.30 mm. The dart sac, defined as the part of the free sac outside the vagina, is shorter in *C. corbellai* n. sp., ranging between 1.05 and 1.5 mm, while Faci (1991) points to *C. camporroblensis* 2.5 mm and Aparicio (1982) between 3.1 and 4.4 mm. The vagina is short in *C. camporroblensis* (1 mm in Faci, 1991) while in *C. corbellai* n. sp. it is longer, from 3.5 mm of the holotype to 4.75 mm in one of the paratypes examined.

About the distribution of the three species, *C. corbellai* n. sp. is known only from one locality, well away from the distribution area of *C. camporroblensis* and *C. rocandioi*, which are more abundant in the Iberian peninsula, coexisting even in the same geographical area (fig. 38). *C. camporroblensis* has been cited in Catalonia (Tarragona) since the 1950s (Altimira, 1959; Bech, 1990). Puente (1994) notes that the description and the citations of these authors do not correspond to this species and should be considered erroneous.

New samples of *C. camporroblensis* in these localities should validate or not its presence in Catalonia after study of its reproductive system. *C. camporroblensis* is present in a large area, occupying almost the entire Iberian System, from Soria to Cuenca in Castilla–La Mancha (Altonaga et al., 1994; Puente, 1994; Talaván & Talaván, 2004; Bragado et al., 2010) provinces of Valencia and Castellón in Valencian Community (Martínez–Ortí, 1999; Martínez–Ortí et al., 2000), the Community of Aragón with the provinces of Zaragoza and Teruel (Faci, 1991; Puente, 1994) (fig. 38), while in Catalonia, Puente (1994) considers erroneous the quotes of Altimira (1959) and Bech (1990) in the province of Tarragona, as noted above. Alonso (1975) also indicated that C. *camporroblensis* could be found in Andalusia, but Puente (1994) has questioned this. Indeed, Ruiz et al. (2006) have not included this species in their guide to land snails of Andalusia. *C. rocandioi*, which has never been cited in Catalonia or in its neighboring provinces, has been found in León, north of Palencia, Burgos and Soria in Castilla–León, La Rioja, Cuenca and Guadalajara in Castilla–La Mancha and in Aragón where it is known from a single locality (Manga, 1993; Altonaga et al., 1994; Puente, 1994; Bragado et al., 2010).

Acknowledgements

We thank the *Sección de Microscopía Electrónica* del S.C.S.I.E. of the Universitat de València for their help using the SEM Hitachi S–4100. This work received financial support from the project of the Spanish *Ministerio de Investigación, Ciencia e Innovación* (CGL2008–01131/BOS).

References

Alonso, M. R., 1975. Fauna malacológica terrestre de la depresión de Granada (España). II. El género *Helicella* Férussac, 1821. *Cuadernos de Ciencias Biológicas*, 4(1): 11–28.

Altimira, C., 1959. Contribución al conocimiento de la fauna malacológica de la provincia de Tarragona. *Miscel.lània Zoològica*, 1: 89–95.

Altonaga, K., Gómez, B., Martín, R., Prieto, C. E., Puente, A. I. & Rallo, A., 1994. *Estudio faunístico y biogeográfico de los Moluscos terrestres del norte de la Península Ibérica*. Parlamento Vasco, Vitoria.

Aparicio, M. T., 1982. Observations on the antomy of some Helicidae from Central Spain. *Malacologia*, 22(1–2): 621–626.

Bech, M., 1990. Fauna malacològica de Cataluña. Mol·luscs terrestres i d'aigua dolça. *Treballs de la Institució Catalana d'Història Natural*, 12: 1–229.

Bragado, M. D., Araujo, R. & Aparicio, M. T., 2010. *Atlas y Libro Rojo de los Moluscos de Castilla–La Mancha*. Organismo Autónomo Espacios Naturales de Castilla–La Mancha, Junta de Comunidades de Castilla–La Mancha, Guadalajara.

Faci, G., 1991. Contribución al conocimiento de diversos moluscos terrestres y su distribución en la Comunidad Autónoma Aragonesa. Ph. D. Thesis, Univ. de Zaragoza.

Fez, S. de, 1944. Contribución a la malacología de la provincia de Valencia. *Boletín de la Real Sociedad Española de Historia Natural*, 42: 211–224.

Gittenberger, E., 1993a. Digging in the graveyard of synonymy, in search of Portuguese species of *Candidula* Kobelt, 1871 (Mollusca: Gastropoda Pulmonata: Hygromiidae). *Zoologische Mededelingen*, 67: 283–293.

– 1993b. On *Trochoidea geyeri* (Soós, 1926) and some conchologically similar taxa (Mollusca: Gastropoda Pulmonata: Hygromiidae). *Zoologische Mededelingen*, 67: 303–320.

Hausford, B., 1988. Zur Kenntnis der systematischen Bezieehungen einiger Taxa der Helicellinae Ihering, 1909 (Gastropoda, Hygromiidae). *Archiv für Molluskenkunde*, 119: 9–37.

Holyoak, G. A. & Holyoak, D. T., 2010. A new species of *Candidula* (Gastropoda, Hygromiidae) from central Portugal. *Iberus*, 28(1): 67–72.

Manga, Y., 1983. *Los Helicidae (Gastropoda, Pulmonata) de la provincia de León*. Ed. Diputación Provincial de León. Institución 'Fray Bernardino de Sahagún'.

Martínez–Ortí, A., 1999. Moluscos terrestres testáceos de la Comunidad Valenciana. Tesis doctoral, Univ. de València.

Martínez–Ortí, A., Faci, G. & Robles, F., 2000. Taxonomical revision of *Trochoidea (Xerocrassa) llopisi* Gasull, 1891 (Gastropoda, Pulmonata, Hygromiidae, Geomitrinae), from the province of Castellón, Spain. *Basteria*, 64: 7–14.

Martínez–Ortí, A. & Uribe, F., 2008. Los ejemplares tipo de las colecciones malacológicas del Museu de Ciències Naturals de Barcelona y del Museu Valencià d'Història Natural. *Arxius de Miscel·lània Zoològica*, 6: 1–156.

Ortiz de Zárate, A., 1950. Observaciones anatómicas y posición sistemática de varios helícidos españoles. *Boletín de la Real Sociedad Española de Historia Natural*, 48: 21–85.

– 1991. *Descripción de los moluscos terrestres del Valle del Najerilla*. Gobierno de La Rioja, Consejería de Educación, Cultura y Deportes, Logroño.

Puente, A. I., 1994. *Estudio taxonómico y biogeográfico de la superfamilia Helicoidea Rafinesque, 1815 (Gastropoda: Pulmonata: Stylommatophora) de la Península Ibérica e Islas Baleares*. Tesis doctoral, Univ. del País Vasco.

Ruiz, A., Cárcaba, A., Porras, A. & Arrébola, J. R., 2006. *Caracoles Terrestres de Andalucía. Guía y manual de identificación*. Junta de Andalucía, Fundación Gypaetus, Sevilla.

Talaván Gómez, J. & Talaván Serna, P. J., 2004. Contribución a la malacología de la Sierra de Cuenca. *Spira*, 1 (4): 11–21.