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Groundwater Oligochaetes from Southern-Europe. I. A new genus and three new species of Rhyacodrilinae (Tubificidae) with a redescription of *Tubifex pescei* (Dumnicka) comb. n.

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Keywords : Oligochaeta, Tubificidae, new species, groundwater, *Rhyacodrilus, Stochidrilus, Tubifex.*

Many Oligochaeta were collected during recent investigations in Southern-European caves. This is the first contribution in which some data concerning the Tubificidae are summarized. Three new species of Rhyacodrilinae, including a new genus, are described: *Rhyacodrilus omodeoi* n. sp., *Rhyacodrilus dolcei* n. sp., *Rhyacodrilus gasparoi* n. sp. and *Stochidrilus glandulosus* n. gen., n. sp. The poorly known species *Frearidrilus pescei* (Dumnicka 1981, augm. 1987) is redescribed on the basis of new material collected in Slovenian caves; this revision allowed the proposal to ascribe it to the genus *Tubifex,* considering the monospecific genus *Frearidrilus* as a junior synonym of *Tubifex.*

Les Oligochètes des eaux souterraines d'Europe méridionale. I. Un nouveau genre et trois espèces nouvelles de Rhyacodrilinae (Tubificidae) avec une redescription de *Tubifex pescei* (Dumnicka) comb. n.

Mots clés : Oligochaeta, Tubificidae, espèces nouvelles, eaux souterraines, *Rhyacodrilus, Stochidrilus, Tubifex.*

Une importante collection d'Oligochètes a été récoltée lors de prospections récentes de nombreuses grottes d'Europe méridionale. Dans cette première contribution à l'étude de ce matériel, trois espèces nouvelles de Rhyacodrilinae, dont l'une appartient à un genre nouveau, sont décrites : *Rhyacodrilus omodeoi* n. sp., *Rhyacodrilus dolcei* n. sp., *Rhyacodrilus gasparoi* n. sp. and *Stochidrilus glandulosus* n. gen., n. sp. *Frearidrilus pescei* (Dumnicka 1981, augm. 1987), espèce peu connue, est redécrite à partir de matériel nouveau récolté dans des grottes de Slovénie; cette révision a permis de proposer l'inclusion de cette espèce dans le genre *Tubifex;* le genre *Frearidrilus*, monospécifique, est donc considéré comme synonyme de *Tubifex.*

1. Introduction

Recent investigations of the groundwater fauna of many european caves (mainly of Italy and Slovenia) yielded several samples of aquatic oligochaetes placed at our disposal by F. Stoch (Museo di Storia Naturale di Trieste, Italy).

We are beginning the study of that interesting collection by the identification of the members of the family Tubificidae. Other taxonomical, as well as faunistic and ecological data on this and other families will be published later, when all the material will be identified. In this paper, we describe three new species of *Rhyacodrilus* and a new genus of *Rhyacodrilinae,* a well diversified subfamily of Tubificidae in subterranean waters (Juget & Dumnicka 1986, Giani & Rodriguez, 1988).

The study of new material of *Frearidrilus pescei* (Dumnicka) from a Slovenian cave allows us a redescription and a reappraisal of this species.

Unfortunately, tubificids are often scarce in caves and difficult to collect. So, very few specimens were at our disposal for the present study.

2. Material and methods

The material collected in different cave habitats was sampled with a hand net of 100 µm mesh size. The samples were fixed in the field with 4 % formaldehyde

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and stored in 70 % ethanol. The specimens were stained with Erlich's haematoxylin and either dissected under a stereo-microscope and then mounted in Canada Balsam on separate microscopic slides, or mounted whole in Canada balsam.

The type material is deposited in the Museo di Scienze Naturali, Trento, Italy (MTSN).

3. Description of species

3.1. *Rhyacodrilus omodeoi* n. sp. (Fig.1)

Holotype. N° MTSN OLI 1, 1 mature specimen, stained in haematoxylin, dissected and mounted in Canada balsam.

Paratype. N° MTSN OLI 2, 1 mature specimen, stained in haematoxylin, dissected and mounted in Canada balsam.

Other material. 8 immature specimens, mounted *in toto* in Canada Balsam.

Type locality. «Krizna Jama» (S. 65), Loz, Cerknica, Slovenia, 09-19-93, subterranean watercourse in Dezmanov Rov, leg. F. Stoch.

Etymology

Species named after Pietro Omodeo, to show gratitude to the professor who first initiate one of the authors (BS) to the study of oligochaetes, and in honour of his large contribution to the knowledge of Oligochaeta.

Description

Small species. Length 3.8-4.3 mm. Maximum width in anteclitellar region (slightly compressed specimens) 0.28 mm. Segments 37-40. Prostomium with rounded tip, 113-125 µm long, 107-137 µm wide at base. Tegument with irregular brownish spots of granular secretions, mainly in the middle and posterior regions. Clitellum extending over 1/2X-XII. In each dorsal bundle of the anterior region (including the clitellum and the

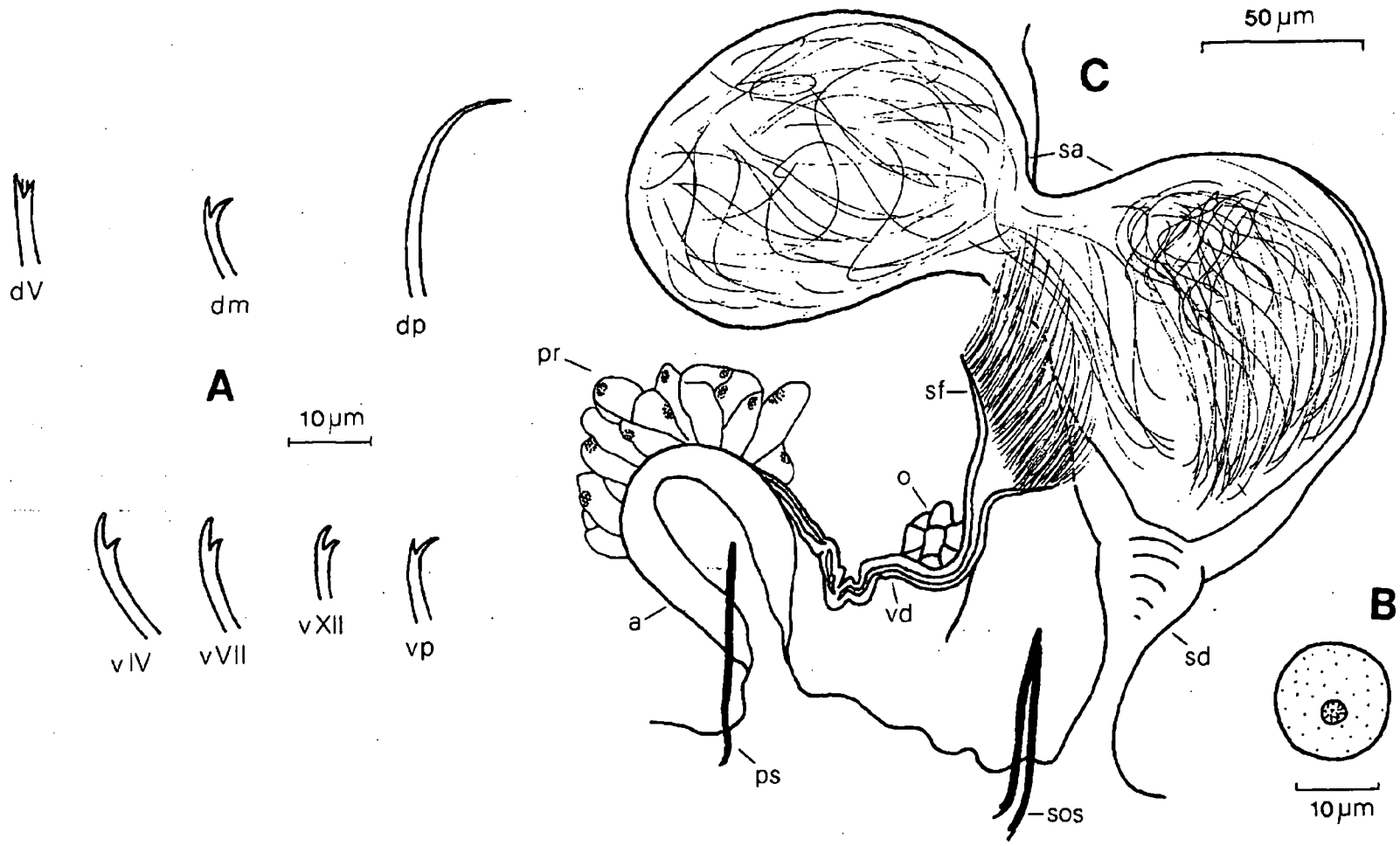

Fig.1. *Rhyacodrilus omodeoi* n. sp. A: somatic setae; B: coelomocyte; C: Lateral view of spermatheca and male genitalia in segments X-XI. a: atrium; dV : dorsal setae of segment V; dp : posterior dorsal setae; o: ovary; pr: prostat gland; ps: penial seta; sa: spermathecal ampula; sd: spermathecal duct; sf: sperm funnel; sos: somatic setae; vd: vas deferens; vIV: ventral setae of segment IV; vVII: ventral setae of segment VII; vXII: ventral setae of segment XII.

Fig.1. *Rhyacodrilus omodeoi* n. sp. A: soies somatiques; B: coelomocyte; C: Vue latérale de la spermathèque et de l'appareil génital mâle dans les segments X et XI. a: atrium; dV : soie dorsale du segment V; dp : soie dorsale postérieure; o: ovaire; pr: prostate; ps: soie pénienne; sa: ampoule de la spermathèque; sd: canal de la spermathèque; sf: entonnoir spermatique; sos: soie somatique; vd: canal déférent; vIV: soie ventrale du segment IV; vVII: soie ventrale du segment VII; vXII: soie ventrale du segment XII.

next three to five postclitellar segments) there are 1-2 finelly serrated hairs, maximum length 240 µm, and (1)2(3) bifid or pectinate crochets (intermediate teeth very fine and only occasionally observed at 1000x oil immersion and phase contrast), with distal and proximal teeth short, about equal in length and distal thinner; in the middle and posterior regions, there are (2) 3, 4, 5 (6) dorsal crochets, that became progressively curved at the distal end, and with distal tooth more and more reduced until it desappears in some crochets of medium-posterior bundles and in all crochets of posterior dorsal bundles; dorsal crochets length = 50-66µm. (4) 5, 6 (7) ventral setae per bundle in segments II-VIII, 1-4 in IX, 1-2 in X, 1 in XI (penial seta) and 3, 4, 5 (6) thereafter; all the anteclitellar setae have distal tooth thicker and 2-3 times longer than proximal; distal and proximal teeth are equal or distal only slightly longer in XII, then the distal become progressively thinner and shorter than proximal, and occasionally desappear; ventral setae length = 55-76 µm. Setae of medium and posterior ventral bundles are similar to the corresponding dorsal ones, but ventral simple pointed setae are much more unfrequent. In the youngest individuals observed (around 30 segments), the simple pointed setae are limited to the posterior dorsal bundles. The penial setae have the most typical shape in the genus; they are 70-75 µm long, straight in their proximal part (maximum width = 2.5µm), with a nodulus placed about 1/3.5 from the distal tip, the distal part faintly curved, and always (?) simple pointed end.

Chloragogen cells from septum V/VI. Coelomocytes abundant, sphaeric, with a clearly visible central nucleus; 7-14 µm in diameter. Pharyngeal glands present in III, IV, V and VI.

One pair of testes in segment X. One pair of ovaries in segment XI. In the holotype a well developed anterior seminal vesicle attempts the septum IV/V, and a large ovigerous sac enters segment XVII.

Male pores in the middle-anterior part of XI, in line with ventral setae, close to the penial ones. Atria small, sphaeric or slightly ovoid, 40-47 µm wide and 60-68 µm long, with walls 8-14 µm thick, and only the distal half covered with a dense layer of pearshaped prostatic cells; there is no a well defined ejaculatory duct. Vasa deferentia 90-120 µm long, 5-13 µm wide, penetrating into the distal part or the atria, in anterior side.

Spermathecal pores in X, near the septum IX/X, in line with ventral setae. Each spermatheca is composed of a short duct dilating into a large thin-walled ampulla, 110-122 µm wide, 240-315 µm long, entering in XI or XII; it contains compact masses of spermatozoids.

Discussion

Rhyacodrilus is a large genus, where *Rhyacodrilus omodeoi* n. sp ranges among a little group of species having some dorsal simple pointed crochets: *R. altaianus* Michaelsen, 1935, *R. lindbergi* Hrabe, 1963 and *R. amphigenus* Juget, 1987. *R. altaianus*, from the Central Altai, with its long hair-like penial setae and long tubular atria is a species quite apart in the genus.

The genital apparatus of *R. lindbergi*, described from a single specimen of a cave in Portugal (Hrabe 1963) is poorly known but it seems closely resembling to that of the new species except for the penetration of the spermathecal ampullae into posterior segments observed in *R. omodeoi* n. sp. and not mentioned for *R. lindbergi*. The new species has only 1 penial seta per bundle instead of 2 (undescribed) for *R. lindbergi*. According to Hrabe (op. cit.), the lower tooth of the anterior ventral setae of *R. lindbergi* from segment 4 up to the posterior end of the body is much longer than the upper one, whereas in *R. omodeoi* n. sp. (including the immature individuals) the distal tooth of all ventral setae from II to X is always 2-3 times longer than the proximal. Simple pointed crochets are present in all postclitellar dorsal bundles of *R. lindbergi* but absent in the first segments following the clitellum of *R. omodeoi* n. sp. Pectinate setae are absent in the anteclitellar dorsal bundles of *R. lindbergi* and present in at least some bundles of the new species (the absence of intermediate teeth could be only apparent as a result of technical problems). Hair setae are present in some postclitellar dorsal bundles of the new species, whereas they are limited to the anteclitellar region in *R. lindbergi*. Finally *R. lindbergi* is devoid of the well visible spots of glandular secretions in the tegument and it seems to be a larger species than *R. omodeoi* n. sp.

R. amphigenus, described from the alluvial plain of the river Rhône, France (Juget 1987) although devoid of visible glandular secretions on the tegument, is also closely related to the new species. The dorsal crochets with rudimentary upper tooth or even simple pointed are already present from the clitellum as in *R. lindbergi*. All posterior ventral crochets have distal tooth as long as lower in *R. amphigenus* whereas it is shorter or even occasionaly absent in *R. omodeoi* n. sp. Penial setae of both species are quite similar in shape and length, but those of *R. amphigenus* are two times thicker. The conspicuous setal glands of *R. amphigenus* are lacking on *R. omodeoi* n. sp. The spermathecae of the new species and those described for *R. amphigenus* Juget (1987 p. 111, Fig. 4) appear quite different in shape and size, but it seems that the latter were not fully developed. Finally, the more reliable differences bet-

ween *R. amphigenus* and *R. omodeoi* n. sp. lie on the male apparatus. Thus, the size of the atria of *R. amphigenus* are about twofold the new species; they are piriform instead of sphaerical or slightly ovoid, their prostate layer is not limited to the distal half, and finally, the vas deferens is said to penetrate the posterior atrial wall instead of the anterior wall as it is common in the genus and it is the case in the new species.

The presence of simple pointed crochets in many dorsal bundles and in some ventral bundles, the marked difference between distal tooth of anterior and posterior ventral setae (distal can even disappear in the most posterior segments) and the penetration of the spermathecae in segment XI could be considered as diagnostic features for this new species. These characteristics are associated with other interesting ones, limited to a little number of other *Rhyacodrilus* species, such as a unique penial seta in each bundle, small subsphaerical atria covered in its distal half by a dense layer of prostatic cells, absence of well defined ejaculatory ducts or presence of glandular spots on the tegument.

Distribution and habitat

Only known from the type locality, a cave in Slovenia. Underground water course.

3.2. *Rhyacodrilus dolcei* n. sp. (Fig. 2)

Holotype. N° MTSN OLI 3, 1 mature specimen, stained in haematoxylin, dissected and mounted in Canada Balsam.

Type locality. «Grotta del Carbone» (VG 2689), Pese, San Dorligo della Valle, province of Trieste, Italy, 01-20-95, leg. S. Dolce.

Etymology

Named in honour of Sergio Dolce who collected the species.

Description

Small species (incomplete specimen), at least 28 segments, more than 4 mm in length. Width in segment V: 0, 21 mm (slightly compressed specimen). Prostomium conical, as long as broad at its base, 110 µm. Clitellum weakly developped, extending over X-XI.

Each dorsal bundle of the examined anterior part, including those of segments X and XI, with 1 (rarely 2) hairs, maximum length 300 µm, and only 1 pectinate crochet, with widely diverging equal lateral teeth (intermediate teeth very fine), on segments II, III, IX and the following ones; 2 pectinate crochets on segments IV to VIII; in the postclitellar region pectinate crochets

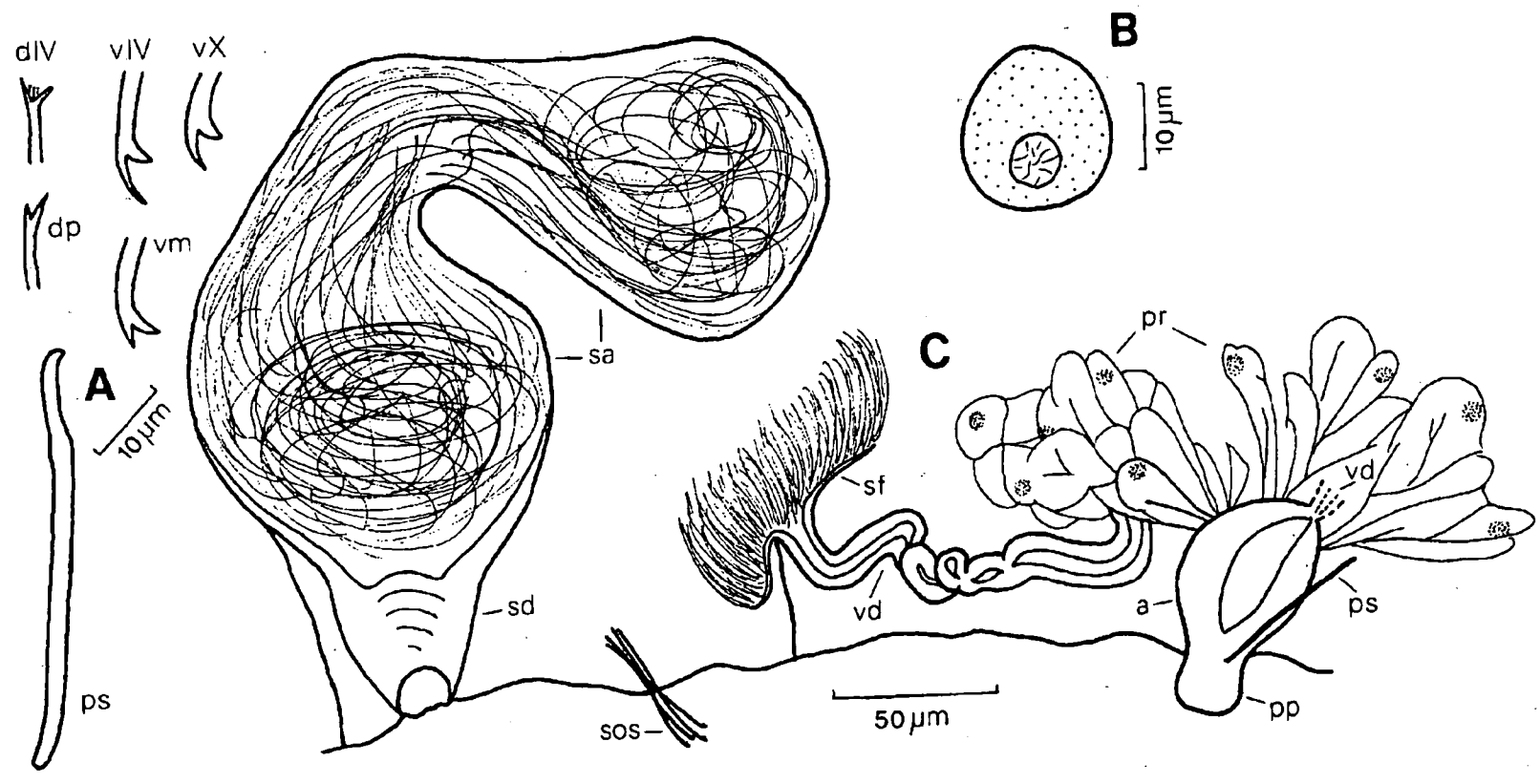

Fig .2. *Rhyacodrilus dolcei* n. sp. A: somatic and penial setae; B: coelomocyte; C : Lateral view of spermatheca and male genitalia in segments X-XI. vp: posterior ventral setae; dIV : dorsal setae of segment IV; vX: ventral setae of segment X; vm : ventral setae of the middle part of the body; others abreviations as in Fig. 1.

Fig .2. *Rhyacodrilus dolcei* n. sp. A: soies somatiques et soie pénienne; B: coelomocyte; C : Vue latérale de la spermathèque et de l'appareil génital mâle dans les segments X et XI vp: soie ventrale postérieure; dIV : soie dorsale du segment IV; vX : soie ventrale du segment X; vm : soie ventrale de la région moyenne du corps; pour les autres abréviations voir Fig. 1.

replaced by 1-2 dorsal crochets with upper tooth thinner and shorter than lower; dorsal crochets length about 66 µm. 4(3) ventral setae per bundle in preclitellar segments and segment X, and 3 in the postclitellar segments; all the anteclitellar setae have distal tooth 2-3 times longer than proximal; in the first postclitellar segments distal tooth equal to the proximal one; in the following segments the upper tooth becomes progressively thinner and shorter than proximal; ventral crochets 60-75 µm length. Penial setae in XI, single in each bundle, close to the male pore, with the typical shape in the genus and simple pointed with a blunted tip.

One pair male pores on the middle part of the segment XI, in line with ventral setae; one pair spermathecal pores in line with ventral setae in the anterior part of the segment X near the septum IX/X.

Chloragogen cells from septum IV/V. Coelomocytes abundant, sphaeric, with a clearly visible central nucleus and granulated; about 18 µm in diameter. Pharyngeal glands present in IV, V and VI.

One pair of testes in segment X. One pair of ovaries in segment XI. Anterior seminal vesicle in segment IX, posterior one in segment XI. Egg sac not observed.

Atria very small, ovoid, 35 µm wide and 53 µm long, with wall 8-13 µm thick, ending in a short pseudopenis. Distal half of atria covered with a dense mass of pearshaped prostatic cells disposed in several tuft. Vasa deferentia about 280 µm long, maximum 13 µm wide , penetrating into the distal part of the atria (junction with atria not clearly visible).

Spermatheca well developed and composed of a very short duct (35 µm long) dilating into a large thin-walled ampulla, 100 µm wide, 390-420 µm long. Lumen of the ampulla entirely filled with a compact mass of spermatozoids. One of the two spermathecae penetrates into segment XI.

Discussion

Rhyacodrilus dolcei n.sp. belongs to a group of small *Rhyacodrilus* species with very small atria, dorsal hair and pectinate setae, without simple pointed somatic setae and devoid of modified spermathecal setae. *Rhyacodrilus dolcei* n.sp is closely related to *R. sketi* Karaman, 1974 and *R. okamikae* Giani & Rodriguez, 1988. The last species is well separated from the other two species quoted above by the presence of an unpaired median spermatheca. *Rhyacodrilus dolcei* n.sp is clearly separated from *R. sketi* mainly by its larger spermathecae, the smaller size of its atria, the presence of pseudopenes, length of vas deferens and the shape of the prostate gland (pedunculated in *R. sketi* and not clearly of the rhyacodriline type). Unfortunately we were not able to borow the type material of *R. sketi* for a full comparison.

Distribution and habitat

Only known from the type locality, a cave in northern Italy. Gours in the percolating zone of the cave.

3.3. *Rhyacodrilus gasparoi* n. sp. (Fig.3)

Holotype. N° MTSN OLI 4, 1 mature specimen, stained in haematoxylin, dissected and mounted in Canada Balsam.

Type locality . «Grotta di Montefosca» (Fr 1649), Torreano, province of Udine, 03-16-1986. leg. F. Gasparo, F. Stoch.

Etymology

Named in honour of Fulvio Gasparo, one of the collectors of the species.

Description

Worm incomplete, broken at segment 30, more than 4 mm long; maximum width in anteclitellar region (slightly compressed specimens) 0.27 mm. Prostomium rounded, 92 µm long, 100 µm wide at base. Tegument finely wrinkled. Anterior segments with a weak secondary annulation. Clitellum extending over 1/2X-XII. All dorsal bundles composed of 1, 2 hair setae (maximum length: 150 µm) and 1, 2 crochets (40-50 µm long); anterior dorsal crochets bifid or pectinate (intermediate teeth very fine and only occasionaly observed in some anterior bundles at 1000x oil immersion and phase contrast), with distal and proximal teeth about equally long and distal sligthly thinner; distal tooth becoming shorter and clearly thinner than proximal in posterior bundles. (3) 4, 5 ventral setae per bundle in anteclitellar segments, 1 modified spermathecal seta in X, (1?)2 modified penial setae in XI and 2, 3 somatic setae thereafter; all somatic ventral setae are bifid crochets, 42-60 µm long; teeth in anteclitellar region are about equally wide, distal 1.3-1.5 longer than proximal; thereafter distal teeth become weaker and equal or slightly shorter than proximal.ones. Spermathecal setae strongly curved at base, bifid, with teeth widely divergent, distal about 2.5 longer than proximal, total length about 50 µm; these setae are associated with a well developed setigeral gland (63-65 µm high, 41-45 µm wide). Penial setae of the most typical shape in the genus; they are about 58 µm long, straight in their proximal part (maximum width = 2.3 µm), with a nodulus placed about 1/3.5 from the distal tip, distal part curved, and with simple or bifid (?) end.

Chloragogen cells from septum IV/V. Coelomocytes with a clearly visible central nucleus, abundant, sphaeric when isolated, and poligonal when concentrated in great masses, which are abundant in anterior segments;

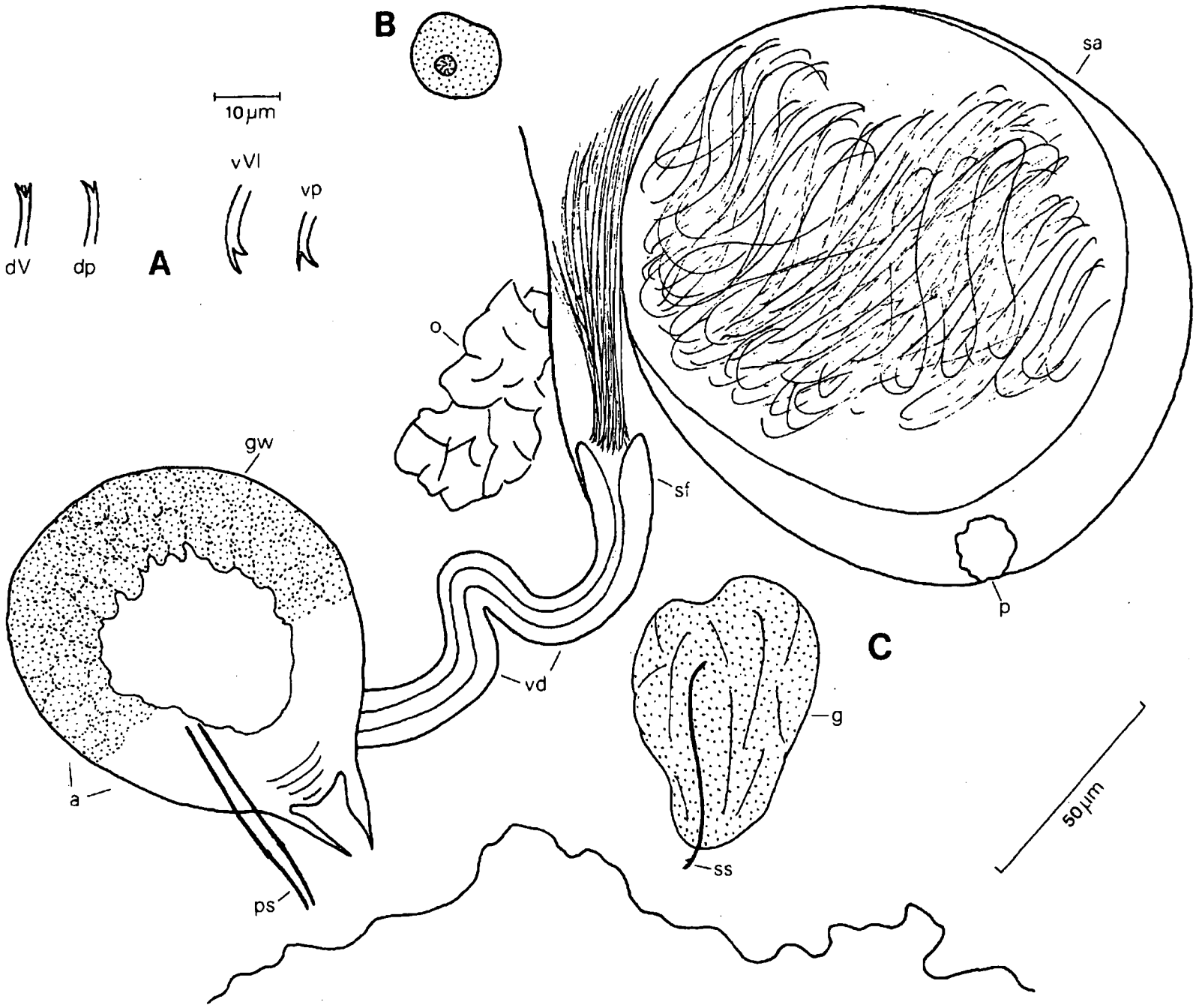

Fig. 3. *Rhyacodrilus gasparoi* n. sp. A: somatic setae; B: coelomocyte; C. Lateral view of spermatheca and male genitalia in segments X-XI. g: gland; p: spermathecal pore; vVI: ventral setae of segment VI; ss: spermathecal setae; others abreviations as in Fig. 1.

Fig. 3. *Rhyacodrilus gasparoi* n. sp. A: soies somatiques; B: coelomocyte; C: Vue latérale de la spermathèque et de l'appareil génital mâle dans les segments X et XI. g: glande; p: pore de la spermathèque; ss: soie spermathécale; vVI: soie ventrale du segment VI; pour les autres abréviations voir Fig. 1.

10-18 µm in diameter. Pharyngeal glands small, present at least in IV, V and VI.

One pair of testes in segment X. One pair of ovaries in segment XI. An anterior seminal vesicle attempt the septum VI/VII.

Male pores in the middle part of XI, in line with ventral setae, just anterior to the penial ones. Atria subsphaeric (92 µm high, 81-82 µm wide), with a large glandular distal wall (about 20 µm wide) and surrounded by a thin muscular layer (1.3-2.8 µm wide); no external prostate glands have been observed; there is not a well defined ejaculatory duct but a small invagination of the tegument comunicating with the sphaeric glandular atria by a small round pore. Vasa deferentia 123-127 µm long, 10-14 µm wide, penetrating into the ectal part of the atria, in anterior side.

Spermathecal pores in X, ventro-lateral, near the septum IX/X, clearly separated from the spermathecal setae. The spermathecae are completly devoid of duct, subsphaeric in shape (diameter: 130-147 µm), with walls thick at base and very thin thereafter; they contain a compact mass of spermatozoids.

Discussion

The absence of external prostatic cells over the atria, the presence of spermathecal setae and its developed associated glands, the absence of spermathecal ducts and the lateral position of the spermathecal pores are the most singular characters of *Rhyacodrilus gasparoi* n. sp.

Pending to a largely needed clarification in the taxonomy of the Rhyacodrilinae, and specially in the aprostatic species assemblage, we tentatively include this new species in the large genus *Rhyacodrilus*. After the inclusion of *Rhyacodrilus billabongus* Brinkhurst, 1984 and *R. lutulentus* Erséus, 1984 in the genus *Ainudrilus* Finogenova, 1982 (Erséus 1986), only two aprostatic rhyacodriline species are included in the genus *Rhyacodrilus, R. simplex* Benham, 1903 and *R. fultoni* Brinkhurst, 1982. These two species for which the ancient name *Taupodrilus* Benham, 1903 could be reestablished (Brinkhurst 1982, Erséus 1984, Brinkhurst & Wetzel 1984, Erséus 1986) are devoid of spermathecal setae and their associated large glands; they have spermathecal ducts, and their spermathecal pores are in line with ventral setae; *R. fultoni* lacks capillar and pectinate setae, but its atrial structure (unknown in *R. simplex*) could be a synapomorphy relating it to *R. gasparoi* n. sp. There could be also an important phylogenetical relationship within these species and the genus *Epirodrilus* as previously suggested by Giani & Martínez-Ansemil (1983).

The presence of spermathecal setae in the genus *Rhyacodrilus* was already known in *R. tauricus* Dembitsky, 1975, *R. svetlovi* Sokolskaya, 1976, *R. carsticus* Kosel, 1980, *R. gernikensis* Giani & Rodrigez, 1988 and *R. ardierae* Lafont & Juget, 1993, but the well developed glands associated with these setae in the new species seems to be unique in the genus *Rhyacodrilus*, although common in *Rhizodrilus* Smith and *Protuberodrilus* Giani & Martinez-Ansemil, other genus of Rhyacodrilinae. Apart from this, several other important characters clearly separate *R. gasparoi n.* sp. from all these species. Unlike *R. gasparoi* all these species have well developed external prostatic cells over the atria, spermathecal pores in line (or only slightly more lateral) with the ventral setae, all but *R. tauricus* have a well defined spermathecal duct, there is no capillar and pectinate setae in the dorsal bundles of *R. carsticus, R. gernikensis* and *R. ardierae*, the vas deferens enters apically the atrium in *R. svetlovi* and its posterior wall in *R. tauricus*, etc.

Distribution and habitat

Only known from the type locality, a cave in northern Italy, in a small rivulet.

3.4. *Stochidrilus* n. gen.

Type species: *S. glandulosus* n. sp.

Etymology. Stoch-: in honour of Fabio Stoch who collected this species and loaned the collection to the authors; *-drilus*: worm in latin.

Diagnosis

Small subterranean freshwater tubificids. Dorsal hair setae present. Dorsal anterior crochet pectinated, posterior simple pointed with strongly curved tips. Ventral somatic setae sigmoid with bifid tips. Spermathecal setae present in X. Penial setae in XI sigmoid, simple pointed and with strongly curved tips. Genital setae associated with glandular cells mass.

Granulated coelomocytes present. Atria elongate, with transparent vacuolisated walls. Prostate gland absent. Non glandular vas deferens entering atria ectally but not apically. Penes absent. Spermathecae paired in X with a short, thick walled duct and a large sphaeric thick-walled ampulla.

Stochidrilus glandulosus n. sp. (Fig. 4)

Holotype. N° MTSN OLI 5, 1 incomplete mature specimen (broken at XII/XIII), stained in haematoxylin, dissected and mounted in Canada Balsam.

Type locality. Virsnica (S. 571), V. Racna (Grosuplje), Radensko Polje, Slovenia, 08-24-1995, leg. F. Gasparo, F. Stoch.

Other material. 1 immature incomplete specimen (broken at XXVII), mounted *in toto in* Canada Balsam.

Etymology

The specific name, *glandulosus*, is related to the characteristic glands located close to the genital setae.

Description

Small species. Maximum width in anteclitellar region (slightly compressed specimens) 0.25 mm. Prostomium somewhat pointed, 107 µm long, 103 µm wide at base. Tegument with irregular brownish spots of granular secretions, mainly in the middle and posterior region. Clitellum extending over 1/2X-XI. 1-2 smooth hairs per bundle from II to XVII, maximum length 370 µm; (1)2(3) dorsal crochets per bundle all along the body, finelly pectinate and with equal external teeth in the most anterior bundles, bifid with distal tooth progressively reduced in the middle region and simple pointed and strongly curved in the posterior one; dorsal crochets length in the anterior region= 60-80µm. (3) 4, 5 ventral setae per bundle in segments II-IX, 1 in X (spermathecal setae), 1-2 in XI (penial setae) and 2 thereafter (observed only in the immature individual, having 3 setae in the anterior region); all the somatic

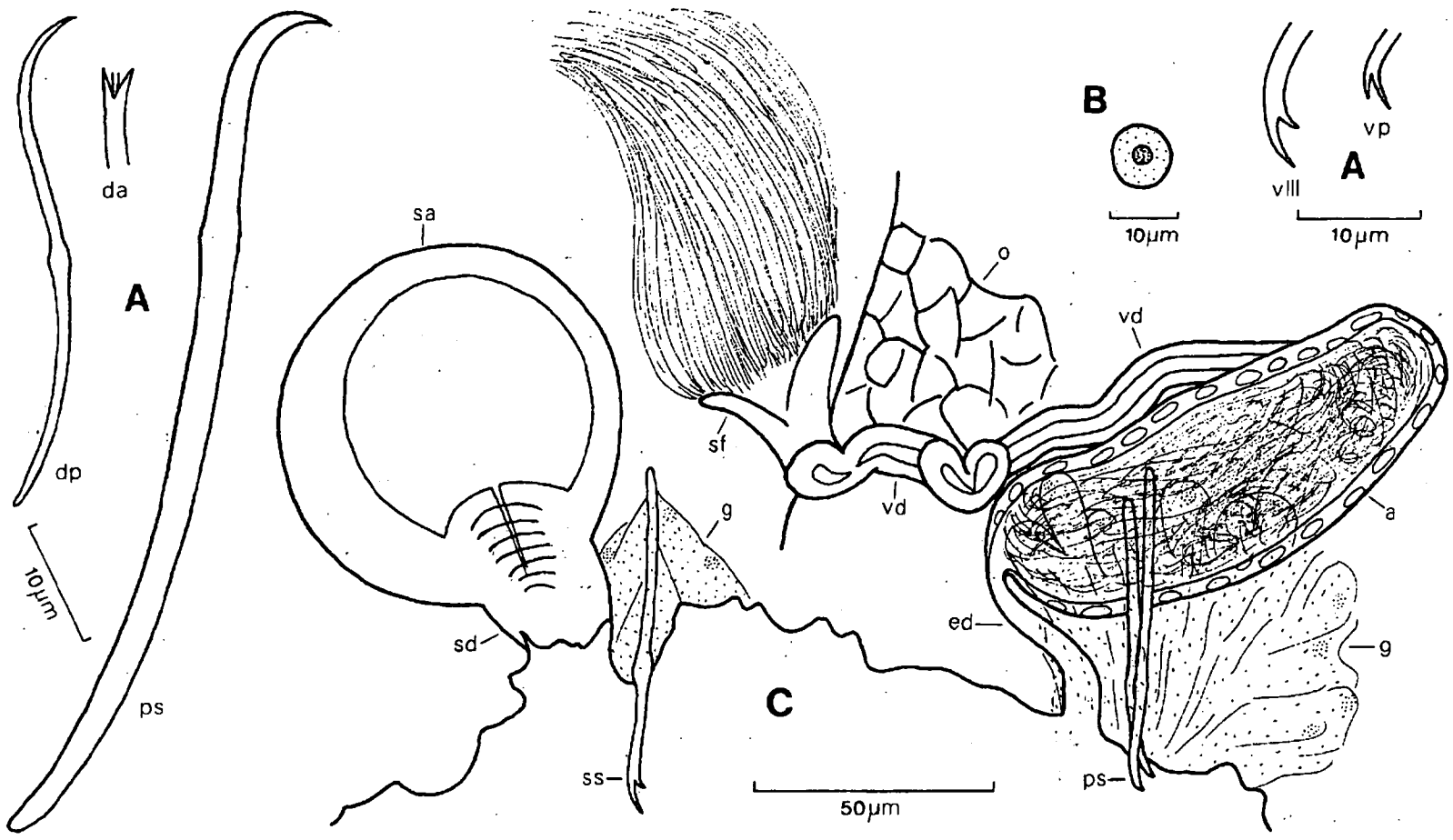

Fig. 4. *Stochidrilus glandulosus* n. gen., n. sp. A: somatic setae; B: coelomocyte; C: Lateral view of spermatheca and male genitalia in segments X-XI. da: anterior dorsal crochet; ed : ejaculatory duct; va: anterior ventral setae; vIII: ventral setae of segment III; others abreviations as in Fig. 1.

Fig. 4. *Stochidrilus glandulosus* n. gen., n. sp. A: soies somatiques; B: coelomocyte; C: Vue latérale de la spermathèque et de l'appareil génital mâle dans les segments X et XI. da: crochet dorsal antérieur; ed : canal éjaculateur; va: soie ventrale antérieure; vIII: soie ventrale du segment III; pour les autres abréviations voir Fig. 1.

anteclitellar ventral setae have distal tooth 1.8-2.3 times longer than proximal; from XII to the end of the body, teeth change progressively from distal about equally large and slightly longer to clearly thinner and shorter than lower, and at the same time the distal part of the crochets becomes more curved; ventral crochets length in the anterior region= 73-90 µm. The spermathecal setae are 90 µm long, and have distal tooth about 3.5 times longer than lower; some glandular cells, very finelly granulated are associated with those setae. The penial setae are sigmoid, strongly curved distally, simple pointed, 63-75 µm long, 2.2 µm wide, with a nodulus placed about 1/3.3 from the distal tip; a large masse of finelly granulated glandular cells is implanted in the tegument, close to the penial setae.

Chloragogen cells from septum V/VI. Coelomocytes of the Rhyacodrilinae type, not very abundant, sphaeric, with a clearly visible central nucleus; 6-12 µm in diameter. Pharyngeal glands present in II, III, IV, V and VI.

One pair of testes in segment X. One pair of ovaries in segment XI. A well developed seminal vesicle in IX.

Male pores in the middle part of XI, in line with ventral setae, close to the penial ones. Atria elongate, completely filled by a dense masse of spermatozoids; 30-35 µm wide and 83-90 µm long, with transparent vacuolisated walls, 4-6 µm thick; ejaculatory duct very weak and narrow (about 8 µm wide, 35 µm long). Vasa deferentia about 150 µm long, 10-12 µm wide, penetrating into the distal part of the atria, in anterior side; sperm funnel large, 32-34 µm wide.

Spermathecal pores in X, near the septum IX/X, in line with ventral setae. Each spermatheca is composed of a short, thick walled duct, 24-25 µm long, 24-26 µm wide, dilating into a large sphaeric thick-walled ampulla, 60-62 µm wide, 64-74 µm long. The spermathecae were devoid of spermatozoids.

Discussion

Among other general characteristics, the presence of typical Rhyacodrilinae coelomocytes, together with

the shape of the somatic and genital setae lead us to the inclusion of *Stochidrilus glandulosus* n. gen. n.sp in this widely diversified subfamily of Tubificidae. Although the presence of a diffuse prostata on the surface of the atrial ampullae was one of the most reliable characters that lead Hrabe (1963) to create this subfamily, there are already several other aprostatic species included in four Rhyacodrilinae genera: the enterely aprostatic *Jolidrilus* Marcus, 1965, *Ainudrilus* Finogenova, 1982, *Epirodrilus* Hrabe, 1930 and three species of *Rhyacodrilus* Bretscher, 1901.

Jolydrilus is a monotypic genus quite singular by its unique male pore and the lack of spermathecae.

The inclusion of *Rhyacodrilus lutulentus* Erséus, 1984 in the genus *Ainudrilus* and the description of its closely related *A. gibsoni* by Erséus (1986) considerably enlarged the diagnosis of *Ainudrilus*, particularly in regard to its narrow and no glandular vas deferens, its no apical entrance in the atrium, and the presence of only two penial setae per bundle. All these characters are shared with *Stochidrilus glandulosus* n. gen., n. sp., but the presence of spermathecal setae with associated glands, the large glandular mass close to the penial setae, and the lack of pseudopenis in the new species clearly separate it from these and the other species of *Ainudrilus*.

Among other characters, *Rhyacodrilus simplex* and *R. fultoni* differ from *Stochidrilus glandulosus* n. gen., n. sp. by the absence of spermathecal setae, the shape and great number of penial setae and the lack of large glandular mass close to them. This last character, together with the shape of the spermathecal and penial setae and the lack of spermathecal duct clearly separates *Stochidrilus glandulosus* n. gen., n. sp. from the above described *Rhyacodrilus gasparoi*. But perhaps the most important differences between *Stochidrilus glandulosus* n. gen., n. sp., *R. fultoni* and *R. gasparoi* have to be found in the atrial structure (transparent and vacuolisated in the former and largely glandular in the two latter).

The atria of *Epirodrilus*, a genus whose number of species has recently increase to eight (see Martin & Giani 1995), are quite different to those of the new genus, as they are very big, convoluted and bipartite, with the ectal wall strongly glandular.

Although we have not found any autapomorphic character owing to the monophyly of the new genus *Stochidrilus*, as we have shown above, a combination of several singular characters clearly separate it from all the other known genera. However, though there is a great need for a revision of the Rhyacodrilinae, *Stochidrilus* n. gen. is proposed on the basis of its vacuolisated and not granulated atrial wall, the non glandular vas deferens entering atria ectally but not apically, the presence of spermathecal setae with developed setigeral glands, the small number of penial setae, strongly curved distally, and the large mass of finely granulated cells implanted in the tegument and related to the male terminalia. Although rare this last character has already been found in other tubificid worms like *Heterodrilus arenicolus* Pierantoni or *Abyssidrilus altus* (Erséus).

Distribution and habitat

Only known from the type locality, a cave in Slovenia. Underground watercourse.

3.5. *Tubifex pescei* Dumnicka, 1981 comb. n. (Fig. 5)

Synonymy

Peloscolex pescei Dumnicka, 1981: 663-666, Figs 1, 2.

Frearidrilus pescei Dumnicka, 1987 : 47-52, Figs 1-5.

New material examined

1 mature specimen and 3 immature specimens (1 incomplete), stained in haematoxylin, dissected and mounted in Canada Balsam, Krizna Jama (S. 65), Loz, Cerknica, Slovenia, 19-09-93, leg. F. Stoch, subterranean water course in Dezmanov Rov.

Description of the new material

Smal species (incomplete specimen), 32 segments present (31 and 20 for the two complete immature specimens), more than 1,6 mm in length, 0.24 mm maximun wide at segment VI (slightly compressed specimen).

Cutaneous papillae absent. A line of stained nucleus of epidermal cells very closed together can be clearly seen along the body, laterally, just between the dorsal and ventral bundles of setae. Prostomium with round tip, 84 µm in length and 104 µm in width at its base.

Each dorsal bundle (dorsal setae absent on segment XI) of the examined anterior part with 1 hair and only 1 crochet (rarely two, only in the posterior part of the body). Hair setae finely serrated (serration only seen at high magnification) very long all along the body, maximum length 560 µm in the anterior bundles. Dorsal crochets thin, pectinated (intermediate teeth large and irregular in shape) in the anterior and median regions of the body, with short, diverging and about equal in length, lateral teeth; distal tooth slightly thinner than proximal. On the posterior region, pectinate crochets are replaced by bifid crochets with distal tooth thinner and shorter than lower; distal tooth desappears in some dorsal setae at the end of the body where each dorsal bundle is then composed of one bifid and one simple pointed setae. Dorsal crochets length about 70 µm. 3-4 setae (2.4 µm thick) in each ventral bundle ex-

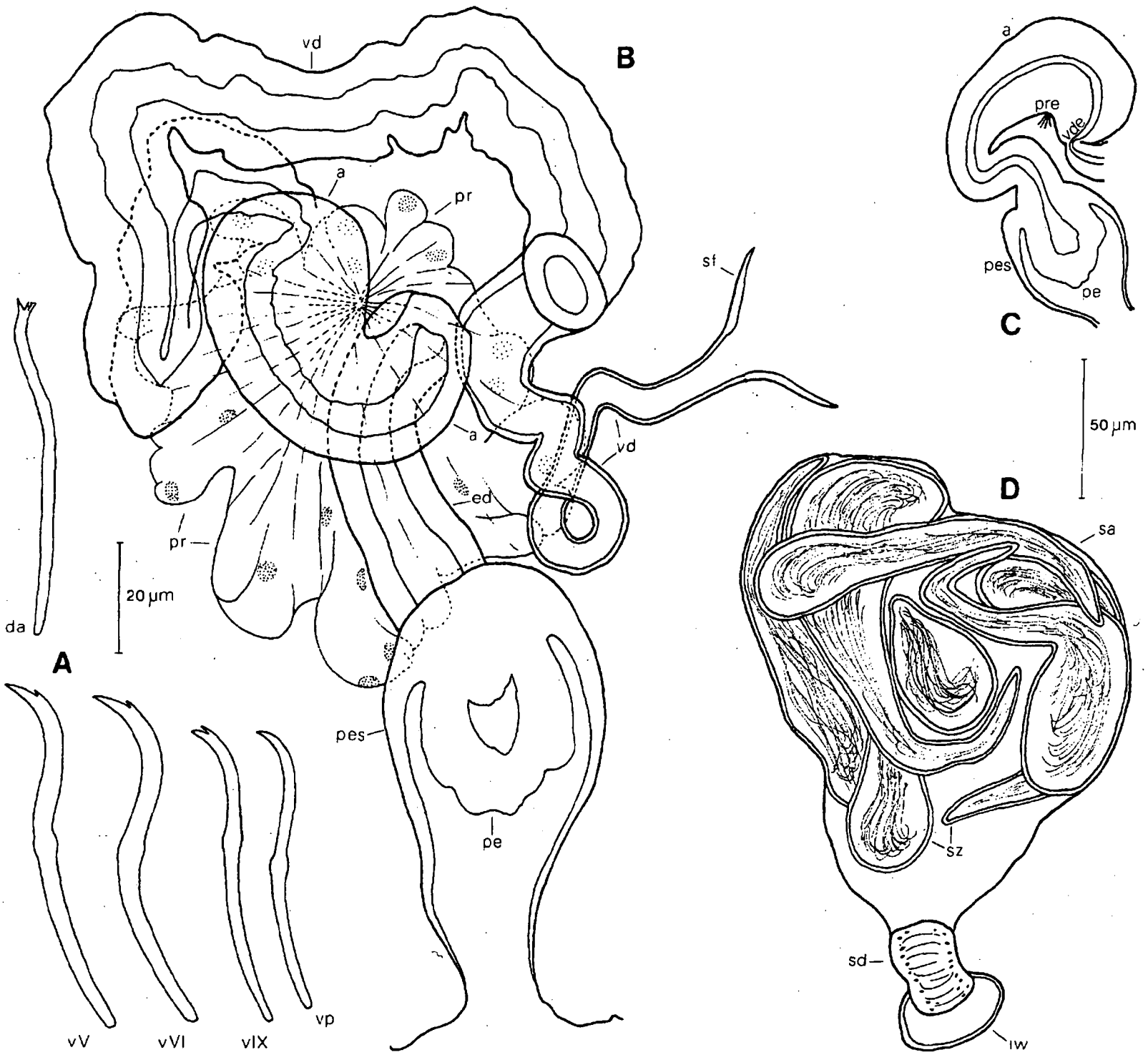

Fig. 5. *Tubifex pescei* (Dumnicka, 1981) comb. n. A: somatic setae; B: male genitalia in segment XI; C : semi-diagrammatic view of atrium; D : spermatheca in segment X. iw: invagination of the body wall; pe: penis; pes: penial sac; pre: prostate entrance; sz: spermatozeugmata; vIX: ventral setae of segment IX; others abreviations as in Fig. 1.

Fig. 5. *Tubifex pescei* (Dumnicka, 1981) comb. n. A: soies somatiques; B: appareil génital mâle dans le segment XI; C : vue semi-schématique de l'atrium; D : spermathèque dans le segment X; iw: invagination de la paroi du corps; pe: pénis; pes: sac pénien; pre: entrée de la prostate; sz: spermatozeugmata; vIX: soie ventrale du segment IX; pour les autres abréviations voir Fig. 1.

cept on segments IV, V, VI where there are only two «giant» sickle-shaped crochets (4 µm thick) per bundle. Ventral crochets 64-69 µm in length (58 µm on segment II) except on segments IV, V, VI where they are longer : 78 µm on IV and 84 µm on V and VI. The giant setae are already present on each of the 3 immature specimens observed (up to 72 µm in length and 3.2 µm in width for the specimen with 31 segments). On the first 6 or 7 setigerous segments distal tooth of ventral setae very reduced and difficult to observe; distal tooth reduced but conspicuous in the median segments (less than 2/3 in length than the proximal one) and disappearing in the posterior segments where the distal ends of the setae are strongly curved. Posterior dorsal and ventral crochets are very similar in shape. Ventral setae of segments X and XI present but unmodified.

Clitellum 1/2X-1/2XII. One pair male pore close to the ventral setae of segment XI, in line with ventral setae; one pair spermathecal pores lateral on segment X, in line with dorsal and ventral setae.

Coelomocytes absent. Chloragogen cells present from septum V/VI (or posterior part of segment V?) forming a dense layer in VI and VII (and posterior part of segment V?) and a thinner one in the following segments. Well developed pharyngeal glands present in segments IV, V, VI and VII.

One pair of testes in segment X. One pair of ovaries in segment XI. Seminal vesicle not observed on the dissected material. Egg sac filling the cavity of segments XII and XIII.

Atria paired, piriform and comma-shaped, 32-36 µm maximun width, ending in a true penis (24 - 32 µm wide, 32 - 40 µm long). Penis enclosed in a penial sac 40 µm maximum width. Cuticular penis sheat not observed. Vasa deferentia, greatly longer than atrium and entirely coiled in segment XI, joining atria apically. Vasa deferentia clearly composed of two distinct parts: the proximal very large (22-24 µm), coiled, with a large, non ciliated, inner lumen; the distal long, narrow (6-9 µm), densely ciliated, coiled closed to the dissepiment and opening in a large sperm funnel. Prostate gland large, compact, clearly pedunculate and joining atrium on its concave side, below the junction of vas deferens.

Spermathecae well developed and composed of a very short duct (38-40 µm long, 25 µm wide) dilating into a large piriform to globular ampulla, 150 µm maximum wide, 175 µm long. Lumen of the ampullae entirely filled with large thin-walled spermatozeugmata (7 were counted in one of the spermathecae). Each spermatheca open in a small invagination of the body wall. One of the two ampullae penetrates into segment XI.

Discussion

In the mature specimen, the male apparatus is clearly of the type usually encountered for the majority of the representatives of the genus *Tubifex* Müller, 1774: atrium comma-shaped, vas deferens apical, prostate compact and pedunculated joining atria just below the vas deferens, particular shape of penis and penial sac, vas deferens composed of two distinct parts... So, our specimen fits very well with the definition of the genus *Tubifex*. As far as this genus is concerned, all our 4 specimens are easy to be discriminated by their original chaetotaxy: long, rare and serrated hair setae, posterior simple pointed setae in the dorsal and ventral bundles, enlarged sickle-shaped ventral setae on segment IV, V, VI. The combination of these setal characteristics constitute a good diagnostic feature for this species. «Giant» ventral setae on segments III-VIII, not sickle-shaped, were previously observed on some *Tubifex tubifex* (Müller, 1774) from Spain (Rodriguez 1984) and from Algeria (Gagneur *et al.* 1986).

Our specimens are very close to the description given by Dumnicka (1981, 1987) for *Peloscolex pescei* later transferred to a new genus *Frearidrilus*, Dumnicka, 1987. So we propose to consider the genus *Frearidrilus* as a junior synonym of *Tubifex*.

The specimens from Slovenia are a little smaller than those described from Italy (Table 1). Some differences related to the setae are also observed. Some of them could result from the power of resolution of the microscope used: this is the case for the single-pointed ventral setae observed on the Italian material.; the upper teeth of the ventral setae of the Slovenian specimens are very minute and difficult to observe. The genital apparatus of the Italian specimens are not described in full details (Dumnicka 1981, 1987). So the main differences between the Italian specimens and those from Slovenia could be summarized as in Table 1. It has to be noted that Dumnicka (1981) mentioned the presence of papillae on the body but she did not make reference to such papillae in the diagnosis of the genus *Frearidrilus* (Dumnicka 1987).

The only significant differences are those regarding the length of hair setae and the presence or absence of simple pointed dorsal and ventral setae. These do not seem sufficient to consider the Italian and Slovenian specimens as representatives of two distinct species, but,taking into account the cavernicolous origin of the material and the frequently high ratio of endemism in such habitats, they can be considered as different local races.

Table 1. Main differences observed between Italian (data from Dumnicka 1981 and 1987) and Slovenian specimens.
Tableau 1. Principales différences observées entre les spécimens d'Italie (d'après Dumnicka 1981 et 1987) et ceux de Slovénie.

	Specimens from Italia (Dumnicka 1981, 1987)	Specimens from Slovenia
Width of the body	0.3-0.35 mm	0.24 mm
Number of hair setae in the anterior bundles	2	1
Maximum length of the hair setae	310 µm	560 µm
Posterior simple pointed dorsal and ventral setae	absent	present
Lateral lines of epidermal nucleus	?	present
Pharyngeal glands	?	segments IV-VII
Body wall papillae	present ?	absent

Distribution and habitat

Previously reported from wells in Marche, Italy, (Dumnicka 1981) and Umbria, Italy (Dumnicka, 1987). The new records are from a cave near Loz, in the vicinity of Cernisko Jezero, Slovenia.

Tubifex pescei comb. n. was collected in phreatic waters in Italy (Dumnicka 1981, 1987) and in a cave in Slovenia; it is a freshwater species clearly belonging to the stygofauna.

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