

NEWS OF *PSEUDAMNICOLA* (*CORROSELLA*) OF SPAIN AND FRANCE (MOLLUSCA: GASTROPODA: TRUNCATELLOIDEA)

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ABSTRACT: *Pseudamnicola* (*Corrosella*) Boeters, 1970 from Spain and France is reviewed: delimitation of the subgenus against the nominotypical subgenus is supported with geographical, anatomical and conchological data. Four new species are described, three from Spain: *P. (C.) collingi* n. sp., *P. (C.) valladolensis* n. sp. with two subspecies *P. (C.) v. valladolensis* n. ssp. and *P. (C.) v. kahbei* n. ssp., and *P. (C.) tajoensis* n. sp., and one from France: *P. (C.) tejedoi* n. sp. Another two species: *P. (C.) hinzi* Boeters, 1986 and *P. (C.) navasiana* (Fagot, 1907), are revised. DNA barcodes (*COI*) were analysed for some of the new species.

KEY WORDS: *Pseudamnicola*, *Corrosella*, subgenus delimitation, new species, *COI*, mitochondrial DNA

INTRODUCTION

The distribution range of the genus *Pseudamnicola* Paulucci, 1878 is at least the Mediterranean area. Reliable reports have been published for northern Africa, i. e. Tunisia and Algeria (BOETERS 1976, GLÖER et al. 2010), Greece (SZAROWSKA & FALNIOWSKI 2011), Italy (GIUSTI & PEZZOLI 1980), France (BOETERS 2000, GIRARDI et al. 2009) and Spain (BOETERS 1988). Recently also some Turkish species have been assigned to this genus (GLÖER & GEORGIEV 2012).

The genus comprises two subgenera, the nominotypical subgenus and *Corrosella* Boeters, 1970. Whereas species of the nominotypical subgenus have been reported from the whole distribution area of the genus, representatives of *Corrosella* have been recorded only from France (BOETERS 2000, GIRARDI et al. 2009) and Spain (BOETERS 1988) yet.

Recently DELICADO et al. (2012) have distinguished *Corrosella* from the nominotypical subgenus, i.e. *Pseudamnicola* s. str., based on five synapomorphies. *Corrosella* is characterised by a more slender shell and a more pigmented and tapered penis, compared to *Pseudamnicola* s. str., whereas the latter has

a longer seminal receptacle and a longer bursa duct. Furthermore, in *Corrosella* the bursa copulatrix varies from pyriform to cylindrical, while in *Pseudamnicola* s. str. it is ovoid to pyriform (HERSHLER & PONDER 1998).

DELICADO et al. (2012) and DELICADO & RAMOS (2012) have distinguished the following six species of *Corrosella* in Granada: *P. (C.) falkneri* (Boeters, 1970), *P. (C.) luisi* Boeters, 1984, *P. (C.) hydrobiopsis* Boeters, 1999, *P. (C.) bareai* Delicado, Machordom et Ramos, 2012, *P. (C.) iruritai* Delicado, Machordom et Ramos, 2012, and *P. (C.) marisolae* Delicado, Machordom et Ramos, 2012; two species in Jaén: *P. (C.) andalusica* Delicado, Machordom et Ramos, 2012 and *P. (C.) manueli* Delicado, Machordom et Ramos, 2012, and one in Valencia and Castellon: *P. (C.) hauffei* Delicado et Ramos, 2012. Another two species of *Corrosella* live in northern Spain, i. e. *P. (C.) hinzi* Boeters, 1986 and *P. (C.) navasiana* (Fagot, 1907), both in Zaragoza. Further east, only one single species of *Corrosella* has been recorded: *P. (C.) astieri* (Dupuy, 1851) in south-eastern France.

DELICADO *et al.* (2012) and DELICADO & RAMOS (2012) have redefined the criteria for distinguishing among the species of *Corrosella*. In the light of their work it is obvious that *P. (Corrosella) hinzi* as originally described (BOETERS 1986) covers two separate species. Thus, *P. (C.) hinzi* is redefined and a new species, *P. (C.) collingi* n. sp., is described in this paper.

With one exception, members of *Corrosella* inhabit drainage systems supplying the Mediterranean Sea and the adjacent Atlantic Golfo de Cádiz. The first and single report of a representative of *Corrosella* inhabiting a system draining the Sistema Central into the Portuguese Atlantic, has been provided by SOLER *et al.* (2006). This paper confirms and elucidates it

by the description of *P. (C.) valladolensis* n. sp. and *P. (C.) tajoensis* n. sp.

A new species of *Corrosella*, *P. (C.) tejedoi* n. sp., is described from the area between Zaragoza and the French Côte-d'Azur, where no member of *Corrosella* has been found previously.

DNA sequences of the mitochondrial cytochrome c oxidase subunit I (COI) gene fragment are frequently used for species identification on molecular level (DNA barcoding; introduced by HEBERT *et al.* 2003). In this study, we analysed COI DNA barcodes, in order to assess the discrimination of the studied taxa at the molecular level.

MATERIAL AND METHODS

Whorls were counted according to GITTENBERGER *et al.* (1970). The shell measurements are presented as minimum-mean-maximum values. The colours of shells and opercula apply to samples kept in ethanol 75% by weight; in dried state, the colour of shells

and opercula changes from white to corneous or from corneous to brownish. Anatomical examination followed BOETERS (1999).

Drawings of shells and animals and parts thereof were done with ZEISS 45 degree Drawing Prism.



Fig. 1. Distribution of species of subgenera *Pseudamnicola* (asterisks) and *Corrosella* (circles) in Spain and the mainland of France. For details see Appendix 1. The distribution areas of the two genera roughly separated with a solid line

Except for Tables 2–3 and Fig. 71, the shell length and diameter were measured with a 5 mm measure plate (0.05 mm grading) at 25× magnification; the measurements were rounded to the nearest 0.05 mm. For the data in Tables 2–3 and Fig. 71 a micrometer was used (reticular ocular 10 : 100).

Photographs of shells were taken with a stereomicroscope ZEISS 2000 C, colour photographs with a digital colour camera SSC-DC SONY with monitor exit TRINITON COLOR VIDEO SONY, to achieve depth of focus. The photographs were touched up with PAINT SHOP PRO (version 9).

The distribution map (Fig. 1, see also: Appendix 1) is based on MGRS (Military Grid Reference System).

For molecular analysis we used 32 *COI* sequences published by DELICADO et al. (2013) and deposited at GenBank (<http://www.ncbi.nlm.nih.gov>) under accession numbers JX081854–JX081885. All of the 32 sequences were originally assigned to *P. navasiana* (DELICADO et al. 2013). The sequences were aligned

using Muscle algorithm (EDGAR et al. 2004) implemented in MEGA version 6.06 (TAMURA et al. 2011). Intra- and interspecific genetic distances were calculated in MEGA using the Kimura two-parameter (K2P) model (KIMURA 1980). The difference between the maximum intraspecific distance and the smallest distance to the nearest neighbour (NN) is known as the “barcode gap” and quantifies the distinctness of species at the DNA barcode locus (MEYER & PAULAY 2005). Barcode gaps were calculated for each species. A neighbour-joining (NJ) topology (SAITOU & NEI 1987) was built based on K2P pairwise genetic distances together with bootstrap analysis of 1,000 replicates (FELSENSTEIN 1985).

The material is kept in the following collections: BOE – Collection HANS BOETERS (München); HG – Collection HENRI CALLOT-GIRARDI (Montfavet); SMF – Forschungsinstitut und Natur-Museum Senckenberg (Frankfurt am Main).

SYSTEMATIC PART

1. *Pseudamnicola* (*Corrosella*) *hinzi* Boeters, 1986 (Figs 2, 10–11, 24–26, 40, 45, 52, Table 1)

1986 *Pseudamnicola* (*Corrosella*) *hinzi* (BOETERS 1986: 125, figs 1–3, pl. 18a: fig. 1)

1988 *Pseudamnicola* (*Corrosella*) *hinzi* (BOETERS 1988: 205, figs 62, 72, 85, pl. 2: fig. 21)

2010 *Pseudamnicola* (*Corrosella*) *hinzi* (DELICADO et al. 2010: 101)

Material examined: Spain, Zaragoza, Bulbunte, at the rio Huecha (tributary of the river Ebro), Balsa de Vargas [at Borja according to DELICADO et al. 2010: 101] [XM12]; HINZ leg. IV.1984; BOE 1240/animals + BOE 2622/shells.

Type locality: “Zaragoza, Bulbunte, Balsa de Vargas” [at Borja according to DELICADO et al. (2010: 101)]

Shell (Figs 2, 45, 52): Translucent, horn- to brownish-coloured even where broken, with 3.25–3.75

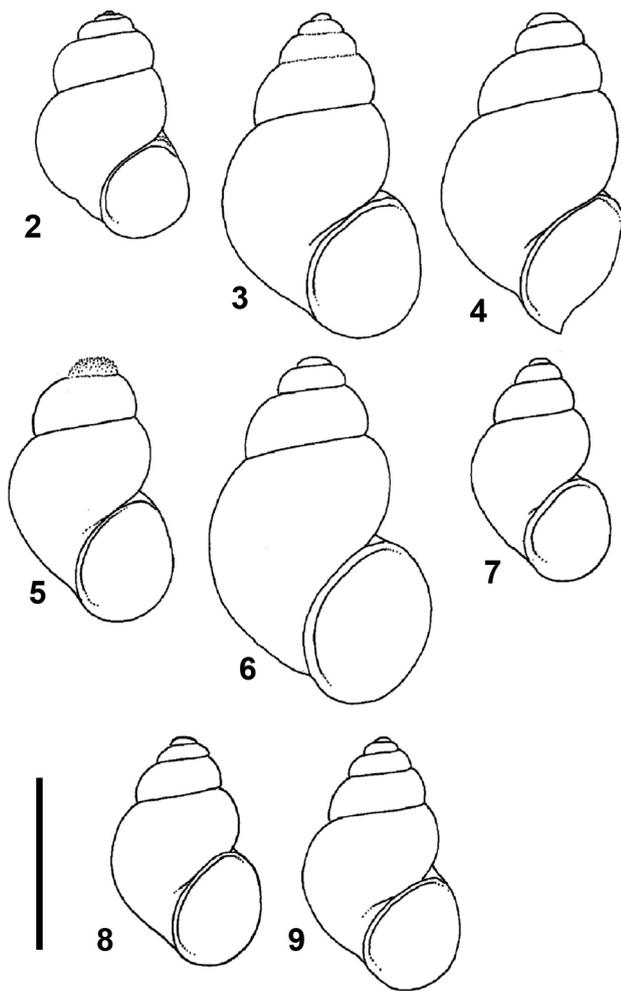
spire whorls, ovate-conical in shape, with nearly straight sides and height to diameter ratio of 1.46; spire whorls fairly vaulted and separated by a deep suture, but body whorl flattened between suture and periphery; aperture inclined ovate, palatal and parietal border forming a rounded angle of slightly less than 90°; parietal border generally fused with shell wall over a long distance, columellar border slightly broadened, closing umbilicus or leaving it only sometimes slit-like open; aperture at best slightly broadened at base; body whorl not deflected upward or downward; peristome sharp. Periostracum more or less eroded, the degree of erosion increases from the last to the first whorl, sometimes to such a degree that the eroded areas are covered by calcareous structures.

Shell measurements (Table 1): Height of uneroded shells 2.30–2.46–2.60 (n=5), diameter 1.60–1.68–1.80 (n=5).

Table 1. *Pseudamnicola* (*Corrosella*) – comparison of shell dimensions

Species	Shell height (h) [mm]	Shell diameter (d) [mm]	h : d ratio
<i>P. (C.) navasiana</i> (1)	3.05–3.34–3.45 (n = 5)	1.85–2.08–2.25 (n = 5)	1.61
<i>P. (C.) collingi</i> n. sp. (5)	2.90–3.15–3.60 (n = 5)	1.95–2.13–2.35 (n = 5)	1.48
<i>P. (C.) astieri</i> (2)	2.65–2.97–3.30 (n = 10)	1.75–2.02–2.25 (n = 10)	1.47
<i>P. (C.) tejedoi</i> n. sp. (6)	2.53–2.81–3.00 (n = 4)	1.40–1.50–1.75 (n = 16)	1.87
<i>P. (C.) hauffei</i> (4)	2.17–2.50–2.85 (n = 18)	1.44–1.59–1.78 (n = 18)	1.57
<i>P. (C.) hinzi</i> (3)	2.30–2.46–2.60 (n = 5)	1.60–1.68–1.80 (n = 5)	1.46

The number of measured specimens of *P. (C.) navasiana*, *P. (C.) astieri* and *P. (C.) hinzi* is small since the examined samples contained only a small number of uneroded shells despite the fact that they comprised a few hundred specimens each. (1) Bulbunte, 2 km W of village (BOE 1239); (2) Spéracèdes about 5 km west of Grasse, open air village washing place (BOE 0804); (3) Borja, Balsa de Vargas (BOE 1240); (4) DELICADO & RAMOS 2012: 65, table 2; (5) Covanera (BOE 0599); (6) Err, Pyrénées-Orientales (BOE 3169)



Figs 2–9. Shells: 2 – *Pseudamnicola (Corrosella) hinzi*: ♂ (same animal as in Figs 10 and 40), Spain, Zaragoza, Borja [non Bulbuenta], Balsa de Vargas, at Huecha river (tributary of Ebro), BOE 1240/paratype; 3 – *Pseudamnicola (Corrosella) collingi* n. sp. Spain, Burgos, Covanera, Pozo Azul [type locality], BOE 0599/paratype; 4–6 – *Pseudamnicola (Corrosella) valladolensis valladolensis* n. ssp. Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca, BOE 2636/paratypes: 4–5 – ♂♂ (same animals as in Figs 14 and 17), 6 – ♀ (same animal as in Figs 30–31); 7–8 – *Pseudamnicola (Corrosella) valladolensis kahbei* n. ssp. Spain, Valladolid, Aguilarejo, Fábrica vieja [type locality], BOE 2635/paratypes: 7 – ♂ (same animal as in Fig. 18), 8 – ♀ (same animal as in Figs 34–35); 9 – *Pseudamnicola (Corrosella) tajoensis* n. sp. Spain, Madrid, Aranjuez, Casa de Marinós, in a Tajo tributary, BOE 0225/paratype. Scale bar 1 mm

Animal (Figs 10–11): On visceral sac whorls light to dark brown spots. Mantle except for its white border pigmented brownish, only eyes, tentacles and head between tentacles pigmented black. Foot seen through operculum with three parallel colour fields running to the tip of operculum, from left to right: brown, white (under nucleus) and brownish. Separated operculum uniformly corneous to brownish. Gill (Fig. 40) with 17 filaments ($n = 1♂$).

Penis (Figs 10–11): Slender, finger-like, only tip tapered, core unpigmented, penial duct meandering towards penis tip.

Female genitalia (Figs 24–26): The proximal, first section of renal oviduct is pigmented black and coiled up to the distal, final section which is straight, only very slightly pigmented and entered by two ducts: the receptaculum duct, and the bursal duct; duct of the small drop- to sac-like receptaculum (rs1) very short; bursa copulatrix long, U-like bent; bursal duct thick, gradually passing into the bursa in front of its bend. The receptaculum reaches the bursa bottom ($n = 2$).

Habitat and distribution: Known from the type locality in Zaragoza, i. e. Borja, Balsa de Vargas, on the river Huecha (tributary of the Ebro), and from two localities in Teruel, i. e. Calamocha and Caminreal, on the river Jiloca (tributary of the Jalón which in turn falls into the Ebro) (DELICADO et al. 2010).

Remarks:

1. The penis in the photograph presented by DELICADO et al. (2010: 108, fig. 6C) differs from that of *P. (C.) tajoensis* n. sp. in being pointed, without any shoulder.
2. *Peringia hispanica* Servain, 1880 described from deposits of the Ebro river at Zaragoza has not yet been identified, but its shell measurements, i.e. height 6 mm and diameter 2.5 mm, indicate that it does not belong to *Corrosella* and it cannot be confused with *P. (C.) hinzi*.

2. *Pseudamnicola (Corrosella) collingi* n. sp.

(Figs 3, 12–13, 27–29, 41, 46, 53–55, Table 1)

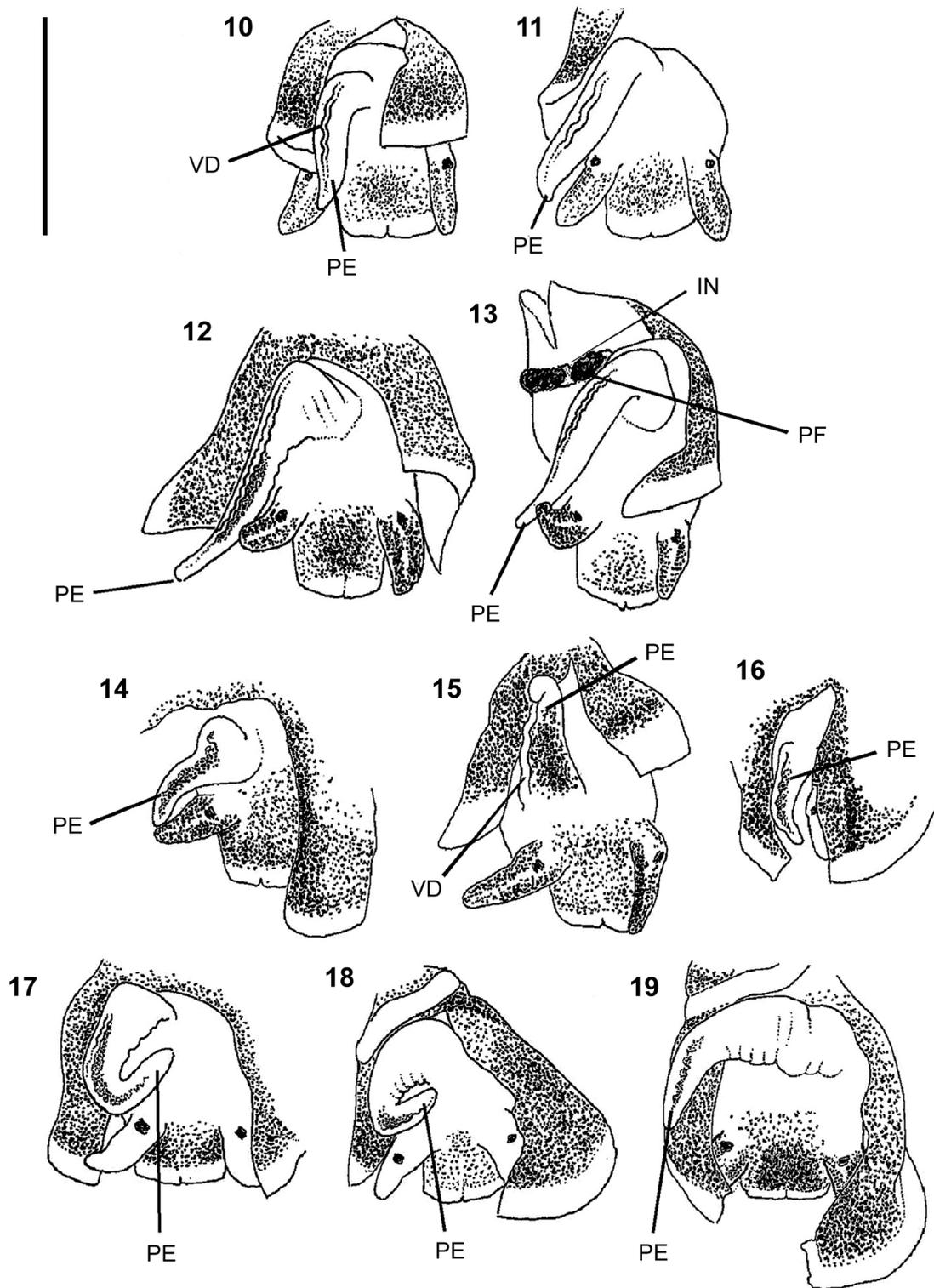
Material examined (holotype and paratypes):

Spain, Burgos, on the river Rudrón (tributary of the Ebro); (i) Covanera, Pozo Azul [VN33]; BOETERS leg. V./VI.1974; SMF 342 412/shell holotype, BOE 0599/animals + BOE 2623/shells; (ii) Tubilla del Agua, spring at exit of village towards Masa [VN32]; BOETERS leg. V./VI.1974; BOE 0600/animals.

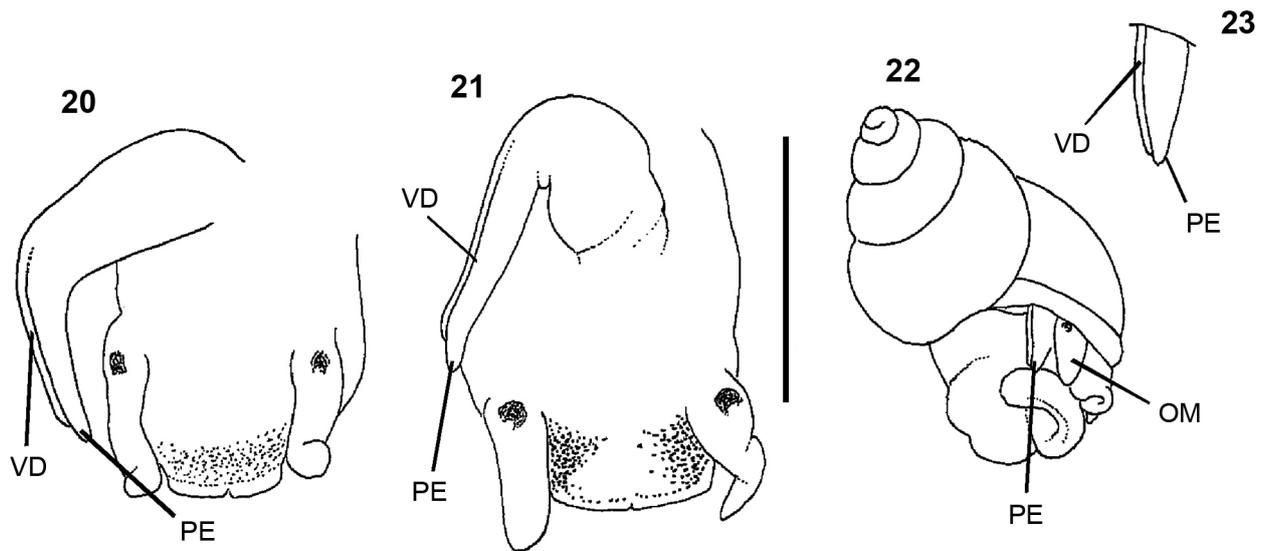
Type locality: Spain, Covanera, Pozo Azul.

Derivatio nominis: Named after MANFRED COLLING (Unterschleißheim) for his indefatigable support of Boeters' malacological activities.

Shell (Figs 3, 46, 53–55): Translucent light corneous, but white where broken, with 3.5 spire whorls, ovate-conical in shape, with height : diameter ratio of 1.48 and with nearly straight sides; spire whorls fairly vaulted and separated by a deep suture; aperture inclined ovate, palatal and parietal border forming a rounded angle of slightly less than 90°; parietal and columellar border slightly broadened, touching the shell wall over a short distance and leaving the umbilicus slit- or funnel-like open; aperture at best slightly broadened at base; body whorl not deflected upward



Figs 10–19. Males: 10–11 – *Pseudamnicola* (*Corrosella*) *hinzi*: heads, mantle slit open to expose penis, Spain, Zaragoza, Borja [non Bulbuenta], Balsa de Vargas, at Huecha river (tributary of Ebro), BOE 1240/paratypes (10 – same animal as in Figs 2 and 40); 12–13 – *Pseudamnicola* (*Corrosella*) *collingi* n. sp.: heads, mantle slit open to expose penis, Spain, Burgos (12 – Covanera, Pozo Azul [type locality], BOE 0599/paratype, 13 – Tubilla del Agua, spring at exit of village towards Masa; BOE 600/paratype); 14–17 – *Pseudamnicola* (*Corrosella*) *valladolensis v. v.* n. ssp.: heads, mantle slit open to expose penis, Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca, BOE 2636/paratypes (14 – same animal as in Fig. 4; 17 – same animal as in Fig. 5); 18–19 – *Pseudamnicola* (*Corrosella*) *valladolensis kahbei* n. ssp.: heads, mantle slit open to expose penis, Spain, Valladolid, Aguilarejo, Fábrica vieja [type locality], BOE 2635/paratypes (18 – same animal as in Fig. 7; 19 – same animal as in Fig. 43). Scale bar 0.5 mm. Abbreviations: FP – faecal pellet, IN – intestine, PE – penis, VD – penial duct (vas deferens)



Figs 20–23. Males of *Pseudamnicola (Corrosella) tajoensis* n. sp. Spain, Madrid, Aranjuez, Casa de Marinos, in a Tajo tributary; BOE 0225/paratypes: 20–21 – heads, mantle removed to expose penis (20 – same animal as in Fig. 44); 22 – animal partially retracted into shell; 23 – detail of Fig. 22: penis). Scale bar 0.5 mm for Figs 20–21 and 23 and 1 mm for Fig. 22. Abbreviations: PE – penis, TE – tentacle, VD – penial duct (vas deferens)

or downward; peristome smooth. Periostracum more or less eroded, the degree of erosion increases from the last to the first whorl, sometimes to such a degree that the eroded areas are covered by calcareous structures.

Shell measurements (Table 1): Height 2.90–3.15–3.60 mm, diameter 1.95–2.13–2.35 mm ($n = 5$ each, from Covanera).

Animal (Figs 12–13): Head between tentacles, eyes, tentacles and mantle except for its white border pigmented black. On visceral sac whorls black spots, fading to brownish only at weakly pigmented areas. Foot seen through operculum with three parallel colour fields running to the tip of operculum, from left to right: black, white (under nucleus) and black. Separated operculum uniformly pale corneous. Gill (Fig. 41) with 14–19 filaments ($n = 4$ ♀♀). Sex ratio among 15 dissected animals was 1 male : 14 females (BOE 0599).

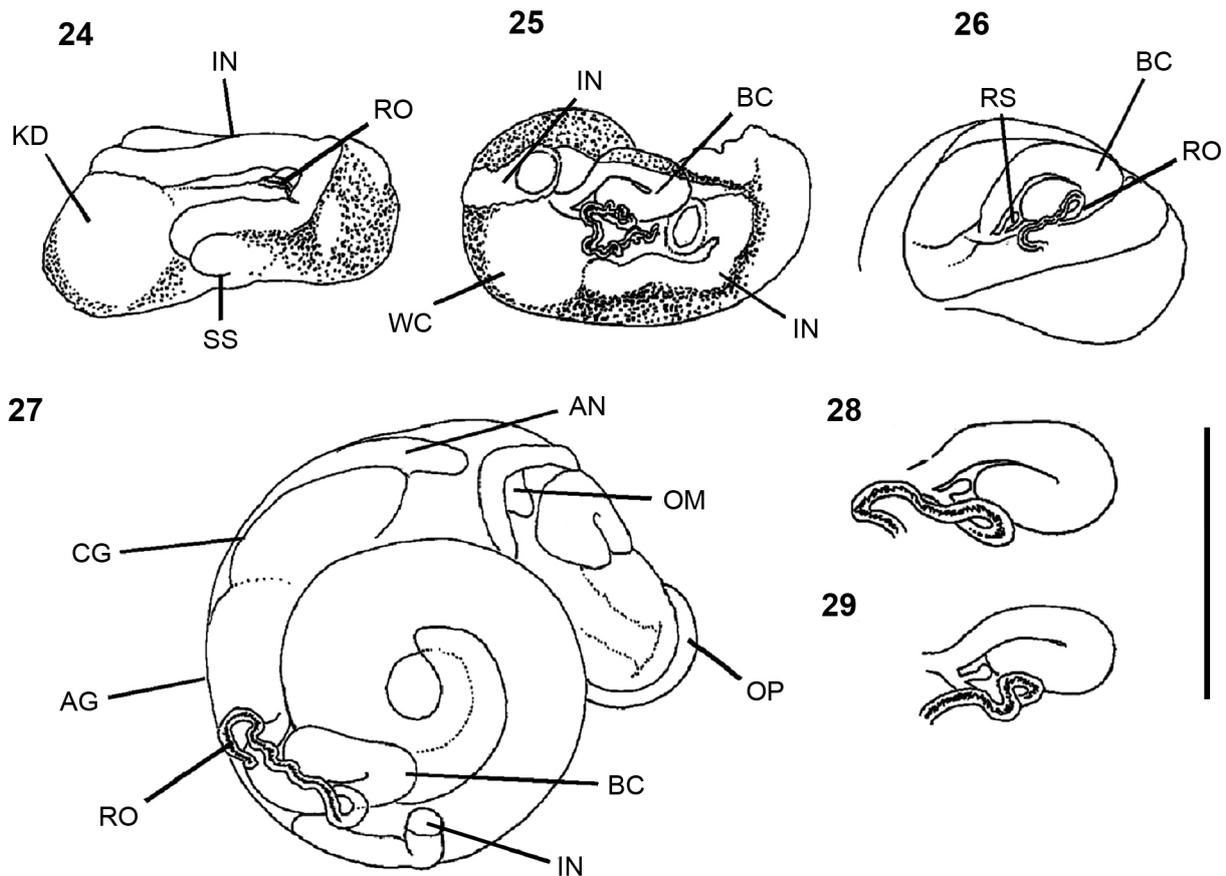
Penis (Figs 12–13): Slender, tapered from base to tip; the penial duct undulates slightly along the penis periphery and is flanked by a weakly blackish pigmented zone of the penis core; the duct ends nearly at the tip of penial body ($n = 1$ each from Covanera and Tubilla del Agua).

Female genitalia (Figs 27–29): The proximal, first section of renal oviduct is pigmented black and coiled up to the distal, final section which is straight, only very slightly pigmented and entered by two ducts, the receptaculum duct and the bursal duct; duct of the small drop- to sac-like receptaculum (rs1) very short; bursa copulatrix long, U-like bent; bursal duct thick, gradually passing into the bursa in front of its

bend. The receptaculum reaches the bursa bottom ($n = 2$ from Covanera).

Differentiating characters:

1. Contrary to *P. (Corrosella) hinzi* the mantle is not pigmented brownish, but black except for its white border. The penial duct is flanked by a slightly blackish pigmented zone of its core. Furthermore, the penis is tapered from base to tip and not finger-like.
2. In *P. (Corrosella) navasiana* the suture is deeper than in *P. (Corrosella) collingi* n. sp. Besides, in *P. (C.) navasiana* the body whorl often shows a slight shoulder between the suture and the periphery, whereas in *P. (C.) collingi* n. sp. such a shoulder is absent. In *P. (Corrosella) navasiana* the bursal duct and bursa are clearly separated from each other, whereas in *P. (Corrosella) collingi* n. sp. the bursal duct passes gradually into the bursa in front of its bend. In *P. (C.) navasiana* the receptaculum is located at a distance from the bursa, whereas in *P. (C.) collingi* n. sp. it touches the bursa. In *P. (C.) collingi* n. sp. the penial duct undulates slightly, whereas in *P. (C.) navasiana* it runs straight down towards the penis tip.
3. In *P. (Corrosella) tajoensis* n. sp. the penis is unpigmented, whereas in *P. (Corrosella) collingi* n. sp. the penial duct is flanked by a slightly blackish pigmented zone of the penis core. Furthermore, in *P. (C.) tajoensis* n. sp. the penial duct runs at the periphery of the penis body straight to the penis tip, while in *P. (C.) collingi* n. sp. the penial duct undulates slightly from the base of the penis up to its tip.



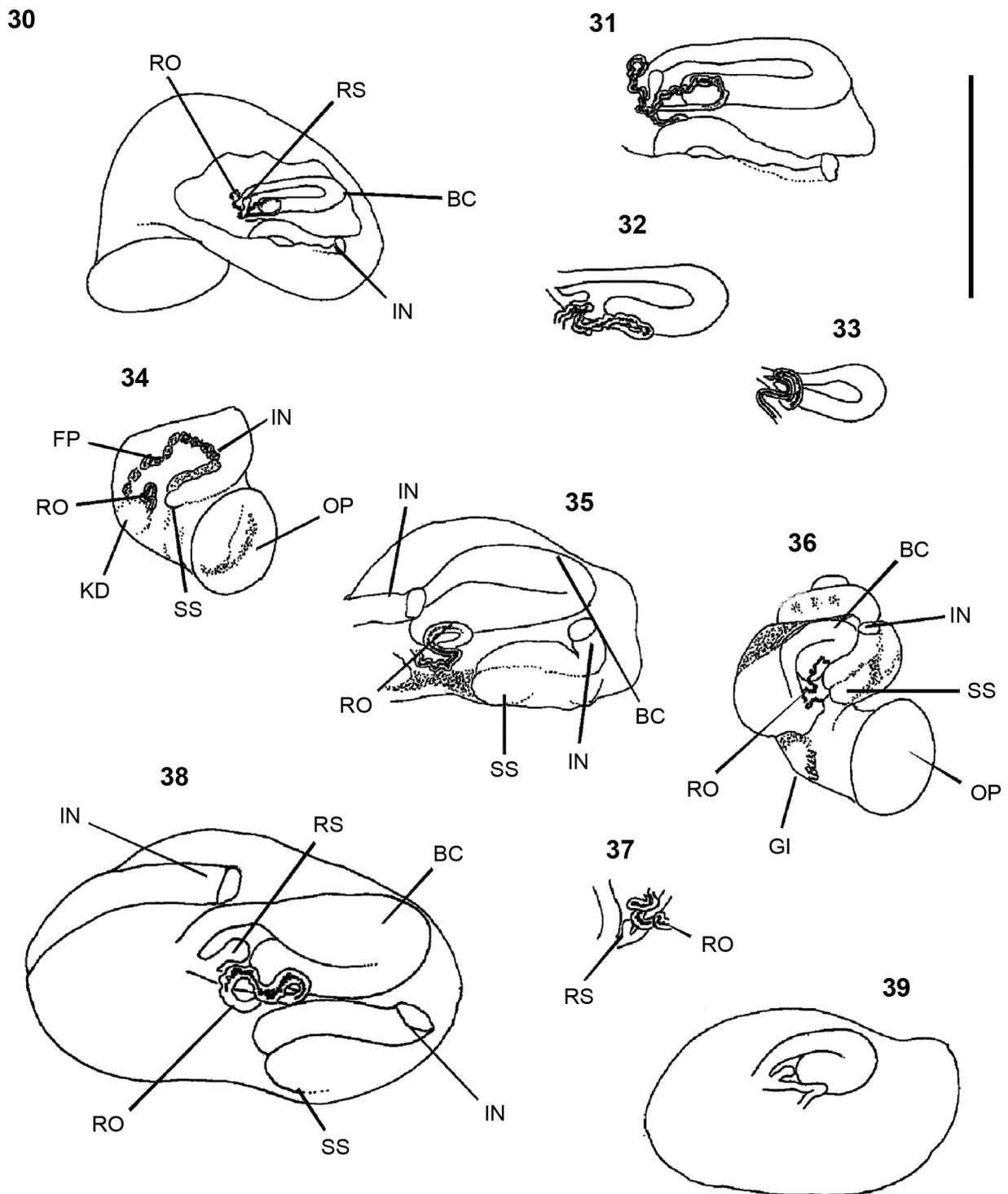
Figs 24–29. Females: 24–26 – *Pseudamnicola (Corrosella) hinzi*, Spain, Zaragoza, Borja [non Bulbuente], Balsa de Vargas, at Huecha river (tributary of Ebro), BOE 1240/paratypes (24 – lateral view of still unopened body, 25 – same animal as in Fig. 24, 26 – body opened and intestine partially removed to show renal oviduct with receptaculum seminis (RS1) and bursa copulatrix; receptaculum slightly separated from bursa wall); 27–29 – *Pseudamnicola (Corrosella) collingi* n. sp. Spain, Burgos, Covanera, Pozo Azul [type locality], BOE 0599/paratypes [27 – same animal as in Fig. 41 (top view; intestine partially removed to show position of bursa copulatrix and renal oviduct to be imagined under bursa and removed intestine), 28–29 – renal oviducts with receptaculum seminis (RS1) and bursa copulatrix]. Scale bar 0.5 mm. Abbreviations: AG – albumen gland, AN – anus, BC – bursa copulatrix, CG – capsule gland, IN – intestine, KD – kidney, OP – operculum, RO – renal oviduct, RS – receptaculum seminis, SS – style sac, TE – tentacle, WC – wall of mantle cavity

Habitat and distribution: Known from four springs in Burgos (see “Material examined” and DELICADO et al. 2013: 390, Table 1; Vld, Tub). At Tubilla del Agua found together with *Alzoniella cantabrica* (BOE 0600; BOETERS 1986: 125). *P. (Corrosella) navasiana* has also been reported from Burgos but not yet sympatrically with the new species (DELICADO et al. 2013: 391, Table 1, Vat).

Remarks:

1. A new species of *Corrosella* from the Ebro basin which during the Lower Miocene (23–16 Ma) became the fluvial network between the Pyrenees and the Iberian Mountain System, draining towards the Mediterranean Sea (VARGAS et al. 1998: 372).

2. Up to now BOETERS (1986: 125, fig. 3 and 1988: 205, figs 63–64, 73, 86) interpreted this species erroneously as *Pseudamnicola (Corrosella) hinzi*.
3. DELICADO et al. (2013: 390, Poz) compared genetically the new species, inter alia from its type locality, with *P. (Corrosella) navasiana* inter alia from Bulbuente (DELICADO et al. 2013: 390, Fon).
4. The DNA barcodes obtained from four populations from Burgos (DELICADO et al. 2013: 390, Poz, Tob, Vld and Tub) exhibited no intraspecific sequence divergence and therefore represented only one haplotype. Its sequence was clearly distinct from the other *Corrosella* sequences (Fig. 81) and showed the genetic distance to the nearest neighbouring species of 1.8% (Table 5).



Figs 30–39. Females: 30–33 – *Pseudamnicola (Corrosella) valladolensis valladolensis* n. ssp. Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca, BOE 2636/paratypes [30–31 – same animal as in Fig. 6 (last whorl opened, intestine partially removed to show bursa copulatrix), 32 – same animal as in Fig. 42, 33 – renal oviduct with receptaculum seminis (RS1) and bursa copulatrix]; 34–37 – *Pseudamnicola (Corrosella) valladolensis kahbei* n. ssp. Spain, Valladolid, Aguilarejo, Fábrica vieja [type locality], BOE 2635/paratypes [34–35 – same animal as in Fig. 8 (last whorl still unopened, and body opened, intestine partially removed to show renal oviduct and bursa copulatrix), 36–37 – body opened, and detail to show position of receptaculum seminis (RS1)]; 38–39 – *Pseudamnicola (Corrosella) tajoensis* n. sp. Spain, Madrid, Aranjuez, Casa de Marinos, in Tajo tributary, BOE 0225/paratypes, body opened and intestine partially removed to show position of receptaculum seminis (RS1) and bursa copulatrix. Scale bar 0.5 mm for Figs 31–33, 35 and 37–39 and 1 mm for Figs 30, 34 and 36. Abbreviations: BC – bursa copulatrix, FP – faecal pellet, GI – gill, IN – intestine, KD – kidney, OP – operculum, RO – renal oviduct, RS – receptaculum seminis, SS – style sac

3. *Pseudamnicola* (*Corrosella*) *valladolensis* n. sp.

This new species inhabits the drainage system of the Rio Duero, with 2 subspecies.

3.1. *Pseudamnicola* (*Corrosella*) *valladolensis vellidoensis* n. ssp.

(Figs 4–6, 14–17, 30–33, 42, 47, 56–57)

Material examined (holotype and paratypes): Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca [type locality; UM70]; GASULL leg. 28.V.1981; SMF 342 413/shell holotype, BOE 2636/animals + BOE 2637/shells.

Type locality: Spain, Valladolid, Fuente del Arca.

Derivatio nominis: The name *valladolensis* refers to the Spanish province (Valladolid) inhabited by the new species.

Shell (Figs 4–6, 47, 56–57): Hardly translucent, corneous to light brownish, but white where broken, with 4.00 to 4.75 spire whorls, ovate-conical to elongated ovate-conical in shape, with height : diameter ratio of 1.56 and with nearly straight sides; spire whorls well vaulted and separated by a deep suture; aperture inclined ovate, palatal and parietal border forming a rounded angle of slightly less than 90°; col-

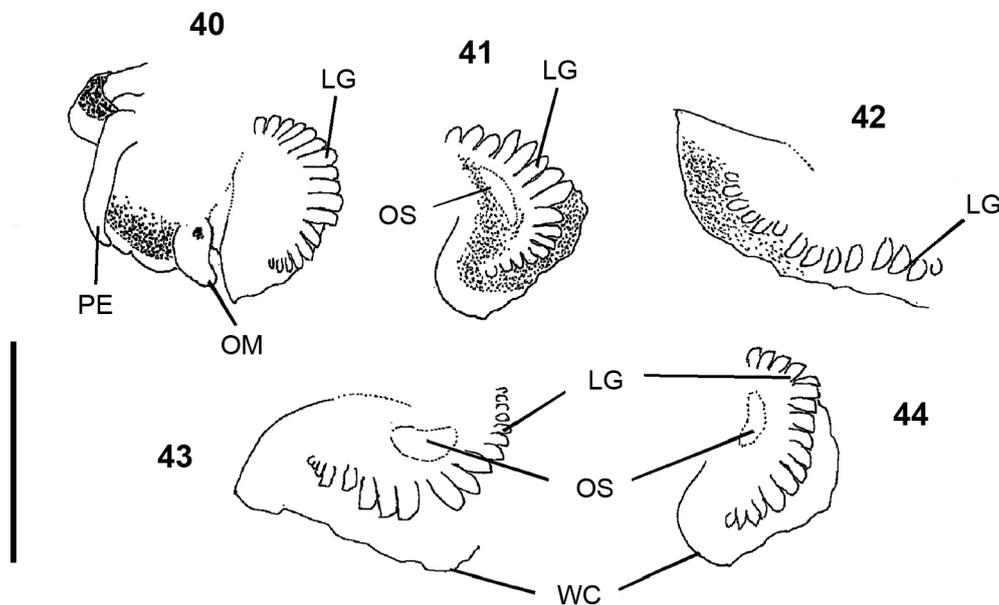
umellar border slightly broadened, leaving the umbilicus funnel-like or, together with the parietal border, slit-like open; aperture at best slightly broadened at base; body whorl not deflected upward or downward; peristome smooth. Some shells show eroded areas, which can be covered by calcareous structures.

Shell measurements: Height (h) 2.95–3.22–3.60 mm, diameter (d) 1.85–2.06–2.30 mm, h : d ratio 1.56.

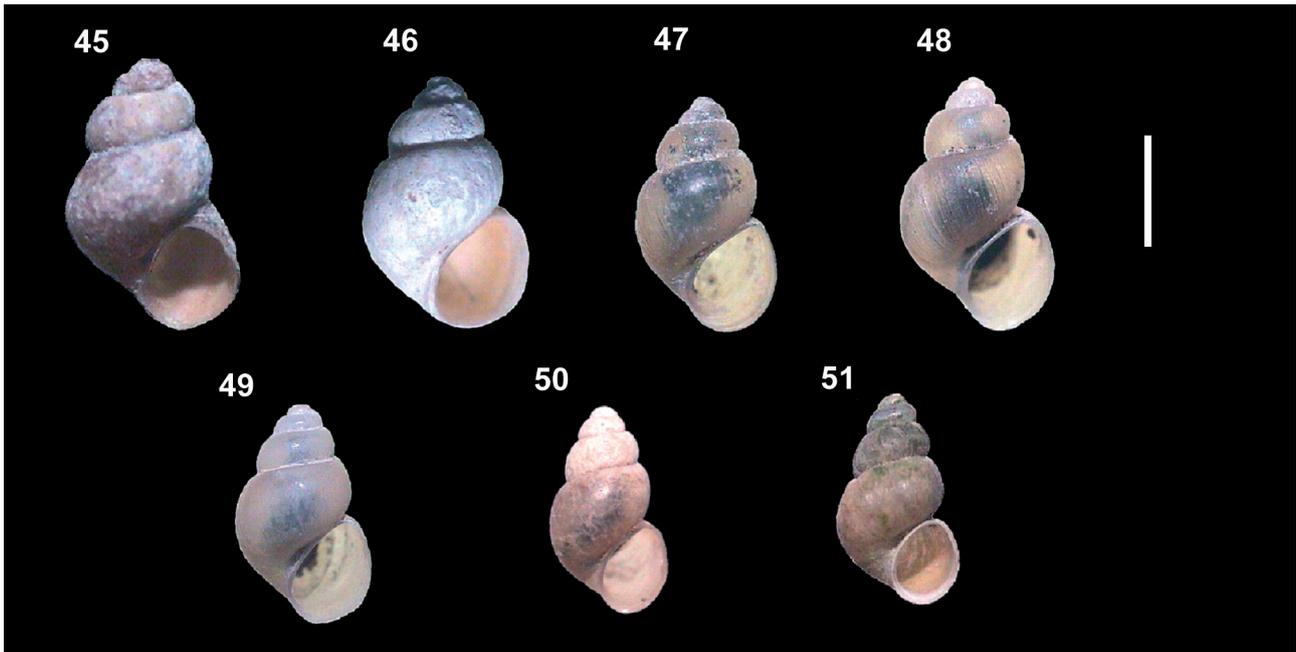
Animal (Figs 14–17): Head between tentacles, eyes, tentacles and mantle except for its white border pigmented black. Visceral sac whorls with lighter and darker pigmented spots. Foot seen through operculum with three parallel colour fields running to the tip of operculum, from left to right: black, brownish (under nucleus) and black. Separated operculum uniformly light brownish except for the slightly more intensively brownish coloured nucleus. Gill (Fig. 42) with 14 filaments ($n = 1\text{♀}$).

Penis (Figs 14–17): Tapered from base to tip, in its resting position with weak transverse folds; penis bent, so that the left, inner periphery of the bend looks slightly wavy; penial duct meandering towards the penis tip and accompanied by a slightly blackish zone of the penis core; remarkably, three out of the four dissected males showed a different shape each ($n = 4$).

Female genitalia (Figs 30–33): The proximal, first section of renal oviduct pigmented black and coiled



Figs 40–44. Gills: 40 – *Pseudamnicola* (*Corrosella*) *hinzi* (same animal as in Figs 2 and 10), Spain, Zaragoza, Borja [non Bulbunte], Balsa de Vargas, at Huecha river (tributary of Ebro), BOE 1240/paratype; 41 – *Pseudamnicola* (*Corrosella*) *collingi* n. sp. (same animal as in Fig. 27), Spain, Burgos, Covanera, Pozo Azul [type locality], BOE 0599/paratype; 42 – *Pseudamnicola* (*Corrosella*) *valladolensis vellidoensis* n. ssp. (same animal as in Fig. 32), Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca, BOE 2636/paratype; 43 – *Pseudamnicola* (*Corrosella*) *valladolensis kahbei* n. ssp. (same animal as in Fig. 19), Spain, Valladolid, Aguilarejo, Fábrica vieja [type locality], BOE 2635/paratype; 44 – *Pseudamnicola* (*Corrosella*) *tajoensis* n. sp. (same animal as in Fig. 20), Spain, Madrid, Aranjuez, Casa de Marinos, in a Tajo tributary, BOE 0225/paratype. Scale bar 0.5 mm. Abbreviations: LG – lamella of gill, OS – osphradium, PE – penis, TE – tentacle, WC – wall of mantle cavity



Figs 45–51. Shells: 45 – *Pseudamnicola (Corrosella) hinzi* (height 2.55 mm), Spain, Zaragoza, Borja [non Bulbuenta], Balsa de Vargas, at Huecha river (tributary of Ebro), BOE 2622/paratype; 46 – *Pseudamnicola (Corrosella) collingi* n. sp. (height 3.00 mm; same animal as in Fig. 27), Spain, Burgos, Covanera, Pozo Azul [type locality], BOE 2623/paratype; 47 – *Pseudamnicola (Corrosella) valladolensis valladolensis* n. ssp. (height 3.225 mm), Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca, BOE 2637/paratype; 48 – *Pseudamnicola (Corrosella) valladolensis kahbei* n. ssp. (height 3.40 mm), Spain, Valladolid, Sardón de Duero, Finca Retuerta, Fuente itoalcahal, BOE 2638/paratype; 49 – *Pseudamnicola (Corrosella) tajoensis* n. sp. (height 2.35 mm), Spain, Madrid, Aranjuez, Casa de Marinos, in Tajo tributary, BOE 2634/paratype; 50 – *Pseudamnicola (Corrosella) tejedoi* n. sp. (height 2.75 mm), France, Pyrénées-Orientales, Err, Source de la Rivière d'Err (Font de la Ribera d'Err), 2,380 m [type locality], BOE 3169/paratype; 51 – *Pseudamnicola (Corrosella) astieri* (height 2.40 mm), France, Var, Pontevès, source du Pavillon, ruisseau le Fauvery, HG. Scale bar 1 mm

up to the distal, final section which is straight, only very slightly pigmented and entered by two ducts, the receptaculum duct and the bursal duct; duct of the small drop- to sac-like receptaculum (rs1) extremely short; bursa copulatrix not oriented parallel to the intestine, but embedded in the albumen gland; the bursa is slim and long, U-like bent, both arms oriented parallel to each other, but at a distance from each other; bursal duct gradually passing into the bursa in front of its bend. The receptaculum does not touch the bursa bottom (n = 3).

Differentiating characters: For differentiation from *P. (Corrosella) v. kahbei* n. ssp. see description of that subspecies.

Habitat and distribution: Known only from its type locality in Valladolid, i.e. Quintanilla de Onésimo [Quintanilla de Abajo] on the Rio Duero, the Fuente del Arca.

Remarks: *P. (C.) v. valladolensis* n. ssp. is the nominate subspecies of the new species of *Corrosella*. It is an endemic species, the only one yet known from the Duero basin which was separated from the neighbouring Ebro and Tajo basins during the Lower Miocene (23–16 Ma) and the Middle Miocene (16–12 Ma), respectively (VARGAS et al. 1998: 372). In contrast to the Ebro drainage system, with *P. (C.)*

navasiana, *P. (C.) hinzi*, *P. (C.) collingi* n. sp. and *P. (C.) tejedoi* n. sp., it supplies the Atlantic and not the Mediterranean Sea.

3.2. *Pseudamnicola (Corrosella) valladolensis kahbei* n. ssp.

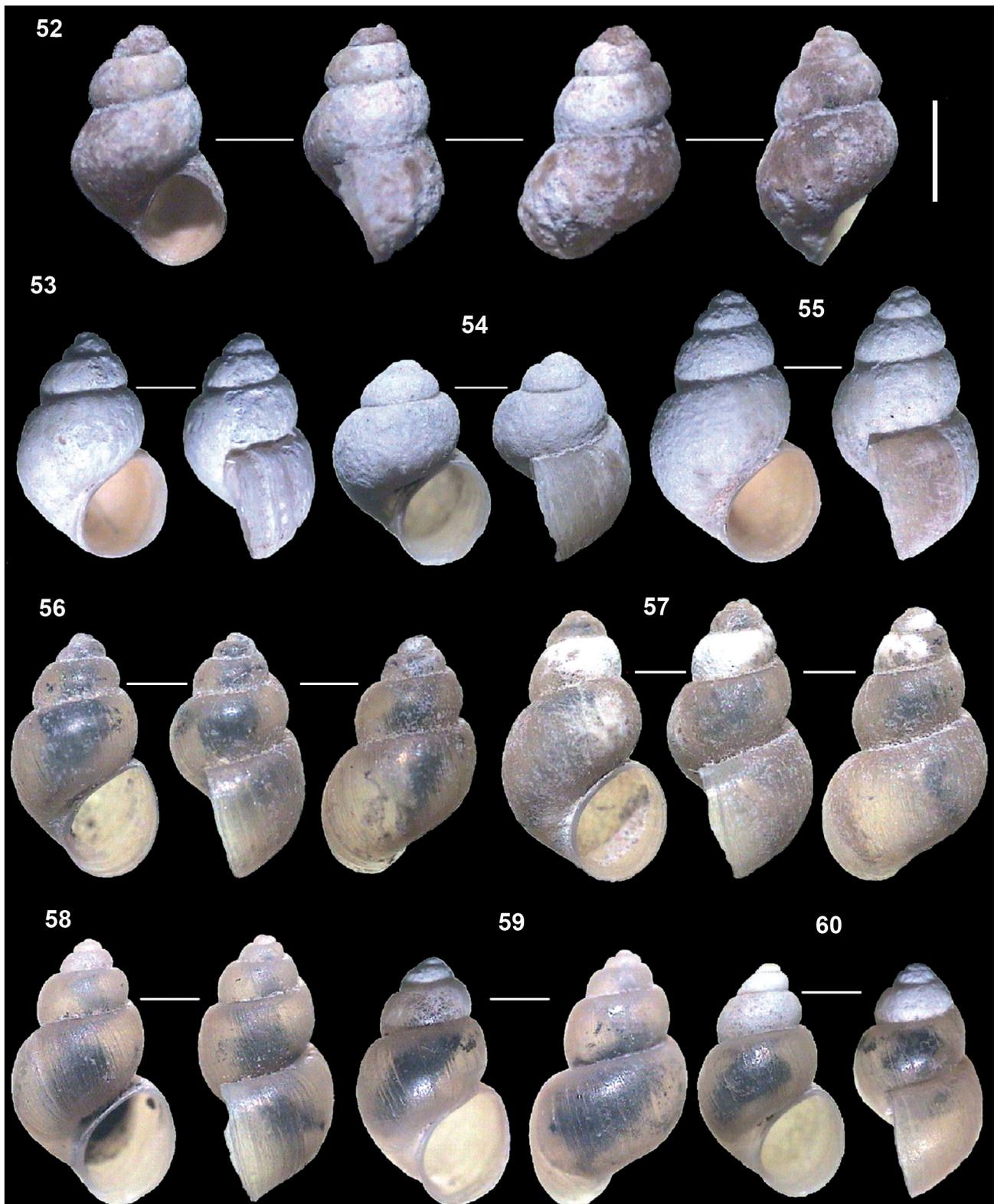
(Figs 7–8, 18–19, 34–37, 43, 48, 58–60)

Material examined (holotype and paratypes): Spain, Valladolid; (i) Aguilarejo, Fábrica vieja [on river Pisuerga, tributary of the Duero, presumably in a spring; UM62]; GASULL leg. 30.V.1981; SMF 342 414/holotype (animal), BOE 2635/animals; (ii) Sardón de Duero, Finca Retuerta, Fuente itoalcahal [UM70]; GASULL leg. 31.V.1981; BOE 2638/shells.

Type locality: Spain, Valladolid, Aguilarejo, Fábrica vieja.

Derivatio nominis: Named after †KARL-HEINZ BECKMANN (Ascheberg-Herbern) for his friendly support of Boeters' malacological activities on the Iberian Peninsula.

Shell (Figs 7–8, 48, 58–60): Transparent whitish to corneous or brownish, with 4.25 to 4.75 spire whorls, ovate-conical in shape, with height : diameter ratio of 1.55–1.56 and with nearly straight sides; spire whorls



Figs 52–60. Shells: 52 – *Pseudamnicola* (*Corrosella*) *hinzi*, Spain, Zaragoza, Borja [non Bulbuenta], Balsa de Vargas, at Huecha river (tributary of Ebro), BOE 2622/paratype; 53–55 – *Pseudamnicola* (*Corrosella*) *collingi* n. sp. Spain, Burgos, Covanera, Pozo Azul [type locality]: 53 – SMF 342 412/holotype, 54–55 – BOE 2623/2 paratypes; 56–57 – *Pseudamnicola* (*Corrosella*) *valladolensis valladolensis* n. ssp. Spain, Valladolid, Quintanilla de Onésimo [Quintanilla de Abajo], Fuente del Arca: 56 – BOE 2637/ paratype, 57 – SMF 342 413/holotype; 58–60 – *Pseudamnicola* (*Corrosella*) *valladolensis kahbei* n. ssp. Spain, Valladolid, Sardón de Duero, Finca Retuerta, Fuente itoalcahal, BOE 2638/3 paratypes. Scale bar 1 mm

fairly vaulted and separated by a deep suture; aperture inclined ovate, palatal and parietal border forming a rounded angle of slightly less than 90°; parietal and columellar border slightly broadened, parietal border touching the shell wall over a short distance or forming a slit with it, columellar border leaving the umbilicus funnel-like or, together with the parietal border, slit-like open; aperture at best slightly broadened at base; body whorl not deflected upward or downward; peristome smooth. Periostracum more or less eroded, the degree of erosion increases from the last to the preceding whorls, sometimes to such a degree that the eroded areas are covered by calcareous structures.

Shell measurements: Height (h) 2.00–2.57–3.05 mm, diameter (d) 1.44–1.66–1.95 mm (Aguilajero, each n = 10); height (h) 2.20–2.66–3.50 mm, diameter (d) 1.50–1.70–2.00 mm (Sardon de Duero, each n = 10), h : d ratio 1.55–1.56.

Animal (Figs 18–19): Head between tentacles, eyes, tentacles and mantle except for its white border pigmented black. Visceral sac whorls with blackish to black spots. Foot seen through operculum with three parallel colour fields running to the tip of operculum, from left to right: black, corneous to slightly brownish (under nucleus) and black. Separated operculum uniformly light brownish except for the hardly more intensively brownish coloured nucleus. Gill (Fig. 43) with 18 filaments (n = 1♂).

Penis (Figs 18–19): Tapered from base to tip, in its resting position bent or bent back into the mantle cavity, so that the left, inner periphery of the bend looks slightly wavy; penial duct meandering towards the penis tip and accompanied by a slightly blackish zone of the penis core (n = 2 from Aguilarejo).

Female genitalia (Figs 34–37): The proximal, first section of renal oviduct is pigmented black and coiled up to the distal, final section which is straight, only very slightly pigmented and entered by two ducts, the receptaculum duct and the bursal duct; duct of the small drop- to sac-like receptaculum (rs1) extremely short; bursa copulatrix long and voluminous, U-like bent; bursal duct remarkably thicker than the renal oviduct, gradually passing into the bursa in front of its bend. The receptaculum reaches the bursa bottom (n = 2 from Aguilarejo).

Differentiating characters: *P. (Corrosella) v. kahbei* n. ssp. is the second of the two subspecies of the new *Corrosella* species. Compared to *P. (C.) v. valladolensis* n. ssp. with its shell height of 3.22 mm, shells of *P. (C.) v. kahbei* n. ssp. are smaller, their height being only 2.57–2.66 mm. Furthermore, whereas in *P. (C.) v. kahbei* n. ssp. the two arms of the voluminous bursa touch each other, in *P. (C.) v. valladolensis* n. ssp. the two arms of the slim bursa are clearly separated.

Habitat and distribution: Known only from a spring at Sardón de Duero (Finca Retuerta) and another

spring at Aguilarejo, both in the drainage system of the Rio Duero.

Remarks: The new subspecies belongs to a new species of *Corrosella* which is the only one yet known to inhabit the drainage system of the Rio Duero which flows into the Atlantic Ocean and not to the Mediterranean Sea. The mentioned differentiating characters of the female genitalia of both subspecies of *P. (C.) valladolensis* n. sp. apply for all the dissected animals and all of them were collected on nearly the same date, i.e. on May 28 and 31, 1981. Thus the differentiating characters are neither the effect of seasonal variation nor of the age of the dissected animals. This suggests that perhaps species rather than subspecies status should be given to the two forms. Further investigations in the drainage system of the Rio Duero should clarify this question.

4. *Pseudamnicola (Corrosella) tajoensis* n. sp.

(Figs 9, 20–23, 38–39, 44, 49, 61–64)

2006? *Pseudamnicola (Corrosella) hinzi* (SOLER et al. 2006: 212, 240, fig. 86)

Material examined (holotype and paratypes): Spain, Madrid, Aranjuez, Casa de Marinos, in a Tajo tributary [FALKNER's label: "Tajo-Zufluss"]; FALKNER leg. 1967; SMF 342 415/shell holotype, BOE 0225/animals + BOE 2634/shells.

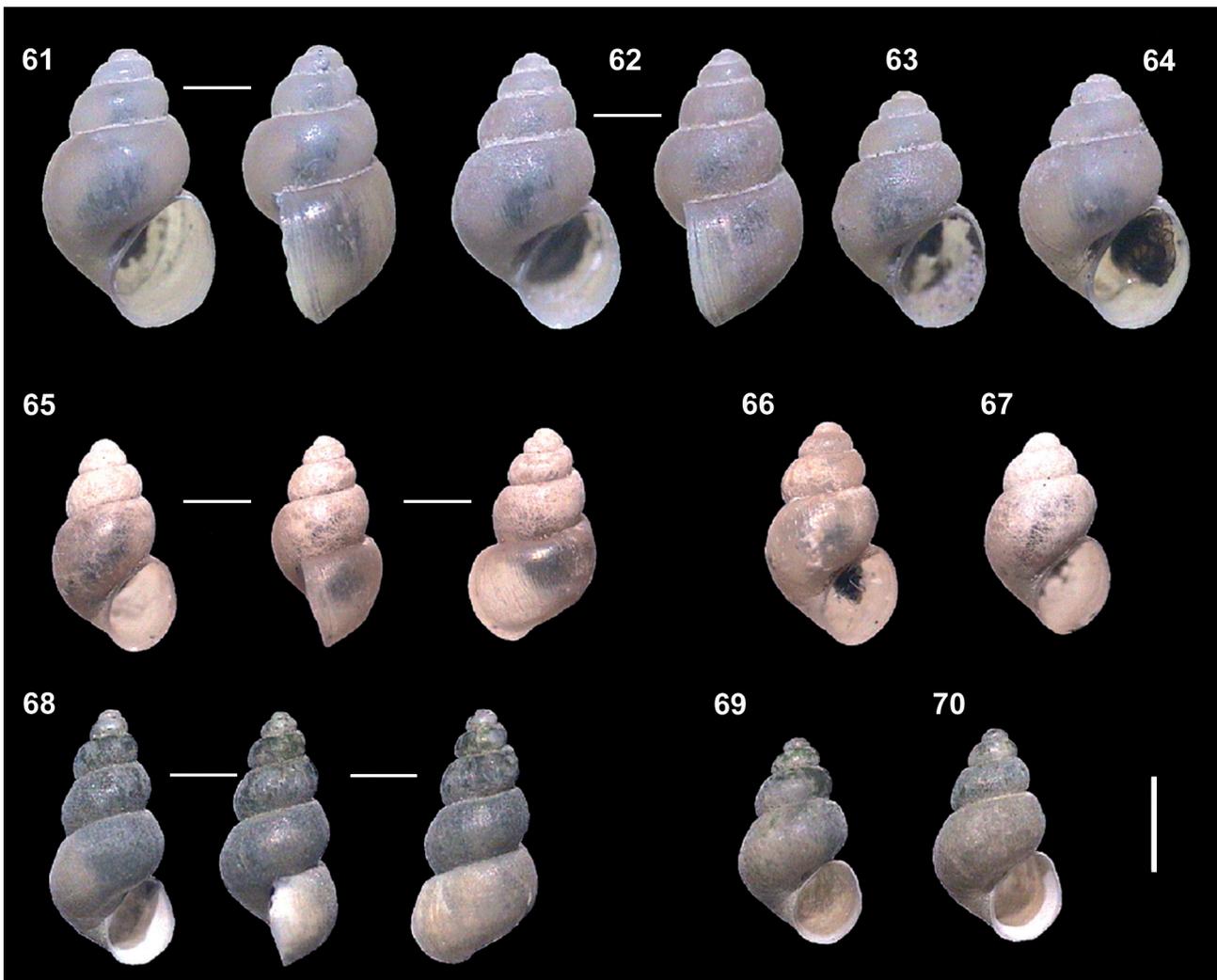
Type locality: Spain, Madrid, Aranjuez, Casa de Marinos [VK43].

Derivatio nominis: The name *tajoensis* refers to the drainage system (Tajo tributary) inhabited by the new species.

Shell (Figs 9, 49, 61–64): Uneroded, translucent whitish to light corneous, but white where broken, with 4.0 to 4.5 spire whorls, ovate-conical in shape, with height : diameter ratio of 1.62 and with nearly straight sides; spire whorls fairly vaulted and separated by a deep suture; aperture inclined ovate, palatal and parietal border forming a rounded angle of slightly less than 90°; parietal and columellar border slightly broadened, touching the shell wall over a short distance and leaving the umbilicus slit- or funnel-like open; no shells with a slit between parietal border and shell wall were observed; aperture at best slightly broadened at base; body whorl not deflected downward or upward; peristome smooth. No eroded shells were observed.

Shell measurements: Height (h) 2.35–2.90–3.25 mm, diameter (d) 1.65–1.79–2.00 mm (n = 12 and 10, respectively), ratio h : d = 1.62.

Animal (Figs 20–23): Head between tentacles with their black eyes with a blackish band. Position of gill filaments marked by blackish outlines, intestine flanked by blackish borders. Proximal whorls of visceral sac with cloud-like blackish spots. Stronger



Figs 61–70. Shells: 61–64 – *Pseudamnicola* (*Corrosella*) *tajoensis* n. sp. Spain, Madrid, Aranjuez, Casa de Marinos, in Tajo tributary (62 – SMF 342 415/holotype, 61 and 63–64 – BOE 2634/3 paratypes); 65–67 – *Pseudamnicola* (*Corrosella*) *tejeidoi* n. sp. France, Pyrénées-Orientales, Err, Source de la Rivière d’Err (Font de la Ribera d’Err), 2,380 m [type locality] (66 – SMF 342 416/holotype, 65 and 67 – BOE 3169/2 paratypes); 68–70 – *Pseudamnicola* (*Corrosella*) *astieri*, France, Var, Pontevès, source du Pavillon, ruisseau le Fauvery, HG/3. Scale bar 1 mm

pigmented animals are rare. Foot seen through operculum white, operculum colourless except for the corneous nucleus. In rare cases three colour fields: a white field flanked by two blackish fields. Gill (Fig. 44) with 16–20 filaments ($n = 2\text{♂♂}$ and 1♀).

Penis (Figs 20–23): tapered from base to tip, in its resting position bent and with weak transverse folds; unpigmented; the penial duct runs at the periphery of the penial body straight towards the tip; the duct ends in front of the tip of the penial body, forming a small shoulder immediately in front of the tip, which protrudes like a wedge ($n = 3\text{♂♂}$).

Female genitalia (Figs. 38–39): Renal oviduct unpigmented or at most very weakly pigmented black. The proximal, first section of renal oviduct is unpigmented or at most very weakly pigmented black and coiled up to the distal, final section which is straight, at most very slightly pigmented and entered by two

ducts, the receptaculum duct and the bursal duct; duct of the small drop- to sac-like receptaculum (rs1) extremely short; bursa copulatrix long and voluminous, U-like bent; bursal duct thicker than the renal oviduct, slightly separated from the bursa or gradually passing into the bursa in front of its bend. The receptaculum reaches the bursa bottom ($n = 2$).

Differentiating characters:

- 1–2. Being 3.22 mm high, the shells of *P. (Corrosella) v. valladolensis* n. ssp. are on average slightly larger than those of *P. (Corrosella) tajoensis* n. sp. (2.90 mm). Compared to *P. (Corrosella) v. kahbei* n. ssp., the vault of the whorls below the suture is well rounded without any indication of even a weak shoulder. In *P. (C.) v. valladolensis* n. ssp. and in *P. (C.) v. kahbei* n. ssp. there is no shoulder at the end section of penis, immediately in front of its tip.
3. Contrary to the new species, in *P. (Corrosella) navasiana* the suture is deeper and the body whorl

Table 2. *Pseudamnicola (Corrosella) tejedoi* n. sp. – shell dimensions (n = 16, details see: Appendix 2A). France, Pyrénées-Orientales, Err, Source de la Rivière d'Err (Font de la Ribera d'Err), 2,380 m [type locality]; BOE 3169/13 paratypes + HG/3 paratypes ex BOE3169

	Shell height (h) [mm]	Shell diameter (d) [mm]	h : d ratio	Body whorl height [mm]	Aperture height [mm]	Aperture diameter [mm]
Mean	2.513	1.504	1.672	1.879	1.166	0.679
Standard deviation	0.231	0.123	0.100	0.151	0.088	0.187
Minimum	2.100	1.320	1.522	1.680	1.020	0.480
Maximum	2.880	1.740	1.840	2.220	1.320	0.960

often forms a slight shoulder between the suture and the periphery, whereas in *P. (Corrosella) tajoensis* n. sp. there is no such shoulder. In *P. (C.) navasiana* the bursal duct and bursa are clearly separated from each other, whereas in *P. (C.) tajoensis* n. sp. the bursal duct gradually passes into the bursa in front of its bend. Furthermore, in *P. (C.) navasiana* the receptaculum is located at a distance from the bursa, whereas in *P. (C.) tajoensis* n. sp. it touches the bursa. In *P. (C.) navasiana* the penial duct ends nearly at the tip of the penial body and forms with it a rounded tip, whereas in *P. (C.) tajoensis* n. sp. the duct ends in front of the tip of the penial body, forming a small shoulder immediately in front of the tip, which protrudes like a wedge.

4. Characters differentiating *P. (Corrosella) tajoensis* n. sp. from *P. (Corrosella) collingi* n. sp. are given under *P. (Corrosella) collingi* n. sp.

Habitat and distribution: Known with certainty only from the type locality, a brook flowing into the river Tajo. However, it is assumed that reports from three other localities in the Comunidad de Madrid, i.e. Estremera, Titulcia and Colmenar de Oreja, published by SOLER et al. (2006: 213) under *P. (C.) hinzi* and from Peralejos (Per), Ontígola (Mar) and Borox (Box) by DELICADO et al. (2013: 390–391) under *P. (C.) navasiana*, also refer to *P. (C.) tajoensis* n. sp.

Remarks:

- P. (Corrosella) tajoensis* n. sp. is an endemic species, the only one yet known from the Tajo basin separated from the neighbouring Duero basin during the Middle Miocene (16–12 Ma) (VARGAS et al. 1998: 372), and supplying the Atlantic Ocean, not the Mediterranean Sea.
- The NJ analysis (Fig. 81) revealed one well supported monophyletic cluster including sequences from Peralejos (Per), Ontígola (Mar) and Borox (Box) published by DELICADO et al. (2013: 390–391). The distance between the “Mar” population and the type locality of *P. (C.) tajoensis* n. sp. is probably less than 3 km. Accordingly, the sequences can be assigned to *P. (C.) tajoensis* n. sp. and show a genetic distance to the nearest neighbouring species of 1.2 % (Table 5).
- Specific characters of the penis are additionally commented on in the Discussion.

5. *Pseudamnicola (Corrosella) tejedoi* n. sp.

(Figs 50, 65–67, 71, Tables 1–2)

Material examined (holotype and paratypes): France, Pyrénées-Orientales, Err, Source de la Rivière d'Err (Font de la Ribera d'Err), 2,380 m; leg. VI. 1995; SMF 342 416/shell holotype, BOE 3169/11 shells, BOE 3318/2 shells with dried bodies + 1 dried body, HG/3 shells with dried bodies ex BOE 3169.

Type locality: France, Pyrénées-Orientales, Err, Source de la Rivière d'Err [DG29].

Derivatio nominis: The new species is dedicated to MANUEL VILELLA TEJEDO (Barcelona) who provided a sample of the snail by letter dated February 18, 1997.

Shell (Figs 50, 65–67, 71): Translucent brownish, with 3.85–4.25 spire whorls, elongated ovate-conical in shape, with nearly straight sides; spire whorls fairly vaulted and separated by a deep suture; aperture inclined ovate, palatal and parietal border forming a rounded angle; parietal and columellar border slightly broadened, touching the shell wall over a short

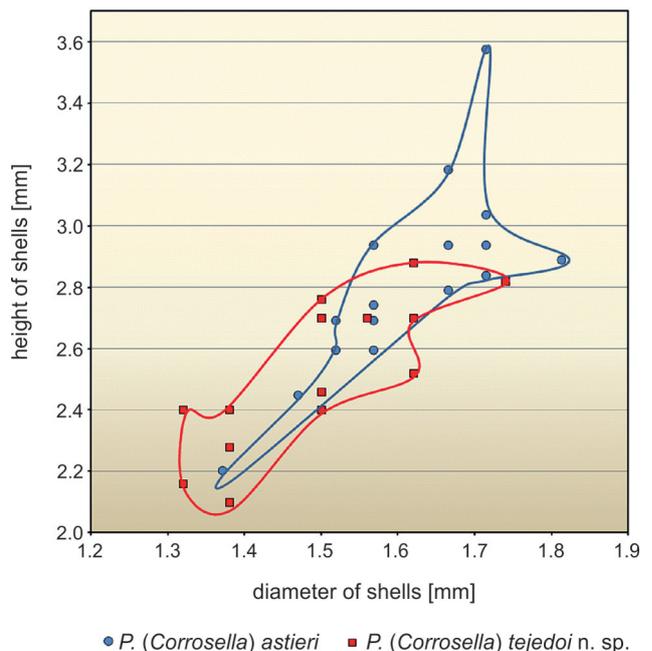


Fig. 71. Conchological comparison of *Pseudamnicola (Corrosella) tejedoi* n. sp. and *Pseudamnicola (Corrosella) astieri*. Data for shell height and diameter based on Appendix 2

Table 3. *Pseudamnicola* (*Corrosella*) *astieri* – shell dimensions (n = 16, details see: Appendix 2B). France, Var, Pontevès, source du Pavillon, ruisseau le Fauvery; HG/16

	Shell height (h) [mm]	Shell diameter (d) [mm]	h : d ratio	Body whorl height [mm]	Aperture height [mm]	Aperture diameter [mm]
Mean	2.821	1.614	1.746	1.929	1.115	0.900
Standard deviation	0.311	0.114	0.125	0.198	0.089	0.071
Minimum	2.205	1.372	1.595	1.617	0.980	0.784
Maximum	3.577	1.813	2.086	2.401	1.274	0.980

distance and leaving the umbilicus slit-like open; aperture at best slightly broadened at base; body whorl not deflected upward or downward; peristome smooth. Periostracum more or less eroded, the degree of erosion increases from the last to the first whorl, sometimes to such a degree that the eroded areas are covered by calcareous structures.

Shell measurements (Tables 1–2, see also Appendix 2A): Height 2.53–2.81–3.00 (n = 4), diameter 1.40–1.50–1.75 (n = 16).

Animal: Head of dried specimen intensively pigmented black. Separated operculum corneous. Proximal section of the renal oviduct coiled and intensively pigmented black (seen through the body wall of a softened female body).

Differentiating characters:

1. Shells of *P. (C.) navasiana* are larger (Table 1), the parietal border of their aperture does not always touch the shell wall, and the umbilicus is more than slit-like open (cf. BOETERS 1988: pl. 2 fig. 20).
2. Shells of *P. (C.) hinzi* are not elongated conical, they are shorter but broader (Table 1), their body whorl is much more vaulted and very slightly angular at its periphery and starts nearly flat at the suture and not with a slight shoulder (cf. BOETERS 1988: pl. 2 fig. 21).

3. The shell of *P. (C.) tejedoi* n. sp. is slimmer than that of *P. (C.) hauffei* from Valencia and Castellon (Table 1). Furthermore, in frontal view the body whorl of *P. (C.) hauffei* is flattened (DELICADO & RAMOS 2012: 68, figs 5A–C), whereas the whorls of *P. (C.) tejedoi* n. sp. are well vaulted.

4. Shells of *P. (C.) astieri* (Figs 51, 68–70, Table 3, Appendix 2B) are less elongatedly conical (Table 1); in *P. (C.) navasiana* the parietal border of the aperture does not always touch the shell wall and the umbilicus is more than slit-like open (cf. BOETERS 1970: 69 fig. 9; DELICADO & RAMOS 2012: 62, fig. 2A).

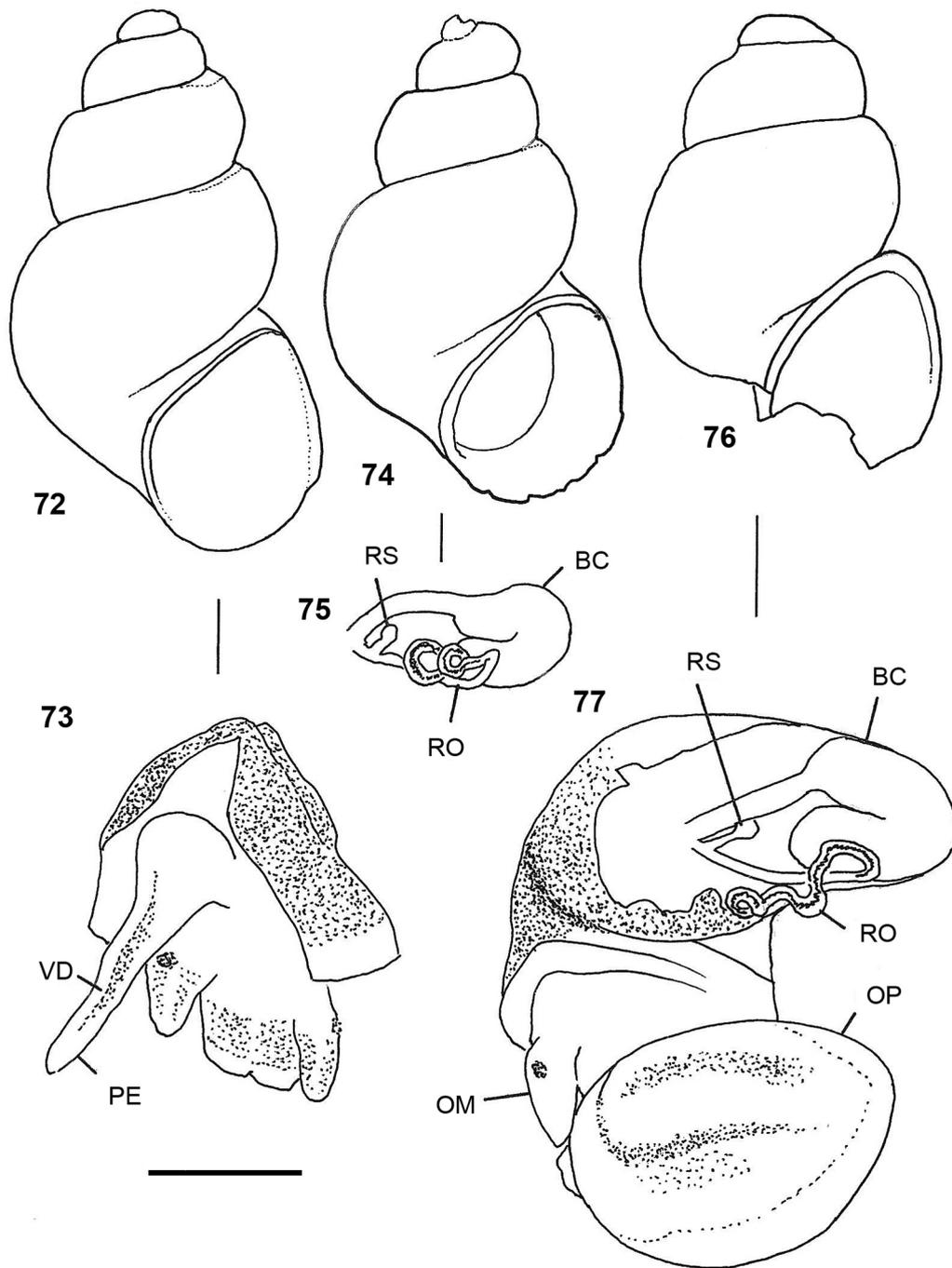
5. *P. (C.) tejedoi* n. sp. differs from all other known species of *Corrosella* not only in the conchological characters, but also in being geographically separated by a distance of certainly more than 300 km from *P. (C.) navasiana* and *P. (C.) hinzi*, more than 350 km from *P. (C.) hauffei* (type locality) and more than 400 km from *P. (C.) astieri*, which live next to the Pyrenees. Besides, the altitude of 2,380 m of the habitat of the new species is extraordinary (Table 4).

Distribution and habitat: Known from the type locality only, the Source de la Rivière d’Err (Font de la Ribera d’Err) in the French Pyrenees (Pyrénées-

 Table 4. *Corrosella* – altitude of localities of the species

Species	Altitude of type locality [m a.s.l.]
<i>P. (C.) astieri</i>	80 (Grasse)
<i>P. (C.) hinzi</i>	450 (Borja, non Bulbuenta)
<i>P. (C.) hydrobiopsis</i>	450 (Loja)
<i>P. (C.) iruritai</i>	450 (Loja)
<i>P. (C.) tajoensis</i> n. sp.	490 (Casa de Marinos)
<i>P. (C.) navasiana</i>	520 (Bulbuenta)
<i>P. (C.) hauffei</i>	600 (Benafer)
<i>P. (C.) v. kahbei</i> n. ssp.	650 (Aguilarejo)
<i>P. (C.) collingi</i> n. sp.	701 (Covanera)
<i>P. (C.) marisolae</i>	780 (Dúrcal)
<i>P. (C.) v. valladolensis</i> n. ssp.	800 (Quintanilla de Onésimo)
<i>P. (C.) andalusica</i>	860 (Albanchez de Mágina)
<i>P. (C.) falkneri</i>	920 (Cerro de la Virgen)
<i>P. (C.) luisi</i>	1,100 (La Peza)
<i>P. (C.) bareai</i>	1,280 (Ermita de las Santas, Collados de la Sagra)
<i>P. (C.) manueli</i>	1,400 (Nava de San Pedro)
<i>P. (C.) tejedoi</i> n. sp.	2,380 (Err)

Remark. Except for *P. (Corrosella) collingi* n. sp. and *P. (Corrosella) tejedoi* n. sp. only rough altitude data were available.



Figs 72–77. *Pseudamnicola (Corrosella) navasiana*, Spain, Zaragoza, spring about 2 km west of Bulbuento, BOE 1239: 72–73 – shell and head of same male (mantle slit open to expose penis); 74–75 – shell and part of renal oviduct, same female; 76–77 – shell and fragment of the same female (proximal whorls plus stomach removed and body opened to expose renal oviduct). Scale bar 0.5 mm for Figs 73, 75 and 77 and 1 mm for Figs 72, 74 and 76. Abbreviations: BC – bursa copulatrix, OP – operculum, PE – penis, RO – renal oviduct, RS – receptaculum seminis, TE – tentacle, VS – penial duct (vas deferens)

Orientalis), sympatric with *Bythinella* sp. (BOE 3157). The river Err is a tributary of the Segre and belongs to the Ebro drainage system.

Remarks: This species is the second representative of *Corrosella* in France, but it inhabits a drainage system which currently drains the waters of the Pyrenees to the river Ebro in Spain. Since its description is based

on conchological and distributional characters only, further investigations, especially of anatomical and genetic characters, are necessary to establish the species identity and distinctness.

6. *Pseudamnicola* (*Corrosella*) *navasiana* (Fagot, 1907)

(Figs 72–80, Table 1)

1907 *Amnicola navasiana* Fagot (FAGOT 1907: 158), type locality: “Buelbunte [sic]”

1988 *Pseudamnicola* (*Corrosella*) *navasiana* (BOETERS 1988: 203, figs 65, 71, 87, pl. 2 fig. 20)

Material examined: Spain, Zaragoza, Fonnueva spring about 2 km west of Bulbunte; HINZ leg. IV.1984 [label: “Zara 1”]; BOE 1239/animals + BOE 1654/shells.

Shell (Figs 72, 74, 76, 78–80): Ovate-conical with strongly vaulted whorls; body whorl often with a slight shoulder between suture and periphery; initial whorls more or less eroded; apex can project like a corkscrew or be completely lost and replaced by whitish deposits; shell surface gives a spotted impression, because the whitish eroded areas alternate with periostracum fragments; areas of intact periostracum and especially fractures of broken shells give an opaque to milky impression resembling shells of *Mercuria*; shells of mature animals may still have about 4 whorls; aperture inclined ovate; palatal and parietal border forming a rounded angle of slightly less than 90°; parietal border broadened, but generally forming a slit with the shell wall, only occasionally fused with it over a short distance; umbilical border often remarkably broadened without covering the umbilicus; umbilicus, however, often closed by whitish deposits; peristome sharp.

Shell measurements (Table 1): Height (h) 3.05–3.34–3.45 mm, diameter (d) 1.85–2.08–2.25 mm (n = 5 each), h : d ratio 1.61.

Animal (Figs 73, 77): Visceral sac whorls with light to intensively darkish spots. Mantle except for its white border, tentacles with eyes and head between tentacles pigmented black. Foot seen through operculum with three parallel colour fields running to the tip of operculum, from left to right: blackish, white (under nucleus) and blackish. Separated operculum

uniformly corneous to brownish. Gill with 15 to 16 filaments (n = 2♀♀).

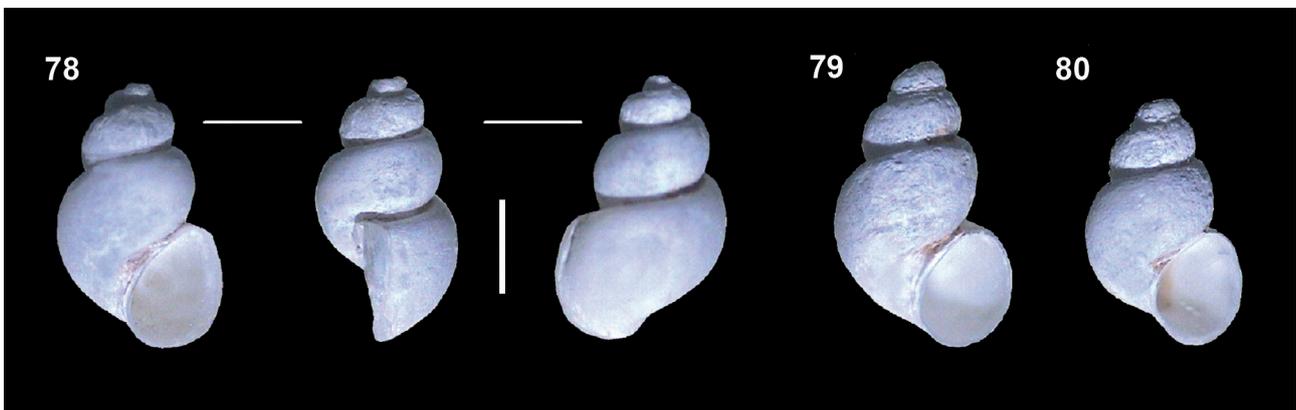
Penis (Fig. 73): Broad tapering penis base bent like a flat U towards the mantle skirt, followed by a slowly tapering slender final section; the penial duct runs straight along the penis periphery, flanked by a slightly blackish pigmented zone of the penis core; behind its bend and opposite to the penial duct, the penis base looks like a saw blade due to unpigmented transverse folds; the penial duct ends nearly at the tip of penial body and forms with it a rounded penis tip (n = 3).

Female genitalia (Fig. 75): The proximal first section of renal oviduct is pigmented black and coiled up to the distal, final section which is straight, only very slightly pigmented and entered by two ducts, the receptaculum duct and the bursal duct; duct of the small drop- to sac-like receptaculum (rs1) very short; bursa copulatrix long, U-like bent; bursal duct and bursa are clearly separated from each other, and the receptaculum does not reach the bursa bottom (n = 2).

Differentiating characters are given under *P. (Corrosella) collingi* n. sp. and *P. (Corrosella) tajoensis* n. sp.

Habitat and distribution: In springs and brooks at least in Burgos, Cuenca, Guadalajara, Soria and Zaragoza (DELICADO et al. 2013).

Remarks: Already the original description characterises the shell as opaque, but muddy greyish [“opaca... sordide grisea”], a character which resembles milky shells of *Mercuria* species. The DNA sequences of the *P. (C.) navasiana* populations formed a monophyletic cluster (Fig. 81) indicating genetic separation from the other species. The genetic distance to the nearest neighbouring species was found to be 1.2% (Table 5). HINZ’ vague indication concerning specimens collected in April 1984 “spring about 2 km west of Bulbunte” could be identified as Fonnueva spring; cf. DELICADO et al. (2013: 390).



Figs 78–80. *Pseudamnicola* (*Corrosella*) *navasiana*, Spain, Zaragoza, spring about 2 km west of Bulbunte, BOE 1239. Scale bar 1 mm

RESULTS OF THE GENETIC ANALYSIS

Thirty two sequences deposited in GenBank by DELICADO et al. (2013) were originally assigned to *P. navasiana*. According to the sampling localities (for details see remarks under species descriptions) seven sequences were supposed to belong to *P. (C.) tajoensis* n. sp. (JX81867, JX81880-JX81885) and six to *P. (C.) collingi* n. sp. (JX81873-JX81878).

Overall, K2P genetic distances calculated from a 658 bp sequence alignment ranged from 0 to 2.3% (see Appendix 3). Within species, the genetic distances varied between 0 and 1.2% in *P. (C.) navasiana* and between 0 and 0.9% in *P. (C.) tajoensis* n.

sp. (Table 5). No intraspecific variation was found among the six sequences of *P. (C.) collingi* n. sp. Interspecific distances were generally found to be higher than the intraspecific ones (Appendix 3). In this context, we do not rely on any standard threshold for COI sequence divergence for the recognition of species, as the use of thresholds is inappropriate to delineate closely related species (MEYER & PAULAY 2005).

The minimum distances between species (distance to the nearest neighbour, Table 5) were 1.8% for *P. (C.) collingi* n. sp., and 1.2% for *P. (C.) tajoensis*

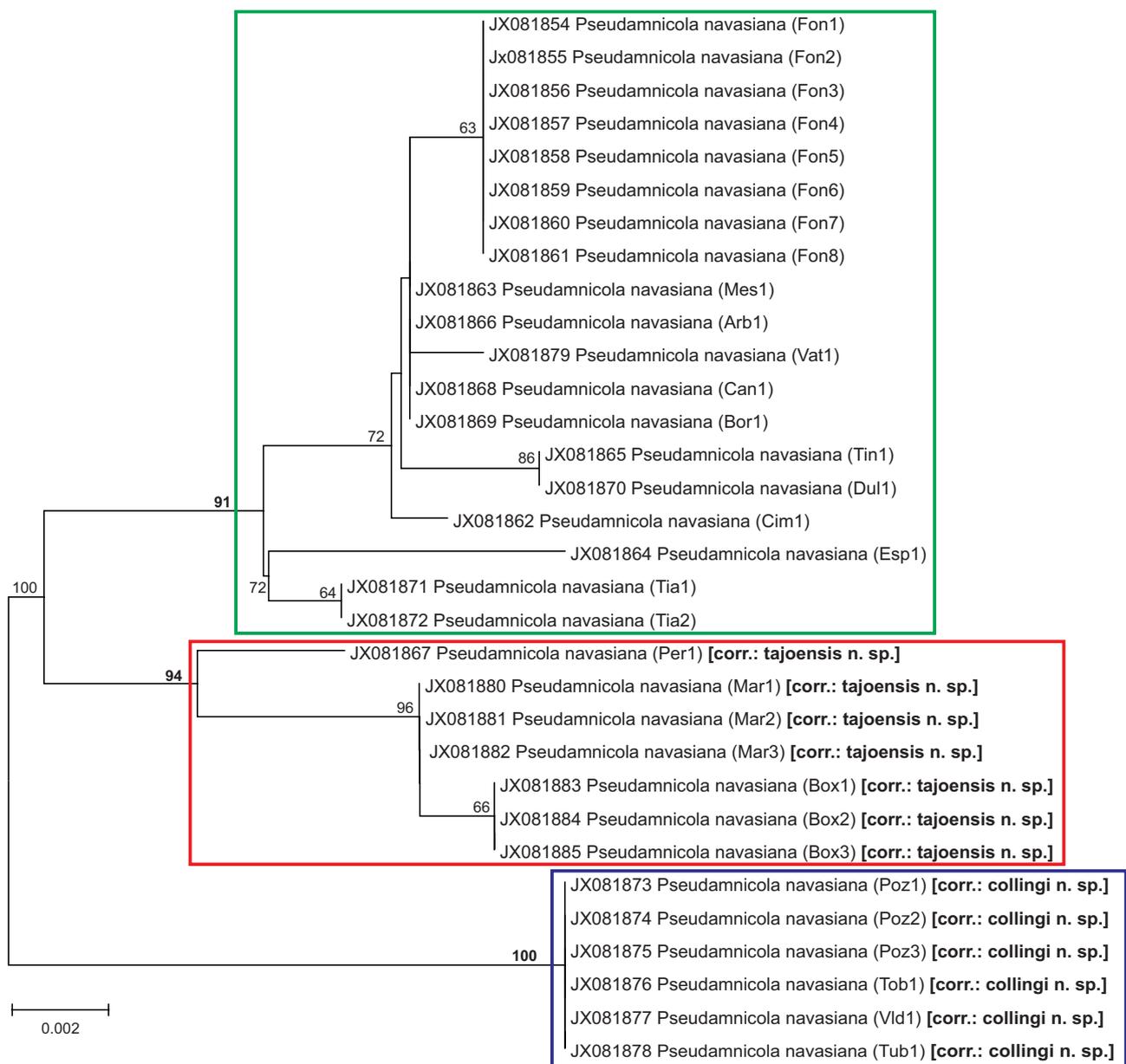


Fig. 81. Neighbour-joining tree based on K2P distances of 32 DNA barcodes of *P. (Corrosella) navasiana* (green box), *P. (Corrosella) tajoensis* n. sp. (red box) and *P. (Corrosella) collingi* n. sp. (blue box). Numbers at nodes indicate bootstrap support values > 50 %



Table 5. Intraspecific variation and barcoding gaps for three species based on K2P genetic distances (details see Appendix 3)

Species	Number of specimens	Mean distance	Standard deviation	Minimum distance	Maximum distance	Nearest neighbouring species	Distance to nearest neighbour	Barcoding gap
<i>P. (C.) n.</i>	19	0.3	0.32	0	1.2	<i>P. (C.) t.</i>	1.2	0
<i>P. (C.) t.</i>	7	0.3	0.36	0	0.9	<i>P. (C.) n.</i>	1.2	0.3
<i>P. (C.) c.</i>	6	0	0	0	0	<i>P. (C.) n.</i>	1.8	1.8

P. (C.) n. – *P. (Corrosella) navasiana*, *P. (C.) t.* – *P. (Corrosella) tajoensis* n. sp., *P. (C.) c.* – *P. (Corrosella) collingi* n. sp.

n. sp. and *P. (C.) navasiana*, respectively. Due to the intraspecific variation barcode gaps were present in *P. (C.) collingi* n. sp. (1.8%) and *P. (C.) tajoensis* n. sp. (0.3%) (Table 5). In *P. (C.) navasiana* the maximum intraspecific distance equalled the distance to the nearest neighbour. The NJ tree based on the K2P genetic distances revealed three distinct monophyletic species clusters with bootstrap support values >90%

(Fig. 81). There is obviously no COI haplotype overlap between the species but the low interspecific distance values may indicate a recent speciation of these closely related congeners. The presence of a barcoding gap in *P. (C.) collingi* n. sp. and *P. (C.) tajoensis* n. sp. may allow reliable species identification in addition to the morphological distinguishing features.

DISCUSSION

DIFFERENTIATION OF THE TWO SUBGENERA OF *PSEUDAMNICOLA*

As mentioned above, DELICADO et al. (2012) with reference to HERSHLER & PONDER (1998) distinguished *Corrosella* Boeters, 1970 from the nominotypical subgenus, i.e. *Pseudamnicola* s. s. Paulucci, 1878 based on five synapomorphies. Here, additional data for the differentiation of the two subgenera are given.

1. **Female genitalia:** According to HERSHLER & PONDER (1998) in *Pseudamnicola* s. str. the shape of the bursa copulatrix varies from ovoid to pyriform, whereas in *Corrosella* the bursa copulatrix is of pyriform to cylindrical shape. However, a description of the bursa in *Corrosella* as simply pyriform to cylindrical is insufficient when not completed by the fact that the bursa is bent like a fishing hook, so that both arms of the hook are subparallel to each other.
2. **Distribution:** Except for some reports from the Spanish inland (SOLER et al. 2006: 212, 240 fig. 86, DELICADO et al. 2014: 40 fig. 1), in the area extending from Spain to France the species of the nominotypical subgenus live close to the Mediterranean coasts (Fig. 1). In Spain reference can be made to *P. (Pseudamnicola) subproducta* (Paladilhe, 1869) (= *Amnicola spirata* Paladilhe, 1869), *P. (Pseudamnicola) gasulli* Boeters, 1981, *P. (Pseudamnicola) beckmanni* Glöer et Zettler, 2007, *P. (Pseudamnicola) granjaensis* Glöer et Zettler, 2007, *P. (Pseudamnicola) artanensis* Altaba, 2007 and *P. (Pseudamnicola) meloussensis* Altaba, 2007 (BOETERS 1981, ALTABA 2007, GLÖER & ZETTLER 2007). For the rediscovery of *P. (Pseudamnicola) spirata* (= *subproducta*) in the region of its type locality, "aux environs de Banolas (Catalogne)", see BOETERS (1988: 199). *P. (Pseudamnicola) gasulli* was reported from coast-

al localities in Almeria and Murcia and from the Balears. The remaining four Spanish species of the nominotypical subgenus were described from the Balears only. Their description requires a revision of *P. (Pseudamnicola) spirata* sensu Boeters from Mallorca and Minorca. In France the only well studied species of *Pseudamnicola* s. s. lives or lived at the border of the Étang de Berre and at the border of the Mediterranean Sea at Carry-le-Rouet (BOE 0306 and 0314), at Salses (DELICADO et al. 2014) and at another yet unpublished locality (BOETERS & FALKNER in preparation). Reports of species of the nominotypical subgenus from the mainland of France, such as *P. (P.) pisolina* Paladilhe, 1876 and *P. (P.) pyrenaicus* Boeters et Falkner, 2009, should be subject to further investigations. However, as regards species of *Corrosella*, DELICADO et al. (2013) stated that they were restricted to mountainous regions of Spain and Southern France. As seen from Fig. 1, they can be found in the Spanish inland only, and reach remarkable altitudes: *P. (C.) luisi* at about 1,000 m at La Peza (Table 4). A similar situation applies to France (Fig. 1). *P. (C.) astieri* avoids the Mediterranean coasts, but lives in mountainous regions of the departments Var and Alpes-Maritimes.

3. **Erosion:** Shells of *Corrosella* are often slightly or even drastically eroded to such a degree that the protoconch, the first or even more whorls are destroyed. Erosion starts with channels running across the periostracum or even the calcareous wall of the shell, also with circular holes in periostracum and the calcareous wall as impressively illustrated by DELICADO et al. (2012: 32, figs 2E–F *luisi*; 37, figs 5F–G *falkneri*; 62, figs 18F–G *iruritai*). These erosion traces look like feeding traces. DELICADO

et al. (2012) also published photographs of eroded shells, for example, of *P. (C.) falkneri* (DELICADO et al. 2012: 40, fig. 8), *P. (C.) iruritai* (DELICADO et al. 2012: 62, fig. 18) and *P. (C.) hydrobiopsis* (DELICADO et al. 2012: 72, fig. 24). The fact that erosion is characteristic of *Corrosella* is especially strange at localities where these species live in sympatry with other freshwater prosobranchs. For example, in its type locality *P. (C.) falkneri* lives in sympatry with *Islamia schuelei* (Boeters, 1981), *P. (C.) tejedoi* n. sp., in its type locality is sympatric with *Bythinella* sp., or *P. (C.) astieri* – with *Belgrandia marginata* (Michaud, 1831) at Draguignan, the type locality of the latter species. In all these cases the other prosobranchs do not show any erosion of their shells.

FEMALE GENITALIA

BOETERS (1970, 1984) and DELICADO et al. (2012) independently of each other showed that characters of receptaculum and bursa could be useful for differentiation of species. The receptaculum can be positioned at a distance from the bursa or touch or lean on it (*luisi*: BOETERS 1984: 10, fig. 2, BOETERS 1988: 204, fig. 88, DELICADO et al. 2012: 35, fig. 4H; *falkneri*: BOETERS 1970: 68, fig. 8, BOETERS 1988: 204, figs 90–91, DELICADO et al. 2012: 39, figs 7H–J). Furthermore, the duct of the bursa can be clearly separated from the voluminous bursa as in *P. (C.) falkneri*, or the duct can gradually pass into the bursa as in *P. (C.) hinzi* (BOETERS 1986: 126, fig. 2, BOETERS 1988: 204, fig. 85).

PENIS

According to DELICADO et al. (2012) and DELICADO & RAMOS (2012), in *Corrosella* the penial duct opens directly on the penis tip (cf. especially *P. (C.) astieri* in DELICADO & RAMOS 2012: 64, fig. 4D and *P. (C.) iruritai* in DELICADO et al. 2012: 65, fig. 20D; see also *P. (C.) andalusica*: DELICADO et al. 2012: 69, fig. 23D; *P. (C.) bareai*: DELICADO et al. 2012: 55; *P. (C.) hauffei*: DELICADO & RAMOS 2012: 72, fig. 7D; *P. (C.) manueli*: DELICADO et al. 2012: 49; *P. (C.) marisolae*: DELICADO et al. 2012: 59, fig. 17D). Starting from the discovery and anatomical examination of *P. (C.) tajoensis* n. sp., this character, needs, however, clarification. In *P. (C.) tajoensis* n. sp. the penial duct is not simply embedded in the penis body but flanks the body on its external side. The penis tip protrudes beyond the opening of the duct in such a manner that the end of the duct forms a shoulder at the periphery of the penis in front of its tip. A re-examination of other species of *Corrosella* now revealed that the described structure applies also to other species, such as *P. (C.) navasiana*, but is not necessarily as pronounced as in *P. (C.) tajoensis* n. sp. This suggests that similar characters might be present in nearly all species of *Corrosella*.

Reference is especially made to the figures given by DELICADO et al. (2012) and DELICADO & RAMOS (2012) for *P. (C.) bareai*, *P. (C.) marisolae* and *P. (C.) hauffei*. These figures show a slight step or shoulder in front of the penis tip despite the fact that according to the figures the duct runs directly up to the penis tip (DELICADO et al. 2012: 54, fig. 14G, 59, fig. 17D, DELICADO & RAMOS 2012: 72, fig. 7D).

The flanking of the penis body by the penial duct might reflect the origin of the closed duct from an open gutter as is known, for example, in the Aciculidae. There is, however, a restricted number of species of *Corrosella* with a slightly undulating, wavy or meandering instead of straight course of the penial duct towards its opening, for example *P. (C.) manueli* and *P. (C.) marisolae* (DELICADO et al. 2012: 49, 59, fig. 17D and 60) and *P. (C.) collingi* n. sp. It would be interesting to clarify whether this structure has simply to do with changes of the penis from its resting to active state or whether evolutionary aspects should be considered.

PSEUDAMNICOLA (CORROSELLA) TEJEDO N. SP.

In the southern foreland of the Pyrenees, species of *Corrosella* are known only from its southwestern part and only from the drainage systems of southern tributaries of the Ebro River (DELICADO et al. 2013: 389, fig. 1). They are completely unknown from the Pyrenees themselves and their northern foreland. The only representative of the subgenus lives far to the northeast of the Pyrenees, in Southeastern France. DELICADO et al. (2013: 395) interpreted the Pyrenees as a geographical barrier. They argued that in the northern part of the Iberian Peninsula, up to Southern France, “some populations [of *P. (C.) Corrosella*] species] were isolated probably due to the last uprising of the Pyrenees during the upper Miocene. (...) This geological barrier may have led to the split between *P. (C.) astieri* and the group formed by *P. (C.) navasiana* and *P. (C.) hauffei*.” Thus, the discovery of a representative of *Corrosella* in the drainage systems of a northern tributary of the Ebro River and directly in the Pyrenees was unexpected.

THE TYPE LOCALITY OF PSEUDAMNICOLA (CORROSELLA) ASTIERI¹

DUPUY (1851) reported “les environs de Grasse” as the type locality for *P. (C.) astieri*. The only known

¹ The species was originally described by DUPUY (1851) as *Hydrobia astierii* with its name dedicated to M. Astier. The species name was amended by DELICADO & RAMOS (2012) according to the current ICZN rules. See also BOUCHET P. (2014). *Pseudamnicola astieri* Dupuy, 1851. Accessed through World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=716159> on 2014-11-10 (editor's remarks).

Table 6. *Pseudamnicola* (*Corrosella*) *astieri* – shell dimensions at different localities

<i>P.</i> (<i>Corrosella</i>) <i>astieri</i>	Shell height (h) [mm]	Shell diameter (d) [mm]	h : d ratio
Spéracèdes (n = 10)	2.65–2.97–3.30	1.75–2.02–2.25	1.47
Draguignan (n = 30)	2.10–2.36–2.94	1.38–1.52–1.74	1.55 (1)
Pontevès (n = 16)	2.10–2.51–2.88	1.32–1.50–1.74	1.67 (2)
Seillons (n = 30)	2.22–2.60–3.06	1.32–1.50–1.80	1.73 (1)

(1) GIRARDI 2009: 141; (2) according to GIRARDI (2009: 141): h : d = 1.78.

locality which corresponds to this indication is Spéracèdes, not more than 5 km west of the centre of Grasse. A comparison of shells from this locality with shells from three other localities about 40, 75 and 85 km west of Grasse is given in Table 6.

Shells from Draguignan, Pontevès and Seillons are smaller than those from Spéracèdes and more elongated which is reflected by the h:d ratio of 1.55, 1.67 (or even 1.78) and 1.73 instead of 1.47. Because of these differences which make shells from Pontevès, for example, more similar to shells of *P.* (*C.*) *tejedoi* n. sp. (Fig. 71), a critical reconsideration of the identity of *P.* (*C.*) *astieri* seems necessary.

In this context it is noteworthy that DUPUY (1851) described his species as having its shell “3–4 mill.” high, which corresponds best to the measurements given for Spéracèdes (Table 6) and the only syntype which has yet come to our knowledge. The shell height of the syntype is 3.05 mm. It will be described in the context of the intended critical reconsideration.

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Appendix 1

1. Subgenus *Pseudamnicola*. The MGRS-map published by BOETERS (1988: 286) is redrafted for *Pseudamnicola* (*Pseudamnicola*) and completed by data published by GLÖER & ZETTLER (2007) and by GIRARDI (2009) and by one yet unpublished locality (BOETERS & FALKNER under preparation). The coordinates for the seven species in alphabetical order are as follows:

- 1 – *P. (P.) artanensis*: Artá (DELICADO et al. 2013: 41);
- 2 – *P. (P.) beckmanni*: DD69, DD97 and DE06 (Esporles = Esporlas, Randa and Deia = Deya; DELICADO et al. 2013: 41), DE60, DE70;
- 3 – *P. (P.) gasulli*: WF98 (Cala de San Pedro; DELICADO et al. 2013: 41), WG93, XG03, XG69, CD71;
- 4 – *P. (P.) granjaensis*: DD69;
- 5 – *P. (P.) meloussensis*: EE72 (Son Saura; DELICADO et al. 2013: 41).
- 6 – *P. (P.) spirata*: DD59, DD68, DD69, DD79, DE60, DE70, DE80, DE81, DG86, ED09, ED18, ED29, ED38, ED39, EE00, EE01, EE82, EE91, EE92, FE01 and FE02, VK52 and XJ 67 (Ontígola and Requene; DELICADO et al. 2013: 41);
- 7 – *P. (P.) spec.* (France): DH94 (DELICADO et al. 2014: 41, Est), EJ51 (BOETERS & FALKNER), FH 79, FJ62, FJ72 (Calissane; GIRARDI 2009: 135).

Remarks

Clarifying whether *P. (P.) spirata* (Paladilhe, 1869) = *P. (P.) subproducta* (Paladilhe, 1869) as interpreted by BOETERS (1988: 199) comprises also *P. (Pseudamnicola) beckmanni* Glöer et Zeitler, 2007, *P. (Pseudamnicola) granjaensis* Glöer et Zeitler, 2007, *P. (Pseudamnicola) artanensis* Altaba, 2007 and *P. (Pseudamnicola) meloussensis* Altaba, 2007 is outside the scope of this publication.

It is not the aim of this publication to clarify to which species the records of *P. (Pseudamnicola)* from the mainland of France actually refer. Reference is made to *P. (Pseudamnicola) chamasensis* Boeters, 2000, regarded by GIRARDI et al. (2009: 135) as a synonym of *P. (Pseudamnicola) moussonii* (Calcara, 1841) with its Sicilian type locality. Thus, these reports are listed as *P. (Pseudamnicola) sp.* A revision should also include the insufficiently known *P. (Pseudamnicola) cyrniaca* (Mabille, 1869), ?*P. (Pseudamnicola) emiliana* (Paladilhe, 1869), ?*P. (Pseudamnicola) pisolena* (Paladilhe, 1876) and *P. (Pseudamnicola) pyrenaicus* Boeters et Falkner, 2009.

2. Subgenus *Pseudamnicola* (*Corrosella*). The MGRS-map published by BOETERS (1988: 286) is redrafted for *Pseudamnicola* (*Corrosella*) and complet-

ed by data for localities published by SOLER et al. (2006), DELICADO et al. (2010, 2012, 2013) and DELICADO & RAMOS (2012) (their UTM coordinates have been converted to fit with the MGRS). *P. (Corrosella) astieri* has been added with reference to GIRARDI (2009) and to yet unpublished localities of BOETERS' collection. The four new species have also been included. The coordinates for the 17 species and subspecies, respectively, in alphabetical order are as follows:

- 1 – *P. (C.) andalucica*: UF98, UG74, UG85, VF08, VG04;
- 2 – *P. (C.) astieri*: GJ22 (Seillon, GIRARDI 2009: 141 and BOE 1473), GJ31 (Bras, BOE 1475), KP52 (Barjols, BOE 0300; Source du Pavillon, ruisseau Fauvery à Pontevès, GIRARDI 2009: 141), KP74 (Aiguines, BOE 0399), KP82 (Tourtour, BOE 3294), KP92 (Draguignan, BOE 0262, 0285, 2171, 2175, 2626), LP23 (Spéracèdes, BOE 0577, 0804, 2627);
- 3 – *P. (C.) bareai*: WG07, WG28;
- 4 – *P. (C.) collingi* n. sp.: VN23 (Sedano) (DELICADO et al. 2013: 391), VN32, VN33;
- 5 – *P. (C.) v. valladolensis* n. ssp.: UM70;
- 6 – *P. (C.) falkneri*: WG28, WG47, WH74, XH17;
- 7 – *P. (C.) hauffei*: XJ74, YJ25, YK02, YK11;
- 8 – *P. (C.) hinzi*: XL42 (Caminreal) and XL43 (Calamocha) (DELICADO et al. 2010: 101 each) and XM12;
- 9 – *P. (C.) hydrobiopsis*: UG91;
- 10 – *P. (C.) iruritai*: UG91;
- 11 – *P. (C.) luisi*: VG05, VG16, VG51, VG63, VG72, WF79;
- 12 – *P. (C.) manuelei*: VG57, VG99, WG07, WG09, WG19, WH32;
- 13 – *P. (C.) marisolae*: VF49, VF59;
- 14 – *P. (C.) navasiana*: VL96 (Canalejas) and VN23 (Sedano) (DELICADO et al. 2013: 390–391), WL42 (Cabrera), WL45 (Medinaceli), WL50 (Bornova River), WL55 (Arbujuelo), XL01 (Mesones) and XL50 (Ojos de Cimballa) (DELICADO et al. 2013: 391), XM12;
- 15 – *P. (C.) tajoensis* n. sp.: VK33 (Borox) (DELICADO et al. 2013: 391), VK43, VK52 (Ontígola) (DELICADO et al. 2013: 391) and VK54 (Titulcia), VK64 (Colmenar de Oreja) and VK94 (Estremera) (SOLER et al. 2006: 213 each as for *P. (Corrosella) hinzi*), WK98 (Peralejos) (DELICADO et al. 2013: 391);
- 16 – *P. (C.) tejedoi* n. sp.: DG29;
- 17 – *P. (C.) v. kahbei* n. ssp.: UM62, UM70.



Appendix 2

Shell dimensions of *Pseudamnicola (Corrosella) tejedoi* n. sp. (A; cf. Table 2) and *Pseudamnicola (Corrosella) astieri* (B; cf. Table 3), 16 specimens each

A

	Shell height (h) [mm]	Shell diameter (d) [mm]	h : d ratio	Body whorl height [mm]	Aperture height (ha) [mm]	Aperture diameter (da) [mm]	ha : da ratio
1	2.700	1.620	1.667	2.040	1.320	0.960	1.375
2	2.520	1.620	1.556	1.920	1.200	0.900	1.333
3	2.700	1.500	1.800	1.920	1.200	0.900	1.333
4	2.760	1.500	1.840	1.920	1.140	0.960	1.188
5	2.400	1.380	1.739	1.800	1.080	0.540	2.000
6	2.400	1.500	1.600	1.800	1.200	0.600	2.000
7	2.820	1.740	1.621	2.040	1.260	0.600	2.100
8	2.280	1.380	1.652	1.740	1.080	0.480	2.250
9	2.460	1.500	1.640	1.920	1.200	0.660	1.818
10	2.160	1.320	1.636	1.680	1.020	0.540	1.889
11	2.700	1.560	1.731	2.220	1.260	0.600	2.100
12	2.400	1.500	1.600	1.800	1.140	0.600	1.900
13	2.100	1.380	1.522	1.680	1.020	0.480	2.125
14	2.520	1.620	1.556	1.800	1.140	0.600	1.900
15	2.400	1.320	1.818	1.740	1.140	0.480	2.375
16	2.880	1.620	1.778	2.040	1.260	0.960	1.313

B

	Shell height (h) [mm]	Shell diameter (d) [mm]	h : d ratio	Body whorl height [mm]	Aperture height (ha) [mm]	Aperture diameter (da) [mm]	ha : da ratio
1	2.597	1.568	1.656	1.813	1.078	0.931	1.158
2	2.940	1.666	1.765	1.960	1.127	0.980	1.150
3	2.793	1.666	1.676	2.009	1.078	0.982	1.222
4	2.695	1.568	1.719	1.862	1.029	0.833	1.235
5	2.695	1.519	1.774	1.715	0.980	0.833	1.176
6	3.038	1.715	1.771	2.156	1.274	0.980	1.300
7	2.744	1.568	1.750	1.960	1.176	0.980	1.200
8	2.450	1.470	1.667	1.715	1.029	0.931	1.105
9	2.205	1.372	1.607	1.617	0.980	0.784	1.250
10	2.597	1.519	1.710	1.764	1.078	0.882	1.222
11	3.577	1.715	2.086	2.401	1.225	0.931	1.316
12	2.891	1.813	1.595	1.911	1.127	0.833	1.353
13	2.940	1.568	1.875	2.058	1.176	0.980	1.200
14	2.842	1.715	1.657	2.009	1.176	0.882	1.333
15	3.185	1.666	1.912	2.107	1.225	0.980	1.250
16	2.940	1.715	1.714	1.813	1.078	0.784	1.375

