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Redescription of two problematic Alpine *Oxychilus*: *O. adamii* (Westerlund, 1886) and *O. polygyra* (Pollonera, 1885) (Pulmonata, Zonitidae)

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The taxonomic and nomenclatural status of *Oxychilus adamii* (Westerlund, 1886) and *O. polygyra* (Pollonera, 1885) is revised. These two, very similar species are tentatively assigned to *Mediterranea*, a 'subgenus' of *Oxychilus* characterized by (1) absent or very short flagellum; (2) penial retractor inserted where epiphallus ends and proximal penis begins; (3) internal ornamentation of penis consisting of pleats and rows of papillae, some of which or all with apical thorn; (4) short epiphallus internally with series of transverse crests on one side and a few slender longitudinal pleats on the other; (5) mucous gland forming muff of glandular tissue, denser and yellower around distal portion of free oviduct; (6) and short mesocone on the central tooth. *O. adamii* is distinguished by a medium-sized shell (diameter 16.1 ± 1.0 mm) and very small papillae without apical thorn covering the initial portion of the proximal penis. *O. polygyra* is distinguished by a small shell (diameter 10.4 ± 0.5 mm) and large papillae with an evident cuticularized apical thorn covering the initial portion of the proximal penis. The paper concludes with a review of the current status of *Oxychilus* taxonomy, including the main problems and some tentative solutions to be verified in the context of individual revisions.

Key words: Gastropoda, Pulmonata, Zonitidae, *Oxychilus*, taxonomy, nomenclature, Italy.

INTRODUCTION

Ten species of *Oxychilus* Fitzinger, 1833, are reported from the Alps: *O. adamii* (Westerlund, 1886), *O. alliarius* (Miller, 1822), *O. cellarius* (Müller, 1774), *O. clarus* (Held, 1838), *O. depressus* (Sterki, 1880), *O. draparnaudi* (Beck, 1837), *O. glaber* (Rossmässler, 1835), *O. helveticus* (Blum, 1881), *O. mortilleti* (Pfeiffer, 1859), and *O. polygyra* (Pollonera, 1885) (Riedel, 1980; Kerney et al., 1983; Falkner, 1990; Manganelli et al., 1995; Manganelli & Giusti, 1998). Of these species, *O. adamii* and *O. polygyra* are the least known.

O. adamii was reported as a subspecies of *O. villae* (Pfeiffer, 1857) [currently *O. mortilleti* (Pfeiffer, 1859) (Manganelli & Giusti, 1998)] by Alzona (1971), and as a distinct species by Riedel (1980) and Kerney et al. (1983) on the basis of unpublished research by the late L. Forcart. *O. polygyra* was listed as a distinct species by Alzona (1971), Riedel (1980), and Falkner (1990). *O. adamii* was assigned to *Oxychilus* (s.s.) by Riedel (1980) and Kerney et al. (1983), and *O. polygyra* to no particular subgenus by Riedel (1980) pending anatomical examination. Both species were recently assigned to the subgenus *Mediterranea* Clessin, 1880 (type species *Helix hydatina* Rossmässler, 1838) by Manganelli et al. (1995).

This paper is devoted to the redescription of these two species, the analysis of their taxonomic and nomenclatural status and, more in general, to a discussion of the taxonomy and systematics of oxychiline zonitids.

MATERIAL AND METHODS

Whole shells were photographed under the light microscope (Wild M5A). All dimensions (NW number of whorls, SD shell diameter, SH shell height, UD umbilicus diameter) were measured using a micrometer.

Live specimens were drowned in water, then fixed and preserved in 75% ethanol buffered with $NaHCO_3$. The bodies were isolated after crushing the shells and dissected under the light microscope (Wild M5A) using thin pointed watchmaker's tweezers. Anatomical details were drawn using a Wild camera lucida. Some parts of the genital organs (e.g. duct of bursa copulatrix, distal vagina, flagellum, proximal portion of penis, 'bottle-neck', distal penis and penial sheath) were measured by micrometer.

Radulae were manually extracted from the buccal bulbs, washed in pure 75% ethanol, mounted on copper stubs with electronconductive glue, sputter-coated with gold and photographed using a Philips 505 SEM.

The material examined is listed as follows: locality, municipality and province names in parentheses (when available maps do not give the municipalities only the province name is shown), UTM reference, number of specimens in parentheses (ps spirit preserved specimen/s, ss shell/s). Locality names and UTM references are according to the official 1:100,000 scale map of Italy (series M 691).

Unless otherwise indicated, all the material examined is kept in the Giusti collection (Dipartimento di Biologia Evolutiva, Via Mattioli 4, I-53100 Siena, Italy).

Oxychilus (Mediterranea) adamii (Westerlund, 1886)

? *Helix Villa* Mortillet in Strobel 1853: 110.

Type series. — Unknown.

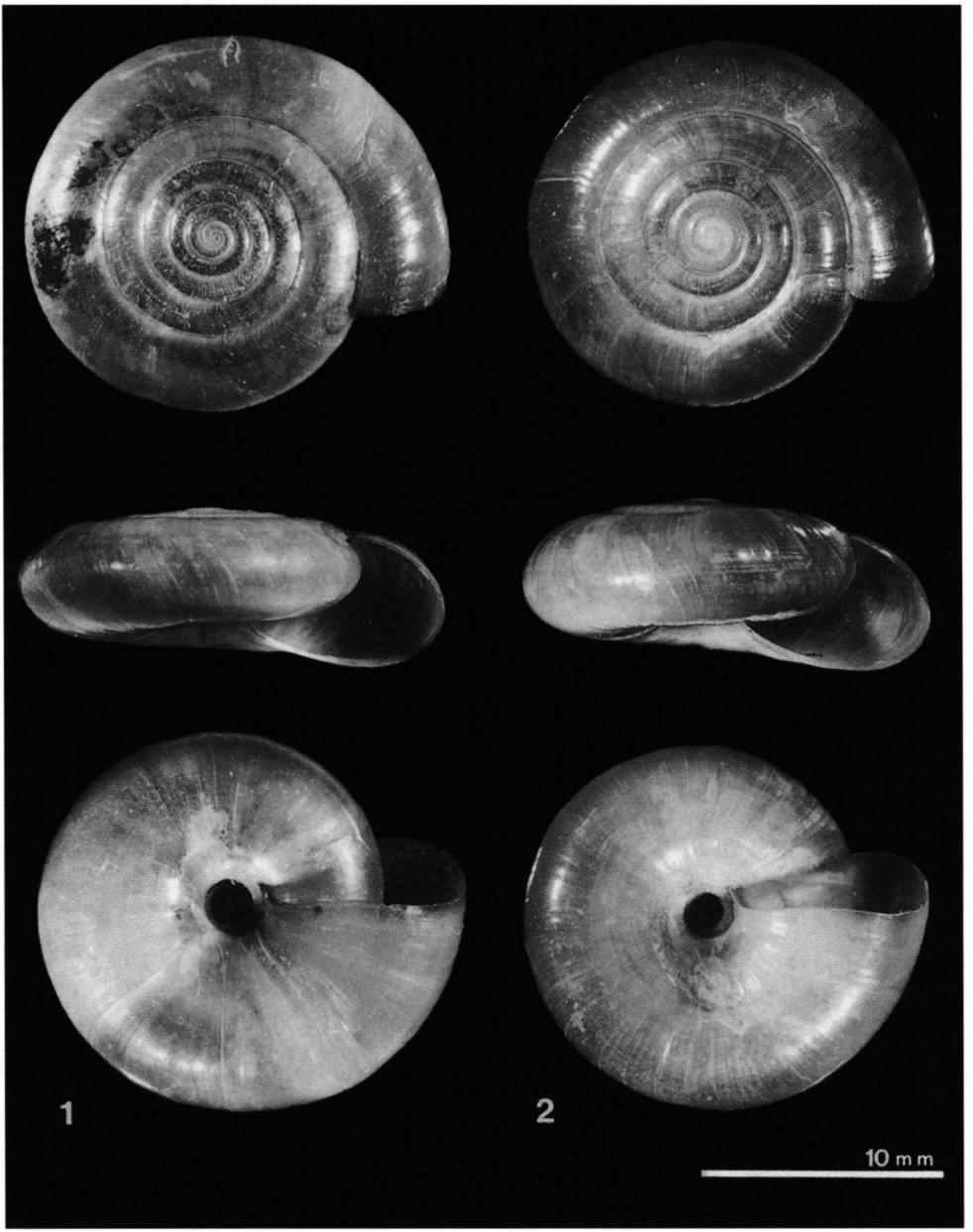
Type locality. — "... rinvenirsi ad ambo le rive di questo lago [Lago del Verbano], nonché nelle isole Borromee".

[*Hyalinia villae*] var. *adamii* Westerlund, 1886: 47.

Type material. — The type material constists of two syntypes belonging to *O. mortilleti* (figs. 20-21) and is kept in the Westerlund collection (no. 124) at the Naturhistoriska Museet (Göteborg, Sweden). In order to preserve this name in the current sense we are applying to the ICNZ to set aside their type status and to designate as neotype the specimen shown in fig. 1. The proposed neotype is in the Museo Zoologico de "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, Italy, MZUF no. 13735.

Type locality. — The original type locality "Lombardei b. Esino" was a mistake because the label states "Italia, Edolo". If the designation of a neotype is accepted by the ICZN, the type locality will become Val Seriana, Valle Asnina, 400-500 m (municipality of Cene, province of Bergamo, Italy, UTM 32T NR 6671).

Identification. — A medium-sized species of *Oxychilus* belonging to *Mediterranea* (a 'subgenus' of *Oxychilus* characterized by (1) absent or very short flagellum; (2) penial retractor inserted where epiphallus ends and proximal penis begins; (3) internal ornamentation of penis consisting of pleats and rows of papillae, some of which or all with apical thorn; (4) short epiphallus internally with series of transverse crests on one side and a few slender longitudinal pleats on the other; (5) mucous gland forming muff of glandular tissue, denser and yellower around distal portion of free oviduct; (6) and short mesocone on the central tooth).



Figs. 1-2. Shells of *Oxychilus adamii* from Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671, G. Comotti leg. 3.IV.1982 (fig. 1), G. Comotti leg. 10.IV.1982 (fig. 2). The proposed neotype (fig. 1) is in the Museo Zoologico de "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, Italy, MZUF no. 13735.

O. adamii is readily distinguished from the other two alpine species of *Mediterranea*, *O. polygyra* and *O. depressus*, by virtue of its larger shell (shell 16.1 ± 1.0 mm vs. 10.4 ± 0.5 mm for *O. polygyra* and 7.0-8.5 mm for *O. depressus*).

Description. — Body slate-blue in colour; neck and upper part of sides with variably wide areas with conspicuous pits (with phylacites); foot slender, aulacopod, pale slate-grey, sole longitudinally tripartite; kidney sigmurethrous; jaw oxygnathous.

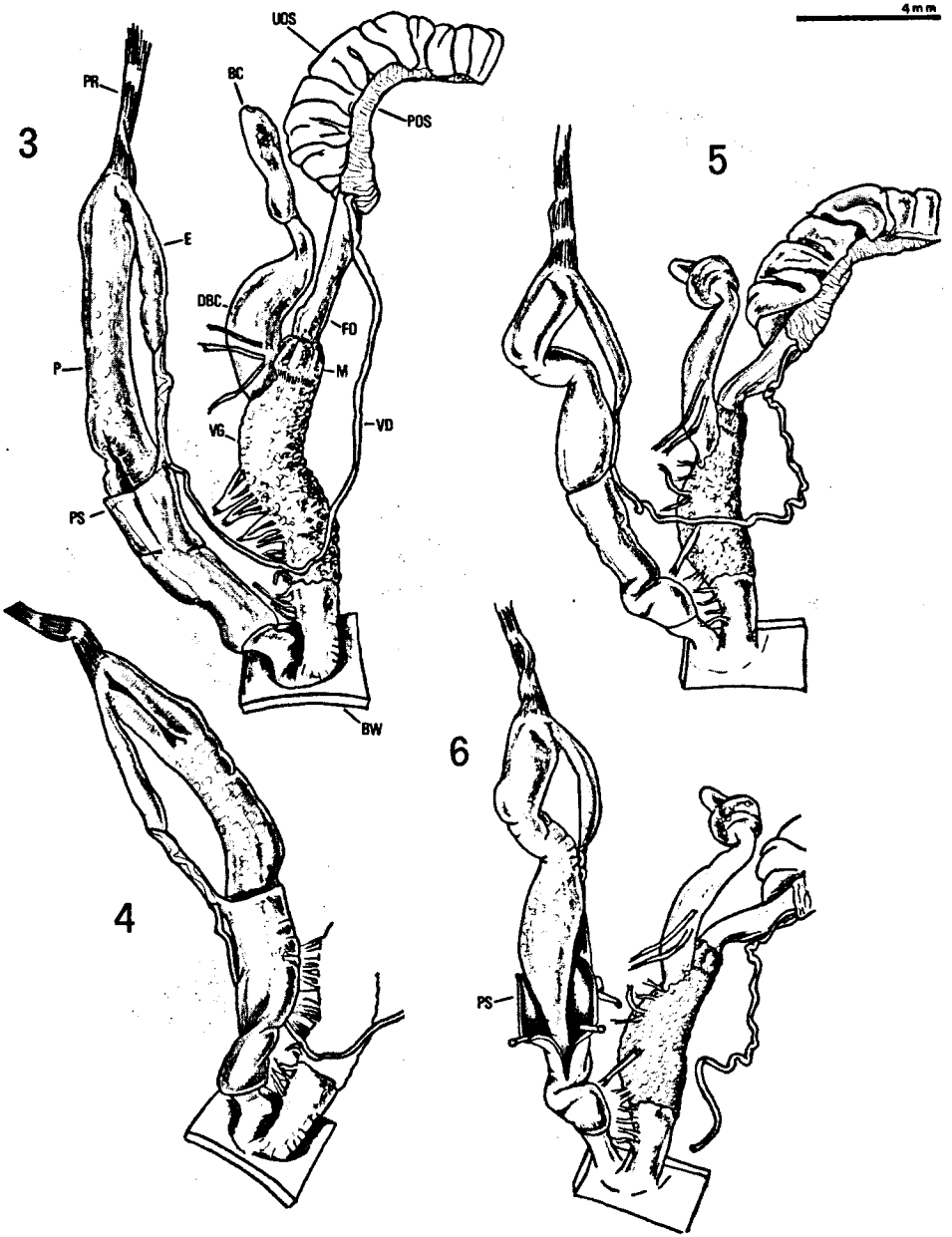
Shell (figs. 1-2, 22, 25) dextral, medium, discoidal, usually tectiform, but frequently flat above, thin, subtransparent, glossy, more or less intensely pale brownish yellow in colour when fresh; external surface smooth or with thin, irregularly spaced growth lines; spire with 6 ± 2/5 (5 7/12-6 3/8) whorls, slowly and regularly increasing (ratio shell diameter/number of whorls = 2.5-2.9), last whorl slightly dilated near aperture, its last quarter descending to some extent; sutures shallow; umbilicus small, about 1/6-1/8 of shell diameter; aperture oval, oblique, its diameter about half the shell diameter; peristome interrupted, simple, not thickened or reflected, its upper vertex starting at or sligtly above periphery of last whorl.

Dimensions (25 shells measured). Number of whorls 6 ± 2/5 (5 7/12-6 3/8); shell diameter 16.1 ± 1.0 mm (14.1-17.5); umbilicus diameter 2.1 ± 0.3 mm (1.7-2.7); height 6.2 ± 0.4 mm (5.3-7.0).

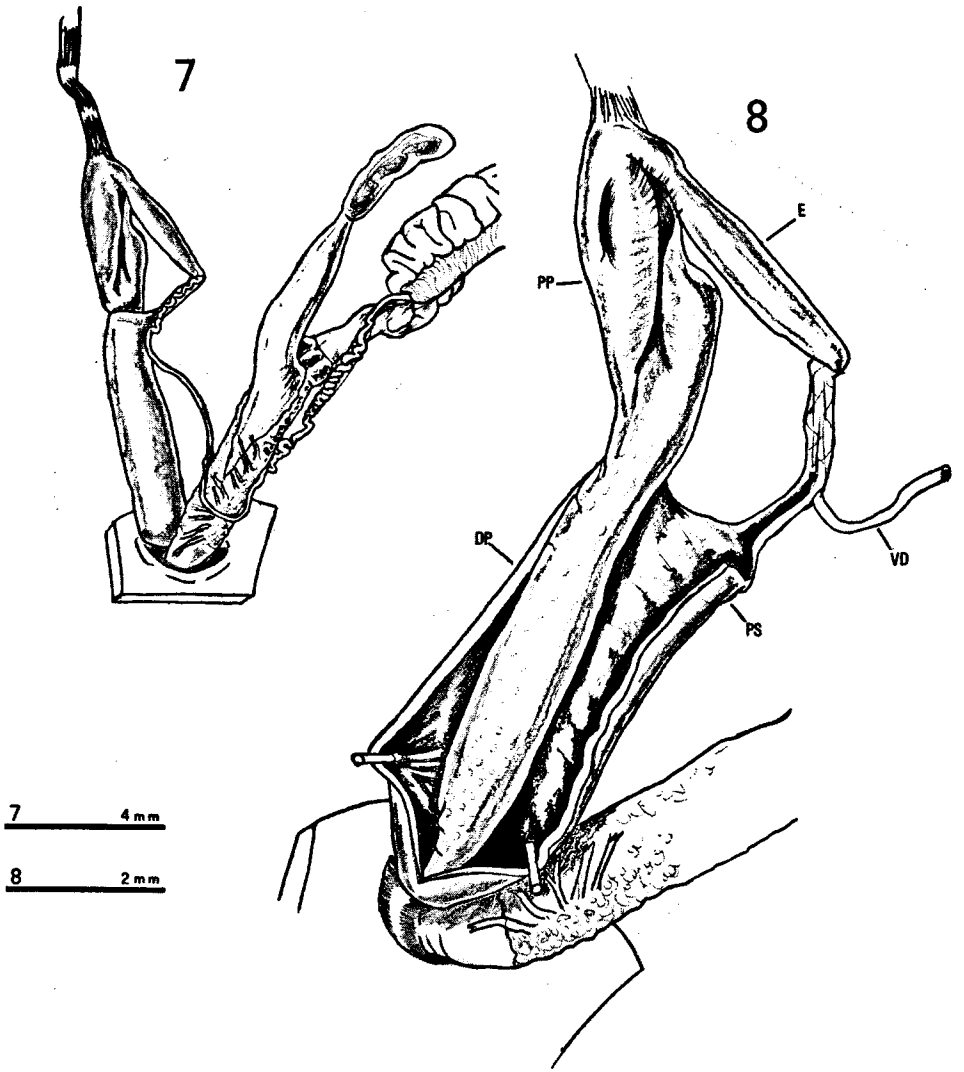
Genitalia (figs. 3-17). General scheme of genitalia as in *Oxychilus* (s.s.). Only distal genitalia are described here.

Female distal genitalia including free oviduct, bursa copulatrix and its duct, and vagina. Part of free oviduct and vagina are covered with glandular tissue constituting vaginal gland. Free oviduct slender with distal portion enveloped by muff of dense, yellowish glandular tissue, which extends to initial portion of proximal vagina and, in form of very thin whitish or pale-yellowish layer of spongy tissue, also to most of the vagina (length of vagina covered by vaginal gland 4.2-6.9 mm; length of vagina free of vaginal gland 0.9-2.8 mm). From this spongy tissue at base of vagina, rather long (3.9-6.9 mm) duct of bursa copulatrix arises, initially well flared, then progressively decreasing in caliber before entering bursa copulatrix, the latter sometimes irregularly shaped, sometimes bean-like or pyriform.

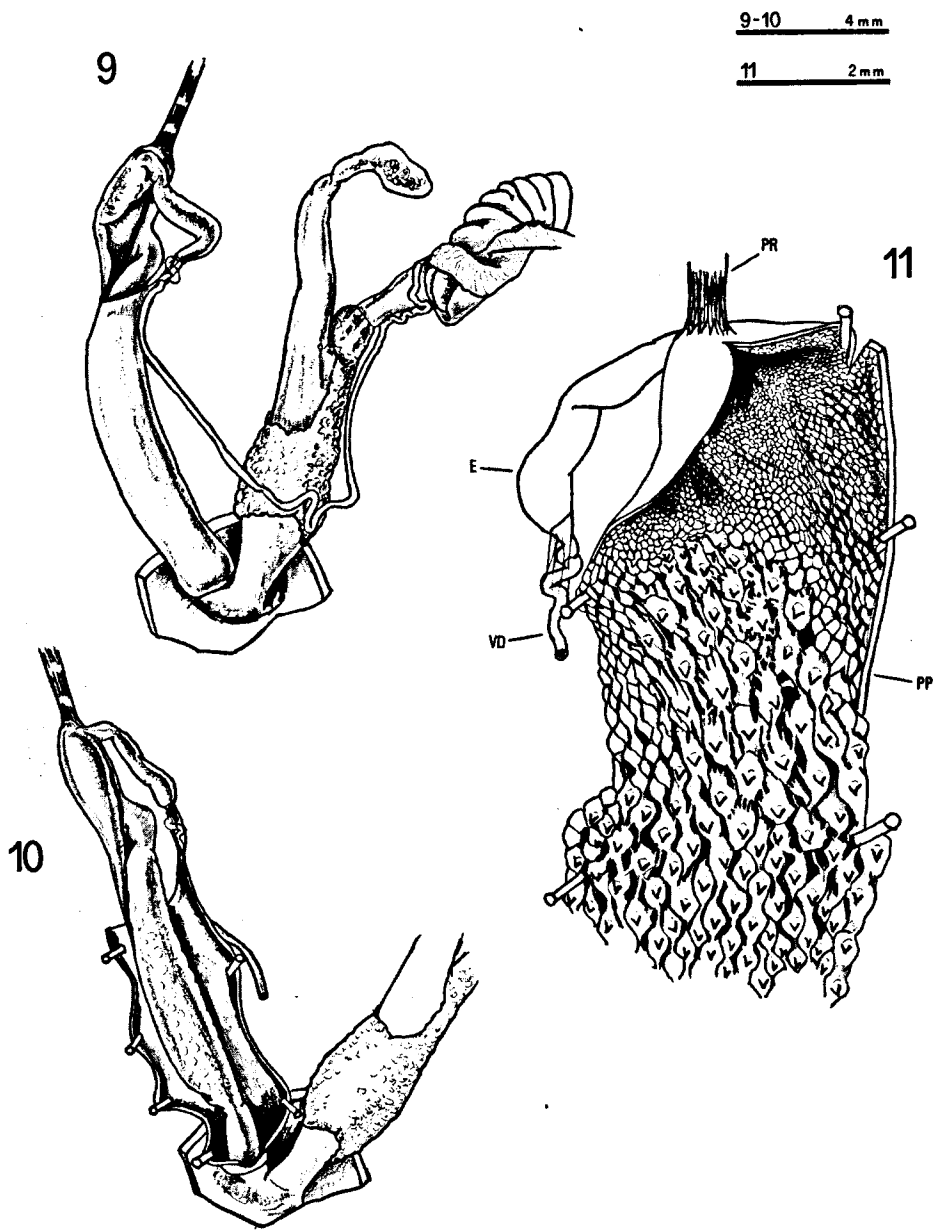
Male distal genitalia including vas deferens and penial complex. Vas deferens long and very slender. Penial complex consisting of epiphallus and penis (flagellum absent). Epiphallus fusiform, rather short (2.8-4.4 mm), with series of transverse, parallel, wrinkled crests on one side of its internal surface and on the other side a few slender longitudinal pleats, which run along whole length of epiphallus; rim of epiphallus opening into proximal penis bordered by very small, elongated, wavy, closely spaced pleats; penis distinguished into proximal and distal portions by marked change in internal ornamentation; penial retractor muscle ending on proximal penis, at epiphallus entrance (implantation area of retractor muscle sometimes extending to distal epiphallus); proximal penis rather long (6.1-10.9 mm), wide and flat, its terminal portion tapering before distal penis begins (exact border between proximal and distal penis can only be recognized by dissection, situated where internal rows of papillae of proximal penis end and pleats of distal penis arise); initial portion of proximal penis well flared and flat so as often to be partly folded on itself; initial portion of proximal penis with internal rows of very small papillae without apical thorn (particularly evident when penis everted, fig. 14); most of the remaining proximal penis with internal rows of variably large, irregularly shaped (sometimes conical, sometimes pyramidal) papillae with marked, cuticularized thorn at tip; base of each papilla linked to base of preceding and subsequent ones by thin, raised, root-like crests; distal penis short (1.0-3.4 mm), very slender, with about



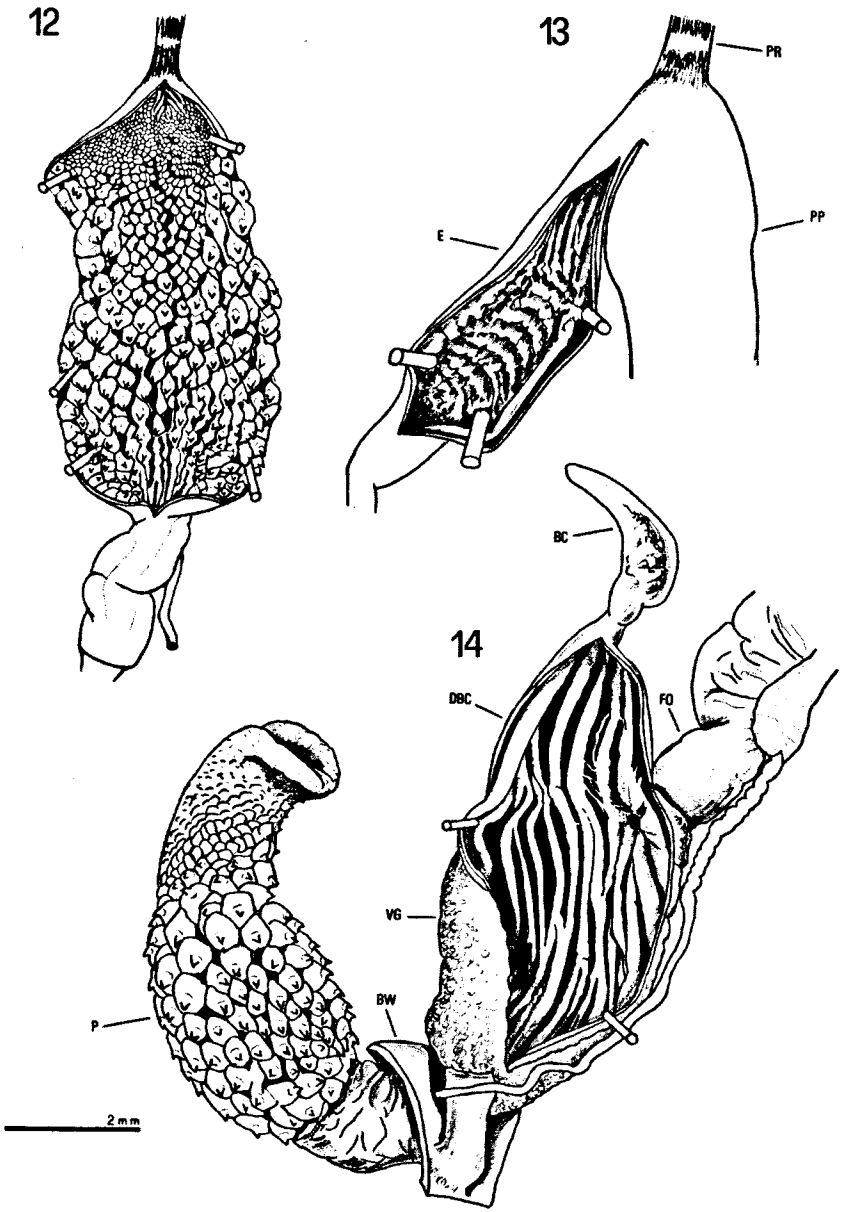
Figs. 3-6. Distal genitalia of two specimens of *Oxychilus adamii* from Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671, G. Comotti leg. 10.IV.1982. Key to acronyms used in figs. 3-14, 26-30: BC bursa copulatrix, BW body wall, DBC duct of bursa copulatrix, DP distal portion of penis, E epiphallus, FO free oviduct, M glandular muff, P penis, POS prostatic portion of ovispermiduct, PP proximal portion of penis, PR penial retractor, PS penial sheath, UOS uterine portion of ovispermiduct, VD vas deferens, VG vaginal gland.



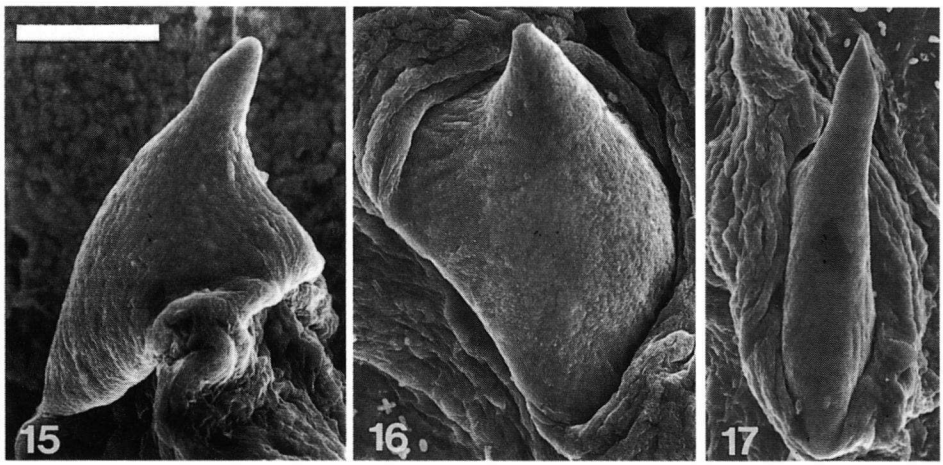
Figs. 7-8. Distal genitalia (fig. 7) and detail of penial complex (fig. 8) of a specimen of *Oxychilus adamii* from Val Serina, 27 km milestone on the road between Ambra and Serina (Bergamo), 32TNR5676, W. Fauer leg. 7.VI.1982.



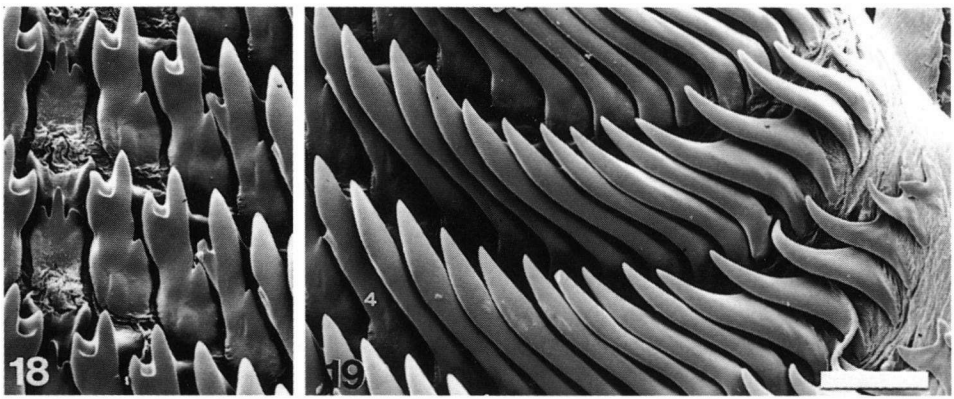
Figs. 9-11. Distal genitalia (fig. 9), penis (fig. 10) and internal ornamentation of proximal penis (fig. 11) of a specimen of *Oxychilus adamii* from Bus de la Volp 1071 Lo BG, 1154 Lo BG (Serina, Bergamo), 32TNR5678, G. Comotti leg. 1.I.1984.



Figs. 12-14. Internal ornamentation of proximal penis (fig. 12), epiphallus (fig. 13), vagina and duct of bursa copulatrix and everted penis (fig. 14) in specimens of *Oxychilus adamii* from Rifugio Grem, 1300-1400 m (Gorno, Bergamo), 32TNR6383, G. Comotti leg,. 18.VIII.1982.



Figs. 15-17. Thorns of the papillae of proximal penis of a specimen of *Oxychilus adamii* from Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671, G. Comotti leg. 10.IV.1982. Scale bar 50 μm.



Figs. 18-19. Radula of a specimen of *Oxychilus adamii* from Rifugio Grem, 1300-1400 m (Gorno, Bergamo) 32TNR6383, G. Comotti leg,. 18.VIII.1982. Scale bar 50 μm.

6-7 rows of internal longitudinal pleats; distal penis and distal portion of proximal penis enveloped by rather short (4.2-6.9 mm), thick, muscular penial sheath, its thickness (maximum sheath thickness 0.18-0.25 mm) progressively reducing from close to genital atrium where it originates, to where it ends; proximal penial sheath traversed on one side by vas deferens; thin muscular strips run from penial sheath to envelop the distal portion of vas deferens and proximal epiphallus; maximum width of distal penis plus penial sheath (level with where penial sheath originates) 1.06-1.87 mm; very short, thin walled tube connects distal penis (level with where penis sheath originates) to genital atrium in which vagina also ends.

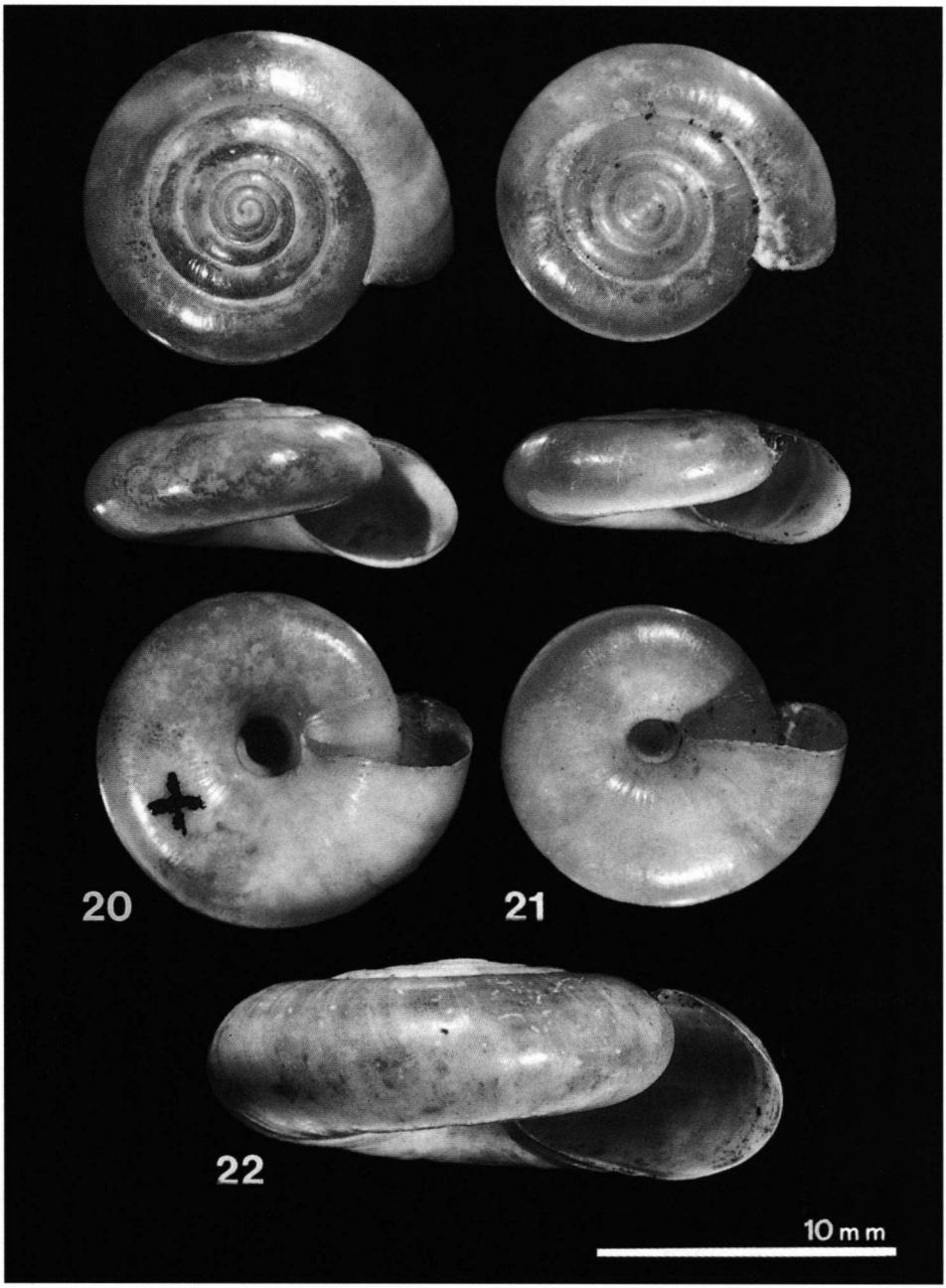
Radula (figs. 18-19) consisting of many rows of about 35-37 teeth, with formula 13-14 M/1 + 1 LM/2 + 3 L/3 + C/3 + 3 L/3 + 1 LM/2 + 13-14 M/1. Central teeth with well developed basal plate, apical portion of which V-like, with pointed vertices; basal plate providing base for short slender pointed mesocone flanked by two very short ectocones. On both sides of each central tooth there are two lateral tricuspid teeth, a latero-marginal bicuspid tooth and series of monocuspid marginal teeth in decreasing order of size.

Type material. — The 'original' type material consists of two syntypes belonging to *O. mortilleti* (figs. 20-21) and is kept in the Westerlund collection (no. 124) at the Naturhistoriska Museet (Göteborg, Sweden). In order to preserve this name in the current sense we are applying to the ICNZ to set aside their type status and to designate the specimen illustrated in fig. 1 as neotype. The proposed neotype is in the Museo Zoologico de "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, Italy, MZUF no. 13735.

Type locality. — Westerlund (1886: 47) reported "Lombardei b. Esino" as type locality but the label accompanying the type material reads "Italia, Edolo". Forcart (unpublished) noted that "Esino" was "Esine", a small village near Edolo, in Val Camonica, not "Esino Lario", a locality near the Lake of Lecco. We think that Forcart was right, because G.B. Adami, who sent the material to Westerlund, spent a period in Val Camonica and devoted a paper to the molluscs of this valley (Adami, 1876). In this paper he frequently mentioned "Esine" though he only collected specimens of "*Hyalina cellaria*" there and not "*Hyalina villae*".

If the designation of a neotype is accepted by the ICZN, the type locality will become: Val Seriana, Valle Asnina, 400-500 m asl, municipality of Cene, province of Bergamo, Italy, UTM 32T NR 6671.

Material examined. — ITALY. 32TNR29) Parlasco, 750 m (Como), 32TNR2795 (2 ps). 32TNR38) Malavedo (Lecco), 32TNR3180 (1 ss). 32TNR39) Ponte di Chiuso, 580 m (Como), 32TNR3490 (1 ps). 32TNR46) Monte Linzone, Bus del Coren 1146 Lo Bg, 1350 m (Palazzago, Bergamo). 32TNR45) Val Taleggio, turn-off for Lavina (Bergamo), 32TNR4551 (1 ss). 32TNR4169 (9 ps). 32TNR47) Val Brembana, Sedrina (Sedrina, Bergamo), 32TNR4970 (1 ss). 32TNR48) Val Taleggio, Sottochiesa (Bergamo), 32TNR4382 (3 ss). 32TNR57) Bus de la Volp 1071 Lo BG, 1154 Lo BG (Serina, Bergamo), 32TNR5678 (2 ss, 2 ps). Costa di Serina (Costa di Serina, Bergamo), 32TNR5875 (2 ps, 1 ss). Orrido di Bracca, 360 m (Bergamo), 32TNR5373 (13 ss, 3 ps). Val Serina, turn-off for Ambriola on the road between Ambra and Serina (Bergamo), 32TNR5674 (1 ss). Val Serina, 24 km milestone on the road between Ambra and Serina (Bergamo), 32TNR5574 (1 ss). Val Serina, 27 km milestone on the road between Ambra and Serina (Bergamo), 32TNR5676 (9 ss, 20 ps). 32TNR67) Val Seriana, Buse de Al Asnina 1001 Lo BG (Casnigo, Bergamo), 32TNR6671 (10 ps). Val Seriana, Buse de Al Asnina 1001 Lo BG (Casnigo, Bergamo), 32TNR6671 (5 ss). Val Seriana, Valle Asnina,



Figs. 20-22. The original type material of *Hyalinia villae* var. *adamii* (figs. 20-21) consists of two syntypes belonging to *Oxychilus mortilleti* (Pfeiffer, 1859) and is kept in the Westerlund collection (no. 124) at the Naturhistoriska Museet (Göteborg, Sweden). A shell of *Oxychilus adamii* (fig. 22) from Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671, G. Comotti leg. 8.V.1982, for comparison.

400-500 m (Cene, Bergamo), 32TNR6671 (4 ss, one of which proposed as neotype of *Hyalinia villae* var. *adamii*; 8 ps). Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671 (2 ss, 24 ps). Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671 (2 ss, 25 ps). 32TNR68) Oltre il Colle (Oltre il Colle, Bergamo), 32TNR6082 (10 ps). Rifugio Grem, 1300 m (Gorno, Bergamo), 32TNR6383 (4 ps). Rifugio Grem, 1300-1400 m (Gorno, Bergamo), 32TNR6383 (12 ps).

Nomenclature. — *Helix villa* Mortillet in Strobel (1853: 100) may have been the first name introduced for this species. This nominal species has been regarded as an older synonym of *Helix villae* Pfeiffer, 1857, currently *O. mortilleti* but this may be incorrect. In fact, the short description by Mortillet ("le caractère essentiel de l'*H. Villa* est d'être complètement plane supérieurement et d'avoir les tours de spire qui se recouvrent presque entièrement") and a subsequent statement by Mortillet (1862: 12-13) ("les premiers échantillons que j'ai reçus des frères Villa étaient très grands et très applatis, les tours de spire se recouvraient successivement ..."), suggests that *Helix villa* was based on shells of *O. adamii*, not of *O. mortilleti* (see Manganelli & Giusti, 1998). However, the revival of this name for the species is absolutely unacceptable.

As anticipated, the original type material of *Hyalinia villae* var. *adamii* consists of two syntypes belonging to *O. mortilleti* (this was also ascertained by A. Riedel in 1968, as demonstrated by his handwritten label accompanying the syntypes). The responsibility for giving the name *Hyalinia villae* var. *adamii* to this species belongs to the late L. Forcart. In an unpublished revision he misinterpreted this nominal species, despite the fact that he had examined the syntypes (Forcart, unpublished). This misinterpretation was later adopted by Riedel (1980) and unwittingly by Kerney *et al.* (1983). Although we became aware of this in 1984, we preferred to maintain Westerlund's name for the species (Manganelli *et al.*, 1995).

The ICZN has already been requested to set aside the type status of original type material in order to preserve a name in the current sense (Gittenberger, 1993). Hence we are applying to the ICZN to set aside the type status of the two original syntypes of *Hyalinia villae* var. *adamii* kept in the Westerlund collection (no. 124) at the Naturhistoriska Museet (Göteborg, Sweden) and to designate the specimen illustrated in fig. 1 as neotype, in order to preserve this name in the current sense.

Taxonomy. — *Oxychilus adamii* is easily distinguished from the other two Alpine species assigned to the same subgenus/group, i.e. *O. polygyra* and *O. depressus* by shell characters and the internal ornamentation of the proximal penis.

The shell of *O. adamii* is larger (SD 16.1 ± 1.0 mm; range 14.1-17.5 mm, n: 25) than that of *O. polygyra* (SD 10.4 ± 0.5 mm) and *O. depressus* (SD 7.0 - 8.5 mm, according to Kerney et al., 1983: 173). Moreover *O. adamii* (as *O. polygyra*) has proportionally more whorls for a given shell diameter than *O. depressus*.

Anatomically *O. adamii* is distinct from these two species by virtue of the very small papillae without an apical thorn which cover the internal wall of the initial portion of the proximal penis, near the opening of the epiphallus into the proximal penis (in *O. polygyra* the papillae are larger and have a marked cuticularized apical thorn; in *O. depressus* the internal wall of the proximal penis has initially rows of small polygonal papillae without apical thorn, and then irregular wavy pleats apparently formed by fusion of papillae, some of which have a slender hook-like apical thorn; Riedel, 1980: figs. 247-248).

Other European species, anatomically related to *O. adamii* and *O. polygyra* (see table 3 and Discussion), can be divided into two groups. One includes species conchologically similar to *O. hydatinus* (Rossmässler, 1838), i.e. *O. inopinatus* (Ulicny, 1887), *O. ionicus*

Riedel & Subai, 1978, *O. pygmaeus* (Riedel, 1983), and perhaps *O. subeffusus* (Boettger, 1879). The other species are similar to *O. depressus*, i.e. *O. amaltheae* Riedel & Subai, 1978, *O. juliae* Riedel, 1990, and *O. mylonasi* Riedel, 1983, plus *O. montivagus* (Kimakowicz, 1890) and *O. planorbis* (Möllendorff, 1899), if they are not related to *Schistophallus* Wagner, 1914. The former group consists of species that have small to very small, whitish, *Vitrea*-like shells not more than 7.5 mm in diameter with tightly coiled whorls (Riedel, 1966, 1969a, 1983; Riedel & Subai, 1978; Kerney et al., 1983). Most of the latter group (*O. amaltheae*, *O. mylonasi*, *O. montivagus* and *O. planorbis*) have slightly larger (never more than 12.0 mm in diameter), yellowish shells, with the last whorl enlarged to very enlarged (Riedel, 1969a, 1983; Riedel & Subai, 1982; Kerney et al., 1983). Due to their much smaller size, none of these species can therefore be confused with *O. adamii*. Only *O. juliae*, endemic to Korfu, is similar in size to *O. adamii* and is an aberrant species which differs from *O. adamii* by virtue of a shell with the last whorl enlarged to very enlarged and a voluminous accessory structure in the penial complex (Riedel, 1990: figs. 31-37 and pl. 2 figs. 16-21)

The Maghrebian species related to *Mediterranea* Clessin, 1880 (see table 3 and Discussion), can also be divided into two groups corresponding to two of the *Oxychilus* subgenera currently in use. The first corresponds to *Allogenes* Gude, 1911, and includes four species: *O. cepedei* (Dautzenberg, 1907), *O. djurdjurensis* (Debeaux, 1863), *O. issericus* (Bourguignat, 1868) and *O. prodigiosus* (Ancey, 1899), and the other to *Pseudopolita* Germain, 1908, and includes three species: *O. eurabdotus* (Bourguignat, 1867), *O. gaudeaui* (Germain, 1907), and *O. subplicatulus* (Bourguignat, 1864). Two of the *Allogenes* species (*O. cepedei* and *O. djurdjurensis*) are similar in size to *O. adamii*, the other two are smaller. All these species can be easily distinguished from *O. adamii* because their shells have the last whorl very large and angled at the periphery (Riedel, 1975: figs. 19-31, pl. 3 figs. 16-30). Only one species of *Allogenes* (*O. cepedei*) is anatomically known. The distal genitalia of *O. cepedei* are very similar to those of *O. adamii*, the only difference consisting in a less developed vaginal gland on the distal vagina (Riedel, 1975: figs. 32-36).

The species assigned to *Pseudopolita* have smaller shells (but never more than 12.0 mm in diameter) than *O. adamii*, with fine microsculpture consisting of regularly spaced, spiral rows of small tubercles (Riedel, 1975: figs. 1-9, pl. 1 figs. 1-9, pl. 2 fig. 13, pl. 4 figs. 31-40). Anatomically, they are very similar, except *O. subplicatulus* which has a small flagellum. All these species differ from *O. adamii* by virtue of a sort of knob on the internal wall of the distal penis. This knob has many thorned papillae and may be everted during copulation (Riedel, 1975: figs. 12-15, 43-46).

Among the sympatric species, *O. adamii* may be confused only with *O. mortilleti* especially if juvenile specimens are involved, because both species have tightly coiled whorls. However, adult shells of *O. adamii* are flatter and larger (SD 16.1 ± 1.0 mm; range: 14.1-17.5 mm, n: 25) than those of *O. mortilleti* (SD 12.1 ± 0.93 mm; range: 10.6-14.7 mm, n: 56). *O. mortilleti* does not belong to *Mediterranea* and is anatomically very different from *O. adamii* (Wagner, 1915: 459, pl. 12 fig. 92; Hudec, 1962: fig. 9; Bishop, 1976: fig. 8; Manganelli & Giusti, 1998: figs. 5-16).

It is surprising that this large and well characterized species was described so late and remained unrevised until now. This was probably due to the fact that *O. adamii* has a limited distribution and often coexists with *O. mortilleti*. These two species have shells with tightly coiled whorls, but with a different size range. However, the largest *O. mortilleti* overlap with the smallest *O. adamii*. Conchologically, therefore the size spectrum of the two species is continuous. This may have been what caused the confusion.

Geographical distribution. — The species has a very narrow distribution, limited to

several valleys in Lombardy (fig. 33). Kerney et al. (1983: 171) also reported it in "Schweiz (Luganer See, S-Tessin)", but this is probably erroneous and based on misidentification of *O. mortilleti*, a very common species in that area (Manganelli & Giusti, 1998).

Status and conservation. — *O. adamii* is not globally threatened. It has a limited distribution, but is not known to have declined with respect to the past or to be under any particular threat at present.

Oxychilus (Mediterranea) polygyra (Pollonera, 1885)

H[yalinia]. (Pol[ita].) polygyra Pollonera, 1885: 681.

Type material. — The lectotype (MRSNT no. 120.1) and four paralectotypes (MRSNT no. 120.1 and 120.2-5) from "Rosazza" and three paralectotypes from "Montasinaro" (MRSNT no. 121.1-3) are in the Pollonera collection at the Museo Regionale di Scienze Naturali (Turin, Italy).

Type locality. — "Contorni di Rosazza in V. Cervo".

H[yalinia]. oropaensis Westerlund, 1886: 47.

Type material. — Lectotype (MZUF no 13040) and nine paralectotypes (MZUF no 13739) from Oropa are in the Paulucci collection at the Museo Zoologico de "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze. The other two paralectotypes are from an erroneous collection site and are in the Westerlund collection (no. 22) at the Naturhistoriska Museet (Göteborg, Sweden) (T. von Proschwitz, personal communication 8.XII.1997).

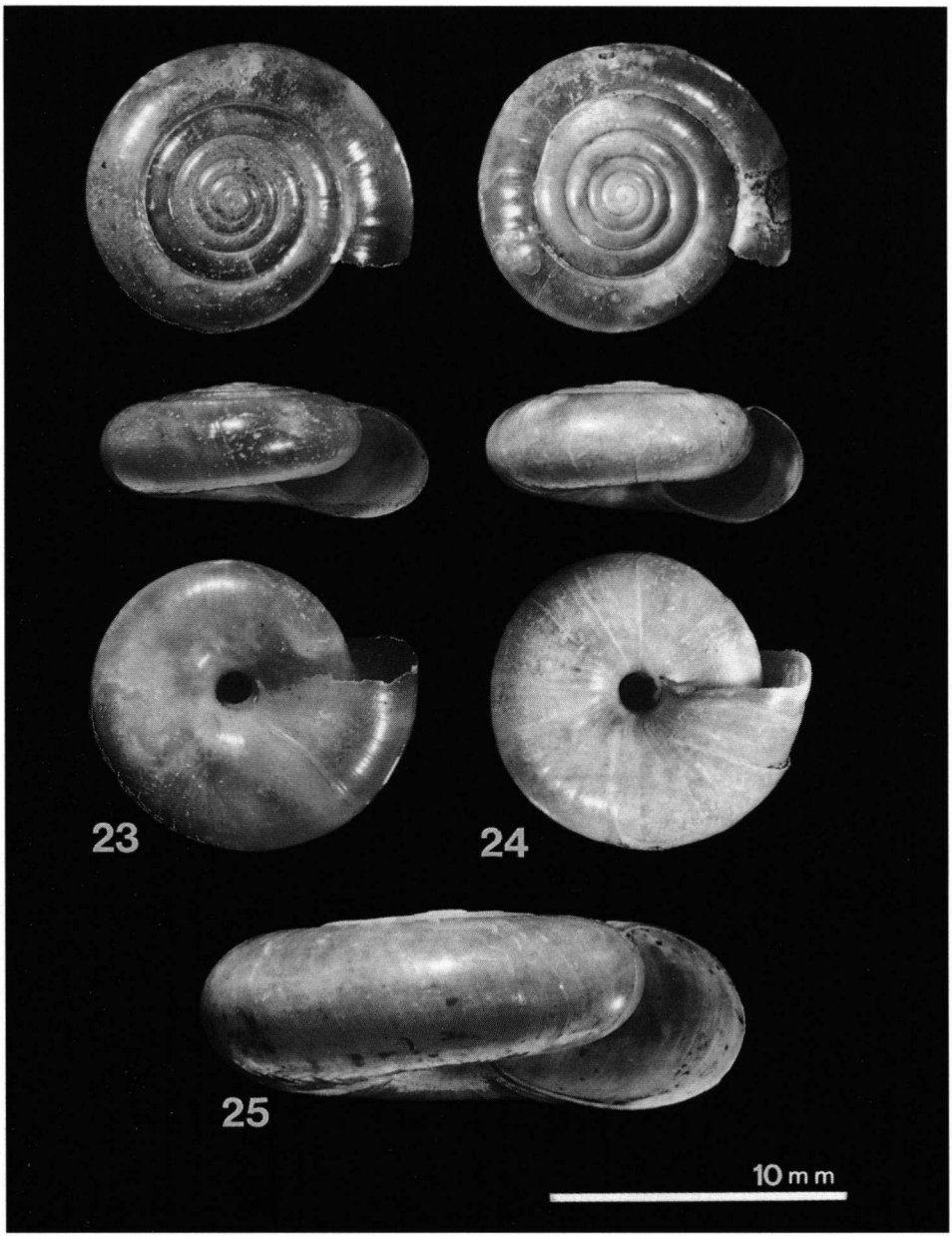
Identification. — A small species of *Oxychilus* belonging to *Mediterranea* (a 'subgenus' of *Oxychilus* characterized by (1) absent or very short flagellum; (2) penial retractor inserted where epiphallus ends and proximal penis begins; (3) internal ornamentation of penis consisting of pleats and rows of papillae, some of which or each of them with apical thorn; (4) short epiphallus internally with series of transverse crests on one side and a few slender longitudinal pleats on the other; (5) mucous gland forming a muff of glandular tissue, denser and yellower around distal portion of the free oviduct; (6) and short mesocone on the central tooth).

O. polygyra is distinguished from the other alpine species of *Mediterranea*, *O. adamii* and *O. depressus*, by virtue of its smaller shell (diameter 10.4 ± 0.5 mm) with respect to *O. adamii* (shell 16.1 ± 1.0 mm) and a last whorl not dilated with respect to *O. depressus* (last whorl much enlarged).

Description. — Body as in *O. adamii*.

Shell (figs. 23-24) dextral, small, discoidal, usually tectiform, sometimes flat above, thin, translucent, glossy, more or less intensely pale brownish yellow in colour when fresh; surface smooth or with thin, irregularly spaced growth lines; spire with 5 5/6 ± 2/7 (5 3/8-6 1/12) whorls, slowly and regularly increasing in size (ratio shell diameter/number of whorls = 1.6-1.9); last whorl slightly dilated near aperture, its last quarter descending to some extent; sutures shallow; umbilicus small, about 1/6-1/8 of shell diameter; aperture oval, oblique, its diameter about half the shell diameter; peristome interrupted, simple, not thickened or reflected, its upper vertex starting at or sligthly above periphery of last whorl.

Dimensions (9 shells measured). Number of whorls 5 5/6 ± 2/7 (5 3/8-6 1/12); shell diameter 10.4 ± 0.5 mm (9.5-11.9); umbilicus diameter 1.3 ± 0.1 mm (1.1-1.5); height 4.2 ± 0.2 mm (3.8-4.7).



Figs. 23-25. Shells of *Oxychilus polygyra* from Rosazza (Rosazza, Biella), 32TMR25 (fig. 23) and Val Sassera, Grotta delle Tassere no. 2630 Pi/VC (Borgosesia, Vercelli), A. Casale leg. 16.IV.1983 (fig. 24). The former shell is the lectotype (Pollonera collection, Museo Regionale di Scienze Naturali di Torino, no. 120.1). A shell of *Oxychilus adamii* (fig. 25) from Val Seriana, Valle Asnina, 400-500 m (Cene, Bergamo), 32TNR6671, G. Comotti leg. 8.V.1982, for comparison.

Genitalia (figs. 26-30). General scheme of genitalia as in *Oxychilus adamii*, but due to the smaller size of *O. polygyra* the single parts are smaller (see table 1). The only difference between the two is the internal ornamentation of the proximal penis, which in *O. polygyra* consists of rows of variably large papillae, each with apical, cuticularized thorn (rows of very small papillae which lack apical thorn in *O. adamii*).

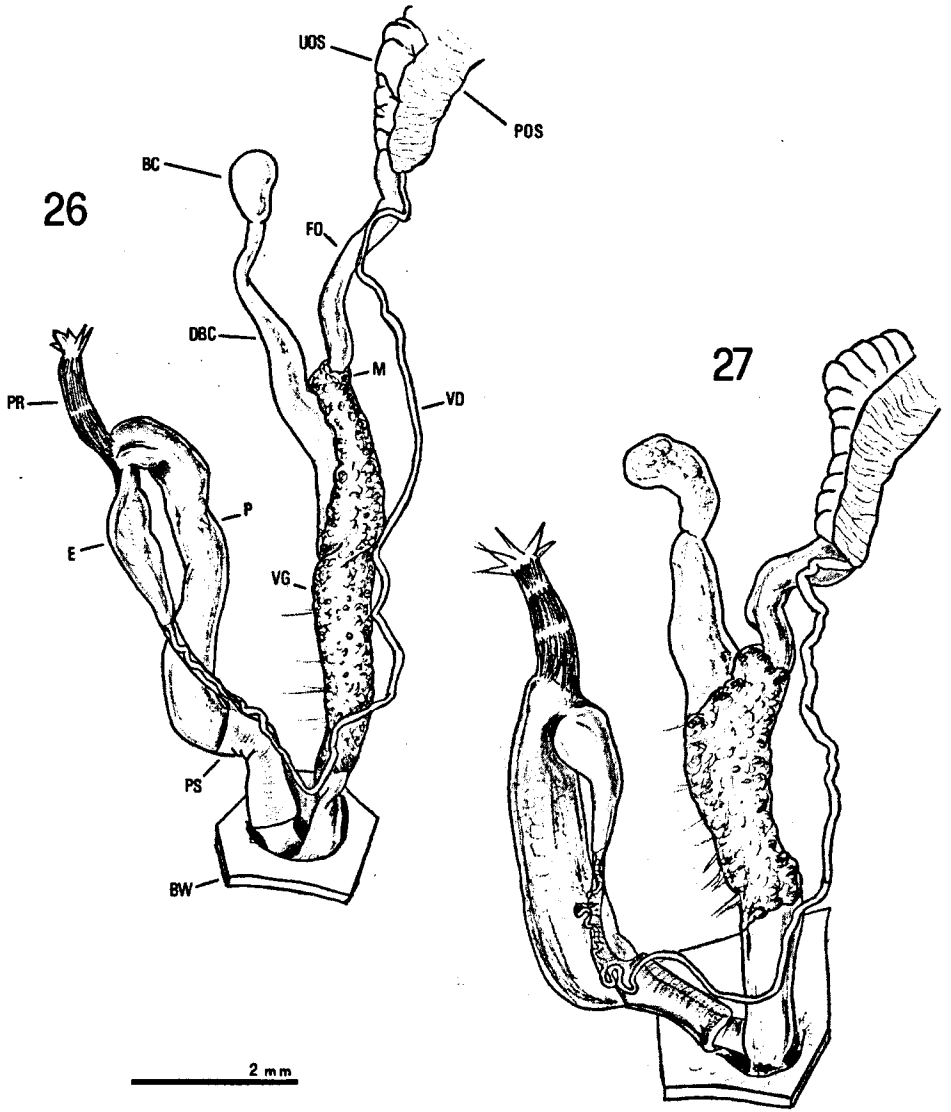
Radula (figs. 31-32). Similar to that in *O. adamii*, but smaller, consisting of many rows of about 35-37 teeth, with formula 14-15 M/1 + 3 L/3 + C/3 + 3 L/3 + 14-15 M/1. Central teeth with well developed basal plate, apical portion of which V-like with pointed vertices; basal plate providing base for short slender pointed mesocone flanked by two very short ectocones. On both sides of each central tooth there are three lateral tricuspid teeth followed by series of monocuspid marginal teeth in decreasing order of size.

Type material. — The type material of *Hyalinia polygyra* is in the Pollonera collection at the Museo Regionale di Scienze Naturali (Turin, Italy). It consists of eight syntypes, three from Montasinaro (MRSN no. 120.1-3) and five from Rosazza (MRSN no. 121.1-5). We designated one of the five specimens from Rosazza (MRSN no. 121.1) as lectotype (fig. 23). The type material of *Hyalinia oropaensis* is in the Westerlund and Paulucci collections (Westerlund credited his species to Paulucci). Two syntypes (juvenile shells) from "Ins. Marettimo" are in the Westerlund collection (no. 22) at the Naturhistoriska Museet (Göteborg, Sweden) (T. von Proschwitz, personal communication 8.XII.1997). According to A. Riedel, who studied them in 1971, they really belong to *O. polygyra*. Their collection site must therefore be erroneous. Ten other syntypes (MZUF nos. 13040 and 13739, one of which, no. 13040, has been designated as lectotype) from Oropa are in Paulucci collection at the Museo Zoologico de "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, (Florence, Italy).

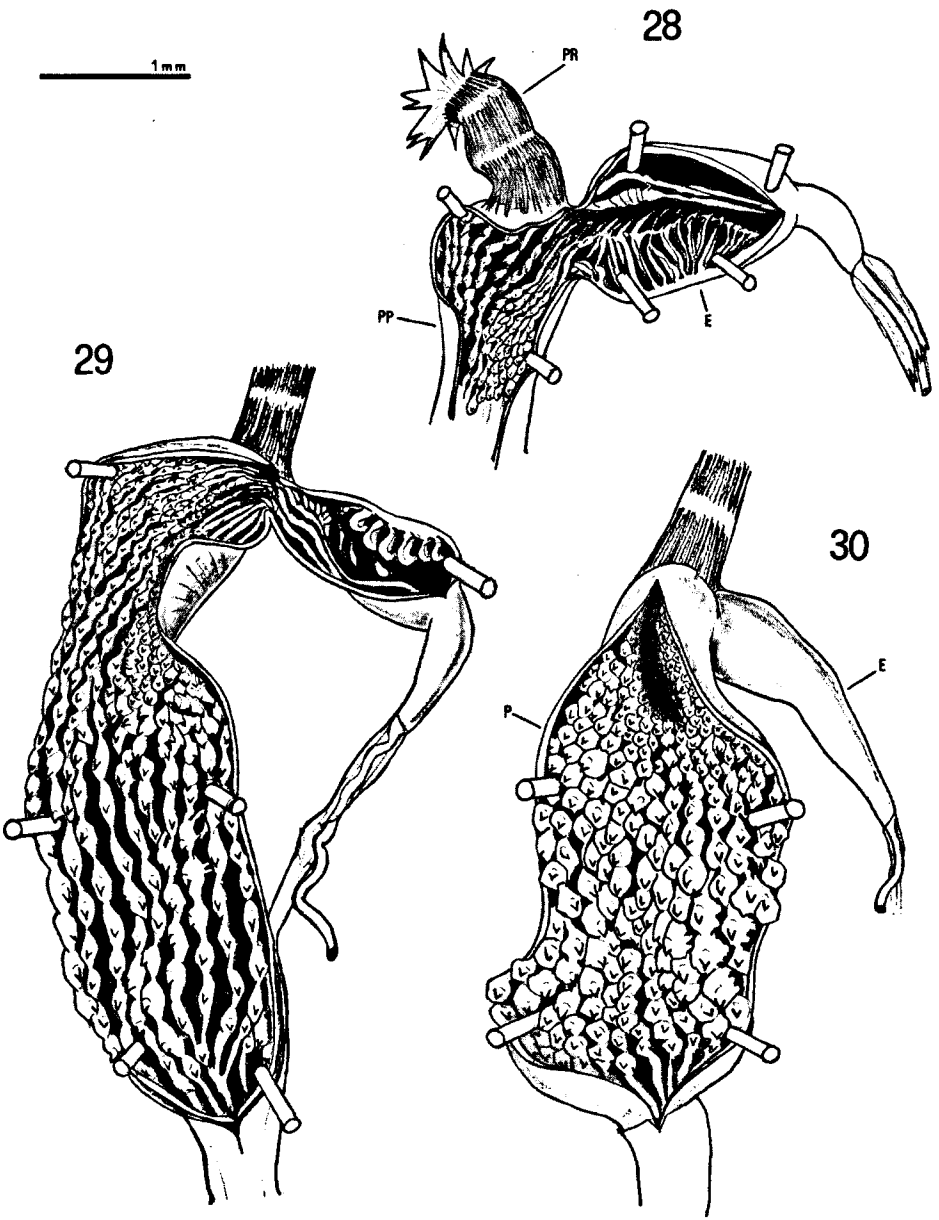
Type locality. — Following the designation of the lectotypes, the original type locality "Contorni di Rosazza in V. Cervo [environs of Rosazza, in Cervo Valley]" is restricted to Rosazza (Rosazza, Biella), 32TMR1959.

Material examined. — ITALY. 32TLR73) Bottegotto, 650 m (Locana, Torino), 32TLR73 (1 ss). 32TLR83) Ingria, 750 m (Ingria, Torino), 32TLR83 (4 ss, 1 sp). 32TLR84) Forzo, 1200 m (Ronco Canavese, Torino), 32TLR8141 (1 ss). 32TLR92) Valle dell'Orco, Grottina Boira Fusca no. 1573 Pi/TO, archaeological excavation SA1 206 Fmo (Courgné, Torino), 32TLR9329 (2 ss). 32TMR14) Netro (Netro, Biella), 32TMR1743 (1 ss, W. Fauer collection). 32TMR15) Pinchiolo (Rosazza, Biella), 32TMR1959 (5 ss, 1 ps; 2 ss, S. Cianfanelli Collection). 32TMR15-16) Montasinaro (Biella, Biella), 32TMR1959, 1960 (3 paralectotypes of *Hyalinia polygyra*, Pollonera collection, MRSNT no 121.1-3). 32TMR25) Oropa, around the sanctuary (Biella), 32TMR2053 (lectotype and 9 paralectotypes of *Hyalinia oropaensis*, Paulucci collection, MZUF nos. 13040 and 13739). Oropa (Biella), 32TMR2053 14.8.82 (6 ps). Bogna, 630 m (Qittengo, Biella), 32TMR25 (3 ss, S. Cianfanelli collection). Rosazza (Rosazza, Biella), 32TMR25 (lectotype and 4 paralectotypes of *Hyalinia polygyra*, Pollonera collection, MRSNT no. 120.1 and 120.2-5; 8 ss, S. Cianfanelli collection). SS no. 144, between Favaro and Hydrotherapy Spa (Biella), 32TMR2151 (1 ss, W. Fauer collection). 32TMR26) Alpe di Mera, La Sacca, 1300 m (Scopello, Vercelli), 32TMR2667 (1 ss). Piedimeggiana, 750 m (Piode, Vercelli), 32TMR2669 (1 ps). Pilone Covetta, 1150 m (Piode, Vercelli), 32TMR2568 (1 ss). 32TMR36) Val Sassera, Grotta delle Tassere no. 2630 Pi/VC (Borgosesia, Vercelli) (2 ss). 32TMR47) Val Sesia, turn-off for Civiasco (Biella), 32TMR4372 (1 ss, W. Fauer collection).

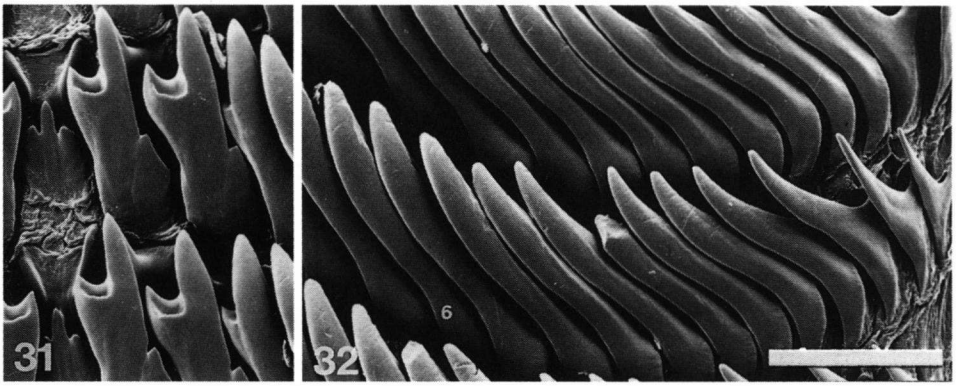
Taxonomy. — *Oxychilus polygyra* is easily distinguished from the other two Alpine



Figs. 26-27. Distal genitalia of specimens of *Oxychilus polygyra* from Oropa (Biella), 32TMR2053, A. Casale leg. 14.VIII.1982.



Figs. 28-30. Internal ornamentation of epiphallus (figs. 28-29) and penis (figs. 29-30) of specimens of *Oxychilus polygyra* from Oropa (Biella), 32TMR2053, A. Casale leg. 14.VIII.1982.



Figs. 31-32. Radula of a specimen of *Oxychilus polygyra* from Oropa (Biella), 32TMR2053, A. Casale leg. 14.VIII.1982. Scale bar 50 μm.

species assigned to the same subgenus/group, namely *O. adamii* and *O. depressus* by shell characters and internal ornamentation of proximal penis.

The shell of *O. polygyra* is smaller (SD 10.4 ± 0.5 mm) than that of *O. adamii* (SD 16.1 ± 1.0 mm; range 14.1-17.5 mm, n: 25) and has more whorls than that of *O. depressus* (NW 4 1/2-5, according to Kerney et al., 1983: 173).

Anatomically *O. polygyra* is distinct from *O. adamii* and *O. depressus* because the papillae which cover the initial portion of the proximal penis (near the opening of epiphallus into proximal penis) are larger and have an evident cuticularized apical thorn (in *O. adamii* the papillae covering the initial portion of the proximal penis are very small and without apical thorn; in *O. depressus* the internal wall of the proximal penis has initially rows of small polygonal papillae without apical thorn, and then irregular wavy pleats apparently formed by fusion of papillae, some of which have a slender hook-like apical thorn, fide Riedel, 1980: figs. 247-248).

No other European species, anatomically related to this group (see comments to *O. adamii*) can be confused with *O. polygyra*. Species with shells similar to *O. hydatinus*, namely *O. inopinatus*, *O. ionicus*, *O. pygmaeus*, and perhaps *O. subeffusus*, have small to very small whitish *Vitrea*-like shells with tightly coiled whorls and are no more than 7.5 mm in diameter (Riedel, 1966, 1969a, 1983; Riedel & Subai, 1978; Kerney et al., 1983). Those similar to *O. depressus* (*O. amaltheae*, *O. juliae*, and *O. mylonasi*, plus *O. montivagus* and *O. planorbis*) (if these two are not related to *Schistophallus*) are similar in size (apart from *O. juliae*) but are distinguished by an enlarged to very enlarged last whorl (Riedel, 1969a, 1983; Riedel & Subai, 1982; Kerney et al., 1983).

Among the Maghrebian species related to *Mediterranea* the *Allogenes* species, i.e. *O. cepedei*, *O. djurdjurensis*, *O. issericus*, and *O. prodigious*, are larger and have a very large last whorl angled at the periphery (Riedel, 1975: figs. 19-31, pl. 3 figs. 16-30). The *Pseudopolita* species, i.e. *O. eurabdotus* (Bourguignat, 1867), *O. gadeaui* (Germain, 1907) and *O. subplicatulus* (Bourguignat, 1864)), are similar in size to *O. polygyra* but are distinguished by a fine microsculpture consisting of regularly spaced, spiral rows of small tubercles (*O. eurabdotus* and *O. gadeaui*) or consisting of radial striae traversed by spiral lines and raised in the subsutural area to give a crenulated appearance (Riedel, 1975: figs. 1-9, pl. 1 figs. 1-9, pl. 2 fig. 13-14, pl. 4 figs. 31-40).

Oxychilus adamii								
Locality	**E**	**P**	**PP**	**DP**	**FO**	**DBC**	**VG**	**V**
Orrido di Bracca	3.6	9.2	7.4	1.8	5.1	5.4	5.1	1.1
Val Serina, km 27	3.9	10.8	9.8	1.0	6.2	4.5	6.1	0.9
Val Serina, km 27	3.9	14.0	10.9	3.1	5.3	4.6	5.1	1.9
Bus de la Volp	3.8	12.9	10.9	2.0	8.1	6.9	6.7	2.1
Val Serina, Valle Asnina	4.0	12.6	9.2	3.4	5.1	4.9	5.2	2.3
Val Serina, Valle Asnina	4.4	14.4	12.2	2.2	5.9	5.5	6.9	2.8
Val Serina, Valle Asnina	3.3	9.9	7.0	2.9	4.0	4.6	4.8	2.5
Val Serina, Valle Asnina	4.3	10.4	7.1	3.3	4.4	4.8	4.2	2.2
Val Serina, Valle Asnina	3.3	12.4	9.4	3.0	4.2	5.3	6.1	1.9
Rifugio Grem, 1300-1400 m	2.8	8.2	6.1	2.1	2.8	3.9	4.4	1.6
Mean and standard error	3.7 ± 0.5	11.5 ± 2.1	9.0 ± 2.0	2.5 ± 0.8	5.1 ± 1.4	5.0 ± 0.8	5.5. ± 0.9	1.9 ± 0.6
Range	2.8 - 4.4.	8.2 - 14.0	6.1 - 12.2	1.0 - 3.4	2.8 - 8.1	3.9 - 6.9	4.2 - 6.9	0.9 - 2.8

Oxychilus polygyra								
Locality	**E**	**P**	**PP**	**DP**	**FO**	**BCC**	**VG**	**V**
Oropa	1.8	5.7	4.3	1.4	1.8	2.6	4.0	1.4
Oropa	1.9	5.2	3.9	1.3	1.6	2.2	4.4	1.7
Pinchiolo	2.0	6.5	5.3	1.2	3.3	1.0	1.9	
Range	1.8 - 2.0	5.2 - 6.5	3.9 - 5.3	1.2 - 1.4	1.6 - 3.3	1.0 - 2.7	4.0 - 4.4	1.4 - 1.9

Table 1. Dimensions of some parts of the distal genitalia in specimens of *Oxychilus adamii* and *O. polygyra*. For localities, see Material examined. Acronyms: E epiphallus, P penis, PP proximal penis, DP distal penis, FO free oviduct, DBC duct of bursa copulatrix, VG vaginal gland, DV distal vagina (vagina free of the vaginal gland). For identification of the parts measured, see the anatomical description.

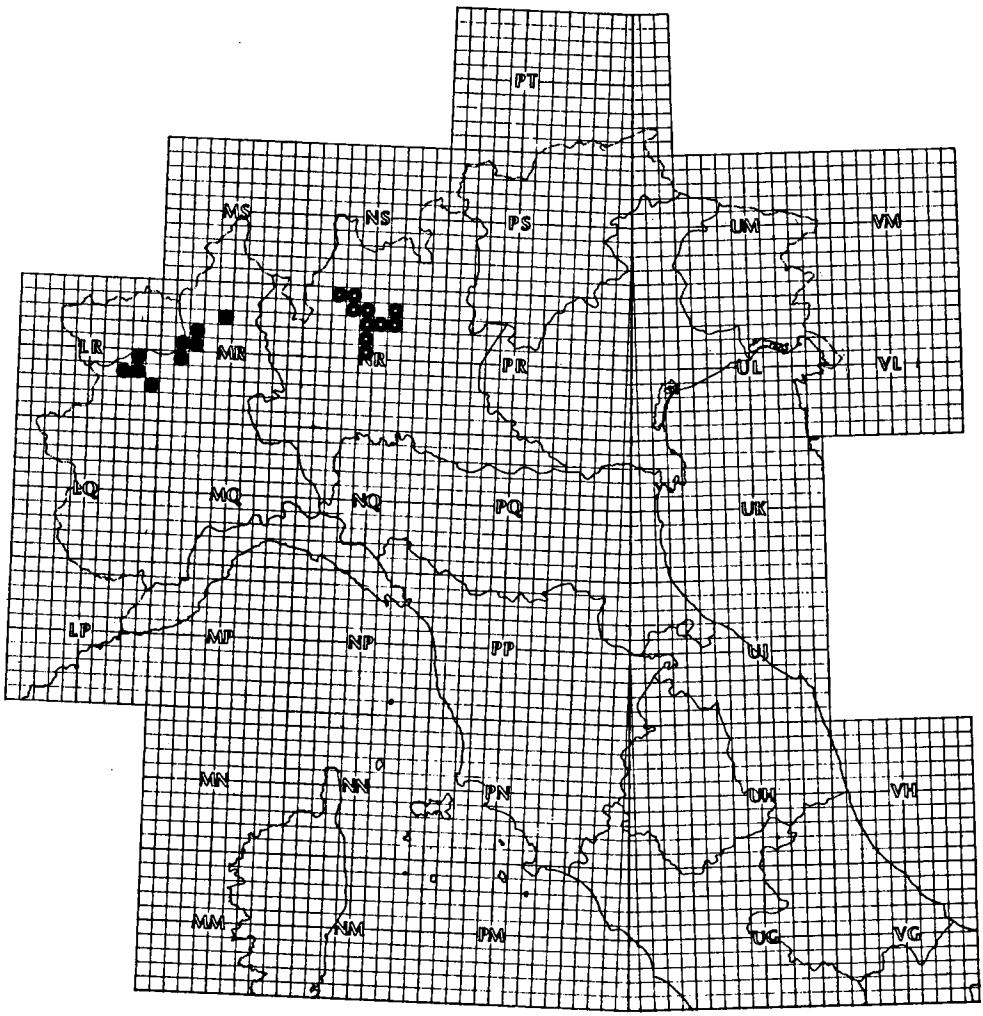


Fig. 33. Distribution of *Oxychilus polygyra* (full dots) and *O. adamii* (empty dots) on UTM map (10 x 10 km squares) in central-northern Italy.

Geographical distribution. — The species has a very narrow distribution, limited to a few valleys in Piedmont (fig. 33). The species is erroneously reported by Westerlund (1886) from Marettimo I., off western Sicily.

Status and conservation. — *O. polygyra* is not globally threatened. It has a limited distribution. It is apparently uncommon, because the number of specimens collected has always been small. However, it is not known to have declined with respect to the past or to be under any particular threat at present.

DISCUSSION

Oxychilus adamii and *O. polygira* are very close because they share a peculiar set of anatomical characters: (1) short epiphallus, about half the length of the penial sheath and penis, (2) internal ornamentation of the epiphallus consisting of a series of parallel, transverse, wrinkled crests on one side and a few long slender longitudinal pleats on the other, (3) absence of penial flagellum, (4) internal ornamentation of proximal penis walls consisting of papillae, a variable number of which with apical, cuticularized thorn, (5) distal penis very short and slender, (6) vaginal gland in form of a very thin, whitish or pale yellowish layer of spongy tissue covering a variable portion of the vagina and forming a muff of denser and intensely yellowish glandular tissue around the distal portion of the free oviduct. We do not treat them as subspecies of the same species because there are constant anatomical differences between them (ornamentation of the initial portion of the proximal penis).

At this point the most difficult problem remains, namely analysis of relationships of *O. adamii* and *O. polygyra* with the other species of *Oxychilus*. This requires a preliminary survey of the taxonomy of this genus.

Oxychilus is a large, speciose genus of the zonitids, currently split into many subgenera (see table 2). This picture mainly emerges from the work of three researchers: J. Thiele, L. Forcart and A. Riedel.

Thiele (1931: 592-593) started with the modern approach to the supraspecific taxonomy of *Oxychilus* Fitzinger, 1833. He split *Oxychilus* into two subgenera: *Oxychilus* (s.s.) (with five sections: *Oxychilus* s.s., *Allogenes*, *Conulopolita* Boettger, 1879, *Drouetia* Gude, 1911, and *Morlina* Wagner in Sturany & Wagner, 1914,) and *Schistophallus* (with three sections: *Schistophallus*, *Cellariopsis* Wagner, 1914, and *Stenorhachiodon* Lindholm, 1927).

Forcart (1957) made the first revision after Thiele, dividing *Oxychilus* into eight subgenera: *Oxychilus* (s.s.), *Ortizius* Forcart, 1957, *Eopolita* Pollonera, 1916, *Helicophana* Westerlund, 1886, *Schistophallus*, *Cellariopsis*, *Conulopolita* and *Morlina*. This involved moving *Eopolita* and *Helicophana*, regarded by Thiele (1931) as a subgenus of *Retinella* Fischer, 1877, and as a distinct genus respectively, to *Oxychilus*. Forcart also synynomized *Stenorhachiodon* with *Schistophallus* and, in line with the nomenclatural rules of his time, recognized only one category below the genus.

Shortly afterwards, as a consequence of further studies, *Eopolita* was regarded as a distinct genus (Riedel, 1957; Forcart, 1960) and other subgenera were introduced or came back into use: *Allogenes*, *Alzonula* Giusti, 1968, *Atlantoxychilus* Riedel, 1964, *Calloretinella* Haas, 1934, *Forcartiella* Riedel, 1966, *Hiramia* Pallary, 1939, *Hyalocornea* Monterosato 1892, *Hyalofusca* Monterosato 1892, *Longiphallus* Riedel, 1958, *Pontoxychilus* Riedel, 1970, *Pseudopolita*, *Radiolus* Wollaston, 1878, *Retowskiella* Riedel, 1966, and *Riedelius* Hudec, 1961 (Hudec, 1961; Riedel, 1958, 1962, 1964, 1966, 1970, 1973; Giusti, 1968).

Riedel (1980: 86-113) published a detailed survey which is the current standard reference for *Oxychilus* taxonomy; the only subsequent, accepted, change concerns *Pontoxychilus*, regarded as a junior synonym of *Retowskiella* by Riedel (1989).

The only criticism of the above system concerns the status of two subgenera, e.g. *Ortizius* and *Riedelius*. *Ortizius* was proposed as a junior synonym of *Oxychilus* (s.s.) by Manganelli & Giusti (1985) and Manganelli et al. (1991, 1995), and *Riedelius* as a junior synonym of *Mediterranea*, by Giusti et al. (1985) and Manganelli et al. (1995) respectively. As for the latter, Giusti et al. (1985) observed that its type species, *O. inopinatus*, was very similar to *O. hydatinus* which was, in its turn, the type species of *Mediterranea*. They therefore considered *Riedelius* a junior synonym of *Mediterranea*. Riedel (1990: 528-529)

agreed that *O. inopinatus* was very similar to *O. hydatinus* and that it was therefore a species of *Mediterranea*. Nevertheless, he claimed that *Riedelus* be conserved (by applying to the ICZN to set aside the original type species designation and to designate *O. depressus* as the new type species) for other species, originally included in this subgenus, which in his opinion were not related to *O. hydatinus*.

At present, no evidence exists that *Oxychilus*, as currently conceived, is a natural taxon. In fact, we failed to find even one synapomorphy supporting the monophyly of the genus. We examined various characters but not one is peculiar to *Oxychilus* or to the oxychiline zonitids. All *Oxychilus* species have a penial sheath (except for *Conulopolita*), an epiphallus (i.e. the widened muscular distal portion of the vas deferens), the penial retractor muscle inserted on the flagellum, or in the absence of the latter, in the area between the distal epiphallus and proximal penis, an oxychiloid shell (except for some species which have *Vitrea*-like shells), a mucous gland forming a muff around the proximal vagina, this muff frequently extending to cover the distal portion of the free oviduct and/or of the duct of the bursa copulatrix (except for *Conulopolita* and *Retowskiella*, which have this muff on the free oviduct). However, many other genera of non-oxychiline zonitids have one or more of these characters, whereas some oxychiline zonitids lack one or more of them. For example, *Zonites algirus* (Linnaeus, 1758) (Zonitini), has a scheme of the distal genitalia identical to that of most *Oxychilus* species, the only difference being that the penial retractor is inserted laterally on the flagellum. This may be due to the fact that at least some of these characters (penial sheath, vaginal gland, long epiphallus) are symplesiomorphies in *Oxychilus* s.l. and therefore support the monophyly of a larger group of taxa.

Natural groups identified by sets of anatomical characters some of which may be synapomorphies, may exist in *Oxychilus* s.l. These are '*Oxychilus*' (including *Alzonula*, *Atlantoxychilus*, *Calloretinella*, *Drouetia*, *Helicophana*, *Hyalocornea*, *Hyalofusca*, *Longiphallus*, *Ortizius*, *Oxychilus* s.s. and *Radiolus*: flagellum present; penial retractor inserted at apex of flagellum; internal ornamentation of penis consisting of pleats or pleats and rows of papillae; epiphallus long, usually as long as proximal penis, its internal wall with slender longitudinal pleats; mucous gland mainly vaginal; long mesocone of central tooth except in *Helicophana*); '*Mediterranea*' (including *Allogenes*, *Mediterranea*, *Pseudopolita* and '*Riedelius*': flagellum absent or very short; penial retractor inserted where epiphallus ends and proximal penis begins; internal ornamentation of penis consisting of pleats and rows of papillae, some of which or each of them with apical thorn; epiphallus short, its internal wall with series of transverse crests on one side and a few slender longitudinal pleats on the other; mucous gland forming muff of glandular tissue, denser and more intensely yellowish, around distal portion of free oviduct, only rarely extending as thin, whitish layer to cover part of surface of proximal vagina; short mesocone of central tooth); *Cellariopsis* Wagner, 1914 (flagellum present; penial retractor inserted at apex of flagellum, extending on one side as thin strand which inserts at apex of lateral outgrowth of proximal penis in which distal epiphallus opens; epiphallus long with small proximal comma-like diverticulum; distal epiphallus embracing proximal penis; mucous gland forming muff around proximal vagina and extending to cover distal third of duct of bursa copulatrix; long mesocone of central tooth); *Conulopolita* (penial sheath absent; flagellum absent; penial retractor inserted between distal epiphallus and proximal penis; penis with an internal U-like shaped crest and tongue-like structure; epiphallus very short and slender; mucous gland forming large muff around middle portion of free oviduct; short mesocone of central tooth); *Morlina* (flagellum present; penial retractor inserted at apex of flagellum; penis with internal series of thin pleats and tongue-like

structure; epiphallus long, its distal portion twisted around proximal penis; mucous gland mainly vaginal, rarely extending to cover site at which free oviduct and duct of bursa copulatrix branch; short mesocone of central tooth); and *Schistophallus* (flagellum absent; short penial diverticulum; penial retractor bifid, one branch inserted at apex of penial diverticulum, other at apex of lateral outgrowth of proximal penis, close to where epiphallus ends; internal ornamentation of penis consisting of pleats and rows of papillae, some with apical thorn; epiphallus long; mucous gland variable in shape and size: entirely vaginal or mainly vaginal, but extending to cover site at which free oviduct and duct of bursa copulatrix branch or forming muff which surrounds small portion of proximal vagina and which extends to cover most of free oviduct; short mesocone of central tooth).

Forcartiella, *Hiramia* and *Retowskiella* are more difficult cases. The former two subgenera include species with internal ornamentation of penis consisting of pleats and/or rows of papillae (some with apical thorn ?), long epiphallus, and variably shaped but mainly vaginal mucous gland. Some [*O. (F.) difficilis* (Boettger, 1888), see Riedel (1966: figs. 181-182), *O. (F.) euxinus* Riedel, 1989, see Riedel (1989: fig. 22), *O. (H.) cyprius* (Pfeiffer, 1847), see Riedel (1991: fig. 13), *O. (H.) paphlagonicus* Riedel, 1983, see Riedel (1993: figs. 6-8) and *O. (H.) syriacus* (Kobelt, 1878), see Riedel (1962: fig. 11)] have penial retractor more or less evidently bifid, one branch inserted at the apex of the flagellum, the other on the outgrowth of the proximal penis close to where the epiphallus ends, a disposition which recalls that of *Schistophallus*. In the absence of any other distinctive characters, *Forcartiella* and *Hiramia* may be regarded as related to *Schistophallus*. *Retowskiella* has a mucous gland forming a muff around the free oviduct, very similar to that of *Conulopolita*. *Retowskiella* and *Conulopolita* also share a penis with an internal U-like crest. Apart from other differences, these two characters might support the monophyly of this group of Anatolian-Caucasian species, with *Retowskiella* having more plesiomorphic characters than *Conulopolita*.

The artificiality of current *Oxychilus* taxonomy is also demonstrated by the difficulty of objectively assigning species to one subgenus or another. For example, why are *O. (Ortizius) lentiformis* (Kobelt, 1882) (see Riedel, 1969b: fig. 6), *O. (O.) tolmini* (Smith, 1905) (see Riedel, 1990: fig. 25) and *O. (O.) translucidus* (Mortillet, 1854) (see Riedel, 1989: fig. 7) not assigned to *Longiphallus*? Why are the Azorean *O. (Ortizius) lineolatus* Frias Martins & Ripken, 1991, and *O. (Radiolus) volutella* (Pfeiffer, 1856) assigned to different subgenera, when they share a very similar penial complex structure (for *O. lineolatus*, see Frias Martins and Ripken, 1991: fig. 5; for *O. volutella* see Riedel, 1964: figs. 35-36; Frias Martins & Ripken, 1991: fig. 7). Why are *O. oglasicola* Giusti, 1968, *O. spectabilis* (Morelet, 1860), *O. mavromoustakisi* (Haas, 1934), *O. aegopinoides* (Maltzan, 1883), *O. denatale* (Pfeiffer, 1857) and *O. volutella* (Pfeiffer, 1856) each assigned to distinct monotypic subgenera when they have the same organization of the distal genitalia as *Oxychilus* (s.s.)? The last question is easy, these species were assigned to distinct subgenera on the basis of their conchological divergence from the standard shell-type of *Oxychilus* s.l. This practice was justified in the context of the evolutionary taxonomic school, but is untenable today. In fact, it is well known that it hides obvious relationships between taxa. If this approach was consistently applied, anatomically aberrant species, such as *O. majori* (Westerlund, 1886), *O. gardinii* Manganelli, Bodon & Giusti, 1991, and *O. juliae* would be assigned to distinct subgenera.

O. adamii and *O. polygyra* share some of their diagnostic anatomical features (epiphallus short and wide with peculiar internal ornamentation; penial flagellum absent; papillae with apical thorn inside proximal penis; mucous gland forming muff of dense, yellowish

glandular tissue around distal portion of free oviduct) with the species of the subgenus '*Mediterranea*' s.l.

This set of characters might support the monophyly of these species, identifying them as members of a natural group, distinct from other natural groups inside *Oxychilus* as currently conceived, irrespective of minor differences in other characters, e.g. the flagellum, a highly variable structure in the zonitids, which is present, but very short in the *Mediterranea* species, in *O. (Pseudopolita) subplicatulus* and in *O. (Riedelius) pygmaeus*.

Other species of *Oxychilus* have some characters of the *Mediterranea* group., e.g. a short ephiphallus (*Conulopolita*), absence of the penial flagellum (*Conulopolita, Forcartiella, Schistophallus* and some *Retowskiella*), papillae with apical thorn inside the proximal penis (*Conulopolita, Forcartiella, Hiramia, Schistophallus* and some *Retowskiella*). However, they may not be closely related to '*Mediterranea*' s.l.. *Conulopolita* is distinct because the mucous gland is on the free oviduct, the penial sheath is absent and a tongue-like structure is present inside the penis. *Forcartiella, Hiramia* and *Schistophallus* are distinct by virtue of a long epiphallus. *Schistophallus* also has a clearly bifid penial retractor and a penial diverticulum. It is nevertheless impossible to establish the objective relations between these taxa without using a much needed cladistic approach to the zonitids.

The aim of this discussion was to point out the existence of a problem, not to provide an immediate solution to it. Table 4 indicates some tentative solutions which must be verified in the context of individual revisions of the taxa involved.

The group of species which is related to *O. adamii* and *O. polygyra* occurs in central southern Europe, Anatolia, Caucasus and the Maghreb. Their presence in Maghrebian northern Africa is not surprising and could be taken as further evidence of the migration of the Alpidic microplates which are said to have moved from the southern border of Europe to the northern border of the African macroplate in the Tertiary (Giusti & Manganelli, 1984).

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Riedel (1980)	Taxon	Type species	Number of species	Geographical distribution	Main references
p. 103	*Allogenes* Gude, 1911	*Vitrea prodigiosa* Ancey, 1899	4	Magreb (NW Africa)	Riedel (1975, 1980)
p. 101	*Alzonula* Giusti, 1968	*Oxychilus (Alzonula) oglasicola* Giusti, 1967	1	Montecristo I. (Tuscan Archipelago	Giusti (1968), Riedel (1980)
p. 96	*Atlantoxychilus* Riedel, 1964	*Helix atlantica* var. *spectabilis* Morelet, 1860	1	Santa Maria I. (Azores)	Riedel (1964, 1980)
p. 90	*Calloretinella* Haas, 1934	*Retinella (Calloretinella) mavromoustakisi* Haas, 1934	1	Cyprus I.	Riedel (1980, 1991)
p. 94	*Cellariopsis* Wagner, 1914	*Schistophallus (Cellariopsis) deubeli* Wagner, 1914	1	E Europe	Riedel (1980)
p. 108	*Conulopolita* Boettger, 1879	*Hyalinia (Conulopolita) raddei* Boettger, 1879	4	Caucasus	Riedel (1980,
p. 95	*Drouetia* Gude, 1911	*Helix atlantica* Morelet & Drouet, 1857	7	Azores	Riedel (1980), Frias Martins (1981, 1989, 1991), De Winter (1989)
p. 106	*Forcartiella* Riedel, 1966	*Hyalinia (Retinella) difficilis* Boettger, 1888	4	Turkey and Caucaus	Riedel (1980, 1989, 1995)
p. 92	*Helicophana* Westerlund, 1886	*Helix (Levantina) aegopinoides* Maltzan, 1883	1	Creta I.	Riedel (1980, 1990)
p. 93	*Hiramia* Pallary, 1939	*Hyalinia (Hiramia) renaniana* Pallary, 1939	5 - 6	E Mediterranean	Riedel (1980, 1991, 1993)
p. 100	*Hyalocornea* Monterosato, 1892	*Helix philippii* Aradas & Maggiore, 1840 sensu Montero	4 - 5	Sicily and perisicilian islands	Riedel (1980)
p. 102	*Hyalofusca* Monterosato, 1892	*Helix denatale* Pfeiffer, 1857	1	Marettimo I. (Egadi Is.)	Riedel (1980)
p. 91	*Longiphallus* Riedel, 1958	*Helix filicum* Krynicki, 1836	7 - 8	E Europe	Riedel (1980, 1989)
	Mediterranea Clessin, 1880	*Helix hydatina* Rossmässler, 1838	5 - 7	Euro-Mediterranean	Riedel & Subai (1982) Riedel (1983, 1984a, 1997), Giusti et al. (1985), Manganelli et al. (1995)
p. 107	*Morlina* Wagner in Sturany & Wagner, 1914	*Helix glabra* Rossmässler, 1835	3	Europe	Riedel (1980), Manganelli et al. (1990), Riedel & Maassen (1993)

p. 88	*Ortizius* Forcart, 1957	*Hyalina (Polita) helvetica* Blum, 1881	about 25-30	W Palearctic	Riedel (1980, 1990), Frias Martins & Ripken (1981), Giusti et al (1985), Manganelli & Giusti (1985), Altonaga (1986, 1990), Frias Martins (1989), Manganelli et al. (1991, 1995)
p. 98	*Oxychilus* Fitzinger, 1833	*Helix cellaria* Müller, 1774	about 10	W Mediterranean	Riedel (1980), Manganelli & Giusti (1993), Manganelli et al. (1991, 1995)
p. 103	*Pseudopolita* Germain, 1908		2	Magreb (NW Africa)	Riedel (1980)
p. 97	*Radiolus* Wollaston, 1878	*Helix volutella* Pfeiffer, 1856	1	Azores	Riedel (1980), Frias Martins & Ripken (1991)
p. 109	*Retowskiella* Riedel, 1966	*Hyalinia (Polita) crenimargo* Retwski, 1889	4 - 5	Turkey	Riedel (1980, 1984b, 1989, 1994, 1995)
p. 111	*Riedelius* Hudec, 1961	*Hyalinia inopinata* Ulicny, 1887	5	SE Europe	Riedel (1980, 1983, 1990), Giusti et al. (1985), Manganelli et al. (1995)
p. 104	*Schistophallus* Wagner, 1914	*Hyalinia (Retinella) oscari* Kimakowicz, 1883	14	SE Europe to Iran	Riedel (1980, 1981, 1990), Manganelli et al. (1990), Maassen & Riedel (1991), Riedel & Maassen (1993)

Table 2. Subgenera of *Oxychilus* according to Riedel (1980).

Taxon	Main references	Remarks
Oxychilus (Allogenes)		
Oxychilus cepedei (Dautzenberg, 1907)	Riedel (1975, 1980)	
Oxychilus djurdjurensis (Debeaux, 1863)	Riedel (1975, 1980)	Anatomically unknown.
Oxychilus issericus (Bourgignat, 1868)	Riedel (1975, 1980)	Anatomically unknown.
Oxychilus prodigiousus (Ancey, 1899)	Riedel (1975, 1980)	Anatomically unknown.
Oxychilus (Mediterranea)		
Oxychilus aliatahani Riedel, 1984	Riedel (1984a, 1995)	Anatomically unknown.
Oxychilus amaltheae Riedel & Subai, 1982	Riedel & Subai (1982)	
Oxychilus hydatinus (Rossmässler, 1838)	Forcart (1965), Riedel (1969a, 1980, 1983), Grossu (1983), Giusti et al. (1985), Varga (1986)	
Oxychilus ionicus Riedel & Subai, 1978	Riedel (1980), Riedel & Subai (1982)	
Oxychilus inopinatus (Ulicny, 1887)	Riedel (1959, 1969a, 1980), Damjanov & Likharev (1975), Grossu (1983)	
Oxychilus mylonasi Riedel, 1983	Riedel (1983)	
Oxychilus samsunensis (Retowski, 1889)	Riedel (1980, 1995)	Anatomically unknown.
Oxychilus (Ortizius)		
Oxychilus subeffusus (Boettger, 1879)	Riedel (1959, 1966, 1980), Akramowski (1976)	Although it is assigned to *Ortizius*, this species has the same organization of the distal genitalia as *O. hydatinus* (Rossmässler, 1838)
Oxychilus (Pseudopolita)		
Oxychilus eurabdotus (Bourguignat, 1867)	Riedel (1975, 1980)	

Oxychilus gadeaui (Germain, 1907)	Riedel (1975, 1980)	Anatomically unknown.
Oxychilus subplicatus (Bourguignat, 1864)	Riedel (1975, 1980)	This species was assigned to *Oxychilis* (s.s.) by Riedel (1975) (probably because it has a small flagellum), but it shares a small knob covered with thorned papillae in the distal penis, with the other Pseudopolita species.
Oxychilus (Riedelius)		
Oxychilus depressus (Sterki, 1880)	Riedel (1957, 1969a, 1980), Damjanov & Likharev (1975), Negrea (1975), Grossu (1983)	
Oxychilus juliae Riedel, 1990	Riedel (1990)	An anatomically aberrant species.
Oxychilus montivagus Kimakowicz, 1890	Riedel (1969a, 1980), Negrea (1975), Grossu (1983)	A species of uncertain affinity. Unlike other *Riedelius* species it has a long epiphallus, a long penis and a small penial diverticulum. It may be related to *Forcartiella/Schistophallus* species.
Oxychilus planorbis (Möllendorff, 1899)	Riedel (1969a, 1980)	Another species of uncertain affinity. Unlike other *Riedelius* species it has a long epiphallus, a long penis and a small penial diverticulum. It may be related to *Forcartiella/Schistophallus* species.
Oxychilus planospiroides Riedel, 1969	Gittenberger (1976), Riedel (1980)	A little anatomically known species.
Oxychilus pygmaeus Riedel, 1983	Riedel (1983)	One of the smallest *Oxychilus*.
Oxychilus serbicus Riedel, 1969	Riedel (1969a, 1980)	A species of *Cellariopsis?* It shares with *O. deubeli* (Wagner, 1915): a proximal epiphallus with diverticulum and a distal epiphallus embracing the proximal penis.

Table 3. Species of the current subgenera of *Oxychilus* which may be grouped into *'Mediterranea'*.

Taxon	F	PR	MG	IPP	CTM	Shell
Allogenes Gude, 1911	no	distal E	mainly on distal FO	papillae	short	carinated
Alzonula Giusti, 1968	yes	FA	mainly vaginal	papillae	long	carinated
Atlantoxychilus Riedel, 1964	yes	FA	mainly vaginal	papillae ?	long	scanalate at periphery
Calloretinella Hass, 1934	yes	FA	mainly vaginal	pleats?	long	normal
Cellariospis Wagner, 1914	yes	FA	mainly vaginal	?	long	normal
Conulopolita Boettger, 1879	no	between P and E	on FO	TLS	short	normal
Drouetia Gude, 1911	yes	FA	mainly vaginal	pleats	long	normal
Forcartiella Riedel, 1966	no	between P and E	mainly vaginal	papillae with thorns	short	normal
Helicophana Westerlund, 1886	yes	FA	mainly vaginal	?	short	carinated
Hiramia Pallary, 1939	yes	bifid: a branch on FA, the other between E and P	mainly vaginal	?	long	normal
Hyalocornea Monterosato, 1892	yes	FA	mainly vaginal	papillae	long	normal
Hyalofusca Monterosato, 1892	yes	FA	mainly vaginal	papillae?	long	normal
Longiphallus Riedel, 1958	yes	FA	mainly vaginal	pleats	long	normal
Mediterranea Clessin, 1880	yes / no	FA / between P and E	mainly vaginal but denser and yellower on FO	papillae with thorns	short	normal
Morlina Wagner in Sturany & Wagner, 1914	yes	FA	vaginal	TLS	short	normal
Ortizius Forcart, 1957	yes	FA	mainly vaginal	pleats	long	normal
Oxychilus Fitzinger, 1833	yes	FA	mainly vaginal	papillae	long	normal
Pseudopolita Germain, 1908	yes / no	FA / between P and E	mainly vaginal but denser and yellower on FO	papillae with thorns	short	normal
Radiolus Wollaston, 1878	yes	FA	mainly vaginal	pleats	long	normal
Retowskiella Riedel, 1966	yes / no	FA / between P and E	on FO	TLS and /or papillae with thorns	long	normal
Riedelius Hudec, 1961	no	FA / between P and E	mainly vaginal but denser and yellower on FO	papillae with thorns	short	normal
Schistophallus Wagner, 1914	no	bifid: a branch on FA, the other between E and P	mainly vaginal	papillae with thorns	short	normal

Table 4. Subgenera of *Oxychilus*, character state distribution and hypothesized taxonomic status. Acronyms: F flagellum, PR insertion of penial retractor, MG mucous gland, PP internal structure of proximal penis, CTM central tooth mesocone.

Autoapomorphies	Remarks	Tentatively proposed status
		Mediterranea / Oxychilus (Mediterranea)
		Oxychilus / Oxychilus (s.s.)
shell with scanalate periphery		*Oxychilus / Oxychilus* (s.s.)
shell with a small basal callus		*Oxychilus / Oxychilus* (s.s.)
PED	It shares a distal epiphallus embracing the proximal penis with *Morlina*.	*Cellariopsis / Oxychilus (Cellariopsis)*
PS absent, pallial tentacle	It shares: penial sheath absent and pallial tentacle with *Vitrinoxychilus*, mucus gland on the free oviduct with *Retowskiella* and TLS with *Morlina* and *Retowskiella*.	*Conulopolita*
umbilical callosity		*Oxychilus / Oxychilus* (s.s.)
	It shares long epiphallus and thorns with Schistophallus.	*Schistophallus / Oxychilus (Schistophallus)*
peristomal callosity		*Oxychilus / Oxychilus* (s.s.)
	Some of the *Hiramia* species have been assigned to *Schistophallus*.	*Schistophallus / Oxychilus (Schistophallus)* ?
		Oxychilus / Oxychilus (s.s.)
		Oxychilus / Oxychilus (s.s.)
		Oxychilus / Oxychilus (s.s.)
		Mediterranea / Oxychilus (Mediterranea)
	It shares a distal epiphallus embracing the proximal penis with *Cellariopsis* and TLS with *Conulopolita* and *Retowskiella*.	*Morlina / Oxychilus (Morlina)*
		Oxychilus / Oxychilus (s.s.)
		Oxychilus / Oxychilus (s.s.)
penial knob	Riedel (1975) assigned *O. subplicatus* to *Oxychilus* (s.s.) but this species shares characters with the *Pseudopolita* species.	*Mediterranea / Oxychilus (Mediterranea)*
		Oxychilus / Oxychilus (s.s.)
	It shares: mucous gland on free oviduct with *Conulopolita* and TLS with *Conulopolita* and *Morlina*.	*Conulopolita* ?
	O. juliae is an aberrant species; *O. montivagus* may belong to *Schistophallus* and *O. serbicus* to *Cellariopsis*.	*Mediterranea / Oxychilus (Mediterranea)*
PD	It shares with *Hiramia* the bifid PR.	*Schistophallus / Oxychilus (Schistophallus)*

Other acronyms: FA flagellum apex, FO free oviduct, E epiphallus, IPP internal proximal penis, P penis, PD penial retractor, PED diverticulum of proximal epiphallus, PS penial sheath, TLS tongue-like structure.

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