Five new species of Enchytraeidae (Annelida: Clitellata) from Mediterranean woodlands of Italy and reaffirmed validity of *Achaeta etrusca*, *Fridericia bulbosa* and *F. miraflores*

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Five new enchytraeid species are described from Mediterranean woodland habitats of Italy: *Achaeta borbonica* sp. nov., *Achaeta giustii* sp. nov., *Fridericia bargaglii* sp. nov., *Fridericia meridiana* sp. nov. and *F. rara* sp. nov. New evidence is presented to confirm the validity of *Achaeta etrusca* Rota, 1995, contrary to its synonymization with *Achaeta iberica* Graefe, 1989 (unlike the latter, *Achaeta etrusca* has knob-like inward-bulging glands). The name *Fridericia bulbosa* is retained for animals fitting the original description of *Neoenchytraeus bulbosus* Rosa, 1887, challenging the view that later confusion makes it a nomen dubium. Consistency between taxonomic procedures also suggests to retain *Fridericia miraflores* Sesma and Dózsa-Farkas, 1993 as valid, contrary to its synonymization with *Fridericia sylvatica* Healy, 1979 (a taxon not type based and poorly described, thus impossible to be conclusively identified).

http://zoobank.org/urn:lsid:zoobank.org:pub:526FC344-E093-4106-B8D6-07DC685ADC51

**Keywords:** *Achaeta; Fridericia; new species; enchytraeid taxonomy; nomenclature*

**Introduction**

During 2009, within the frame of a project addressing the biodiversity of soil-dwelling invertebrates in Mediterranean urban environments, some holm oak (*Quercus ilex*) woodland parks of Siena and Naples, Italy, were intensively sampled for enchytraeids. A total of 36 species (Rota et al. 2013, 2014) were recorded, five of which were undescribed. Among them, two (*Achaeta* sp. 1, *Fridericia* sp. 2) were new discoveries, and three others (*Achaeta cf. bohemica* sensu Nielsen and Christensen’, *Fridericia* sp. 1, *Fridericia* sp. 3) were known from previous collections in residual native Mediterranean woodland habitats of Italy (Rota 1995; Santi et al. 2010), but they were still awaiting description. In this paper, an in-depth taxonomic study of the five new species (named *Achaeta borbonica* sp. nov., *Fridericia rara* sp. nov., *Achaeta giustii* sp. nov., *Fridericia meridiana* sp. nov. and *Fridericia bargaglii* sp. nov., respectively) is presented. Augmented diagnoses of three other taxa, *Achaeta etrusca* Rota, 1995, *Fridericia bulbosa* (Rosa, 1887), and *Fridericia miraflores* Sesma and Dózsa-Farkas, 1993, occurring abundantly in the same habitats, are also included to reaffirm their validity against relegation to junior synonyms or nomina dubia (Schmelz 2003; Schmelz and Collado 2010, 2012).

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The present work contributes towards an inventory of the enchytraeid fauna inhabiting the Mediterranean region, but as has happened previously (Rota 1994, 1995), it is not unlikely that the new species dwell undetected in similar forest habitats elsewhere in Europe.

Material and methods

Collecting localities (alphabetical list)

Ca-1. Italy, Campania, Astroni State Nature Reserve, 8.5 km to the northwest of Naples, under the canopy of the oldest Q. ilex trees surviving in the crater (40.8490°N, 14.1499°E, 50 m asl). Thick coarse litter on loose, organic-rich soil with volcanic ash and pumice, pH 5.8, 14.05.2009 and 27.10.2009 (plot N4 in Rota et al. 2014).

Ca-2. Italy, Campania, Naples city, Capodimonte Park, a 134 ha historical urban park, positioned on the top of a hill in the northern part of the city (40.8717°N, 14.2519°E, 50 m asl). Holm oak trees with underbrush of Ruscus aculeatus, Hedera helix and, occasionally, Tradescantia fluminalis. Litter and dark humus on loose, coarse-textured soil with fragments of pyroclastic origin, moist, pH 6.1–7.0, 13.05.2009 and 26.10.2009 (plots N1–N3 in Rota et al. 2014).

La-1. Italy, Latium, Allumiere, 72 km NW of Rome, Bosco del Faggeto, mesophilous beech forest (Fagus sylvatica), Site of Community Importance (42.1555°N, 11.9117°E, 500 m asl). Brown soil under a beech, moist, pH 4.3, 22.05.1994 (site Latium 5 in Rota 1995).

La-2. Italy, Latium, Selva del Circeo (Latina), in the National Park of Circeo, about 100 km S of Rome, 3 km from the seashore, on a continental dune of reddish quartziferous sands mixed with silt and clay deposited by wind (41.3514°N, 13.0363°E, 40 m asl). Grass and litter of Pinus pinea and Quercus cerris on sandy soil, moist, 25.03.1992 (site Latium 3 in Rota 1995).

Tu-1. Italy, Tuscany, La Verna (Arezzo), centuries-old Abies alba and beech forest with young maple, Helleborus and Viola on bryzoal limestone (43.108°N, 11.9319°E, 1120 m asl). Brown sandy humus and wood litter under rotten logs, moist, pH 5.9, 02.05.1996 (site Tuscany 8a in Rota 1995).

Tu-2. Italy, Tuscany, La Selvaccia, 1.5 km NW of Montalbuccio, about 4.5 km W of Siena. Chestnut wood (Castanea sativa) with Q. cerris, some Q. pedunculata, Carpinus betulus; thin underbrush of Juniperus communis, Calluna vulgaris, Cytisus scoparius, Cistus salvifolius, Pteridium aquilinum on fine reddish-yellow sand (43.3236°N, 11.2739°E, 300 m asl). Chestnut and oak litter, slightly moist, pH 3.4–4.0, 29.10.1993 (site Tuscany 14a in Rota 1995).

Tu-3. Italy, Tuscany, Rovine di Castelvecchio (43.4320°N, 11.0052°E, 400 m asl), about 4 km N of Castel S. Gimignano, 8 km SW of San Gimignano (Siena). Oak wood (Q. cerris and Q. pubescens) on limestone, pH 7.1–7.3, 23.05.1994 (site Tuscany 9 in Rota 1995).

Tu-4. Italy, Tuscany, Siena, Bosco S. Agnese Nature Reserve, among the Siena Chianti hills, Q. ilex and Cupressus woodland on limestone and marls (43.4875°N, 11.2226°E, 400 m asl), 8–16.06.2004 (sites 2–6, 9–10 in Santi et al. 2010).

Tu-5. Italy, Tuscany, about 3.5 km WSW of Siena city centre, Q. ilex forest surrounding the 12th century Castle of Belcaro (43.3072°N, 11.2900°E, 350 m asl). Deep litter and humus on yellowish-brown, compact, coarse sandy soil under H.
helix. Moist, pH 6.6–7.2, 04.11.1993, 24.04.2009, 05.11.2009 (site Tuscany 13 in Rota 1995; plot S4 in Rota et al. 2014).

Tu-6. Italy, Tuscany, Siena city, Orti dei Tolomei (43.3146°N, 11.3324°E, 330 m asl), grass under Laurus nobilis shrubs on yellowish-brown sandy soil, 10.01.1995 and 31.03.2004.

Tu-7. Italy, Tuscany, Siena city, Villa Patrizia, a private urban park (43.3369°N, 11.3078°E, 346 m asl) with large holm oak trees and undergrowth of H. helix, L. nobilis, Prunus laurocerasus, R. aculeatus and Lamium. Coarse litter and raw to fine dark humus on brown to yellowish-brown compact sandy soil developed from Pliocene marine deposits, pH 6.5–6.8, 03.04.1995, 24.04.2009 and 05.11.2009 (plots S1–S3 in Rota et al. 2014).

Tu-8. Italy, Tuscany, Siena, Ponte al Rigo, about 4.5 km W of Siena, near the point where roads to San Leonardo al Lago, Volte Basse and Strada del Ferratore meet (43.3173°N, 11.2737°E, 270 m asl). Pinus trees at roadside. Dark loam with wood litter on grey-brown soil. Moist, 01.04.1992 (site Tuscany 11 in Rota 1995).

Tu-9. Italy, Tuscany, Siena, Bosco di Lecceto, about 100 m S of loc. Tu-8, in a mixed wood (Quercus, Acer, Ostrya carpinifolia) with underbrush of Juniperus, R. aculeatus, Rubus, Spartium, Pyracantha coccinea, Cytisus sessilifolius, on a slope at roadside (43.3146°N, 11.2739°E, 280 m asl). Quercus leaf litter and dark humus on brown soil. Moist. pH 7.4–7.6, 17.10.1993 (site Tuscany 12 in Rota 1995).

Tu-10. Italy, Tuscany, Siena, Fattoria La Chiocciola, 8 km NW of Siena, about 2 km from Via Cassia along the road to Riciano. Oak wood (Q. pubescens) on limestone (43.3510°N, 11.2385°E, 400 m asl). Deep oak litter on shallow soil at roadside, and meadow at the edge of a pool, moist, 27.02.1991 and 17.10.1993 (site Tuscany 10 in Rota 1995).

Methods
Methods employed for the collection of soil samples are reported in Rota (1995), Santi et al. (2010) and Rota et al. (2013, 2014). Collecting dates refer to the sampling of soil, not to the extraction of specimens, which took place within 1–7 weeks from collection. All specimens were extracted using the wet funnel method (as modified by Healy and Rota 1992) and were initially examined in vivo by transmitted light, then transferred to 70% alcohol or Bouin’s fluid. The preserved specimens were later stained in paracarmine, dehydrated through an ethanol/xylene series and mounted whole in Canada balsam. Live specimens and permanent whole-mounts were examined and photographed under a DM LB Leica microscope connected to a Coolpix 4500 Nikon digital camera. Measurements were obtained by using an eyepiece micrometer. Only some details of Fridericia bargaglii sp. nov. are illustrated by drawings. For all other species, line drawings would add little information, because their organs are of a very common shape. Photographs are provided to show them in an unequivocal, specific, anatomical context, or in their fairly unusual size or arrangement (e.g. the few preclitellar nephridia of F. rara sp. nov.; the small sperm funnels of F. meridiana sp. nov.; the long oesophageal loops of Achaeata etrusca). In text and figures, segments are referred to by Roman numerals; intersegmental furrows and septa are referred to by Arabic numerals (fractions).

The type series of the five new species are deposited in the Museo Civico di Zoologia di Roma (MCZR), Italy, and the Swedish Museum of Natural History.
Concerning *Fridericia bulbosa*, Rosa (1887) did not mention any type material or a depository where he might have left specimens. I made an inquiry to the Turin Museum of Natural History (where Daniele Rosa worked during 1881–1898), but was not successful. Schmelz (2003) did not find type specimens in other museums.

Abbreviations used in the figures

ac, anucleate coelomic corpuscles; b, brain; chl, chloragogen tissue; chy, chylus cells; cl, clitellum; co, collar of sperm funnel; coe, coelomocytes; dg, clitellar dorsal gap; dv, dorsal blood vessel; e, egg; ecd, spermathecal ectal duct; fg, flask-shaped gland; fp, female pore; ggc, granular gland cell; hgc, hyaline gland cell; hp, head pore; i, intestine; lc, lateral chaetae; lm, longitudinal muscle fibres; mp, male pore; nc, nucleated coelomocytes; nd, nephridial efferent duct; ne, nephridium; nf, nephridial funnel (nephrostome); oe, oesophagus; ov, ovary; p, prostomium; pb, penial bulb; phg, pharyngeal gland; php, pharyngeal pad; sa, spermathecal ampulla; sf, sperm funnel; sp, spermathecal ectal pore; sh, heads of spermatozoa; sv, seminal vesicle; vc, ventral chaetae; vd, vas deferens; vnc, nerve cord.

Results

Class **CLITELLATA** Michaelsen, 1919  
Family **ENCHYTRAENIDAE** Vejdovský, 1879b  
Genus **Achaeta** Vejdovský, 1878

Anatomical remarks on the genus

The flask-shaped (=pyriform) glands, when occurring, always start in a species-specific segmental position (own observation) (e.g. Figures 1B, 3A), although this diagnostic character is generally omitted in identification keys (e.g. Nielsen and Christensen 1959; Schmelz and Collado 2010). The lateral commissures between dorsal and ventral blood vessels in European *Achaeta* are always three pairs (two in III, one in IV) (see Vejdovský 1884, plate 7, figure 1; Rota 1995). The shortness of the longitudinal muscle fibres gives the body wall surface a peculiar lozenge pattern; this condition, first noted by Michaelsen (1889) in *Achaeta bohemica*: ‘The slow, lumbering movement of the animals is related thereto’ (pp. 47–48) (Figure 2B), seems to be distinctive for most species in the genus (pers. obs.; Figure 3D), as compared with the longer muscle strands observed in other genera. In *A. bohemica*, Michaelsen (1889) also detected intracellular canals (Figure 2C) in the gut epithelium of segments behind the origin of the blood vessel: ‘The columnar epithelial cells are run through by a system of exceedingly fine canals, which apart from being much finer, recall the chylus cells of some *Fridericia* species. The canals lie parallel to the length direction of the cells, so that a cross section thereof has a sieve-like appearance. A more intimate relationship with the blood vascular system could not be proven’ (p. 48). However, these intracellular canals have never been observed since in *Achaeta*, not even in the very large-sized

(SMNH), Stockholm.
A. gigantea Dózsa-Farkas, 2000; the question should be further investigated by histological methods.

**Achaeta borbonica** sp. nov.  
(Figure 1)

*Achaeta* sp. 1, Rota et al. 2013, table 1 and figure 3 (species ‘s1’); Rota et al. 2014, tables 1, 2 and Suppl. 1.

**Type material**  
**Holotype.** MCZR Oligochaeta 0174, whole-mounted specimen, fully mature.

**Type locality**  
Italy, Campania (Ca-1), Astroni State Nature Reserve, 8.5 km to the northwest of Naples, under the canopy of the oldest *Q. ilex* trees surviving in the crater (40.8490°N, 14.1499°E, 50 m asl). Thick coarse litter on loose, organic-rich soil with volcanic ash and pumice, pH 5.8, 27.10.2009, E. Rota coll.

**Paratype.** MCZR Oligochaeta 0175, one whole-mounted specimen, fully mature, from type locality, 14.05.2009.

**Other material.** One whole-mounted specimen from type locality, 14.05.2009, in the author’s collection.

**Etymology**  
Discovered within a former hunting preserve for the Bourbon royal family.

**Diagnosis**  
Small species, with flask-shaped glands occurring dorsally from V, clitellum including two mid-dorsally contiguous hyaline bands, male pores in XI, preclitellar nephridia one pair at 7/8, spermathecae short, confined to V, opening ventrally.

**Description**  
Small, filiform species (Figure 1A). Live body length 2.2–3.2 mm, width 0.125–0.150 mm at XII; after fixation, length 1.3–2.0 mm, width 0.10 mm at clitellum. Segment number 20–22. Prostomium (Figure 1A) rounded both in frontal and lateral views, pointing forwards, one-fourth longer than peristomium (32 μm after fixation). Flask-shaped glands present dorsally from V (Figure 1B), conspicuous (30–35 μm long *in vivo*, about 25 μm in fixed material), absent ventrally. Knob-like glands and lentiform glands absent. Clitellum (Figure 1A, G, H) in XI–1/2XII, gland cells in 18 transverse rows, hyaline cells present only dorsilaterally, forming one longitudinal band per side, the two hyaline bands dorsally contiguous; granular cells covering all other sides of clitellum but absent in its middle along the midventral line.
Figure 1. *Achaeta borbonica* sp. nov. (A) Anterior body half in a dorsal view. Note the intestinal loop in IX; (B) lateral view of segments IV–V, showing the right spermatheca; asterisks indicate the oesophageal dorsal ridge; (C) ventral view of segment V, revealing the closely spaced spermathecal pores; (D) sperm funnel in segment X; (E) lateral view of nephridium in segment VIII; (F) coelomic cavity of caudal segments (lateral view), showing the coarse granulation of the chloragogenous cells and the small size of coelomocytes as compared with the flask-shaped glands. (G and H) Lateral views of clitellum, *in vivo* (G) and after fixation (H). All except (H) from live specimens. In (A), (D) and (E) anterior to the top; in all others, anterior to the right.
Head pore at 0/1. Spermathecal pores ventral at 4/5. Male pores in XI (Figure 1A, G, H).

Cuticle and body wall thin. No thickened septa. Brain twice longer than broad (60 μm long when fixed), posteriorly rounded. Oesophageal outer ridge dorsal on III–V (Figure 1B). Pharyngeal glands, three pairs, all well developed and connected dorsally, secondary lobes absent (Figure 1A). One pair of preclitellar nephridia, anchored (but not constricted) by septum 7/8 (Figure 1A, E).

Coelomocytes smaller than flask-shaped glands, oval or drop-shaped, finely rugose and grained, pale (Figure 1B, F). Transition between oesophagus and intestine gradual. Gut constantly forming a loop in IX (Figure 1A). Intestinal floor of 1/2XV–XVII modified as an inner ridge of tall cells (ventral intestinal ridge). Chloragogenous cells in vivo filled with large (3 μm) opaque inclusions (Figure 1B–F), somewhat resembling the oil globules filling of Enchytraeus species, but rendering the sides of gut dark-brown in transmitted light. Dorsal blood vessel arising in VI.

Seminal vesicle absent. Sperm funnels (Figure 1D) twice longer than broad, in vivo 60 by 30 μm, with distinct collar (7 μm high). Heads of spermatozoa about 10 μm long and vasa deferentia 4.5 μm thick in vivo. Penial bulbs small, oval, compact, 25 μm long in vivo, 21 μm after fixation (Figure 1A, G, H). One egg mature, conspicuous, generally stretching through two whole segments (Figure 1A). Spermathecae (Figure 1B, C) short, confined to V, club-shaped, thicker-walled in their distal half (ectal duct), totally about 50 μm long and 15 μm across (live). Sperm arranged as a straight bundle inside ampulla.

Remarks
This new species resembles A. minima Southern, 1907 in body size, dorsal occurrence of the flask-shaped glands and position and size of the spermathecae (A. minima and A. borbonica sp. nov. are the only known Achaeta species possessing flask-shaped glands with spermathecae confined to V), but differs from it by the cephalic displacement of the genital organs, the size of the sperm funnels and the location of the first preclitellar nephridia. An identical cephalic displacement of the genital organs, combined with ventral spermathecal pores, dorsal flask-shaped glands and possession of one pair of preclitellar nephridia, as in the new species, is observed in the northern European A. abulba Graefe, 1989 and A. bibulba Graefe, 1989. From the latter two, the new species appears different because: (1) the nephridia comprise an anteseptal part and occur preclitellarly at 7/8 rather than at 6/7; (2) compact penial bulbs are present; (3) the spermathecae are confined to V and lack any glandular formation at pore.

Distribution
Only recorded in the Astroni State Nature Reserve, sexually mature both in spring and autumn.

Achaeta bohemica (Vejdovský, 1879a)

Remarks on Achaeta bohemica (Vejdovský, 1879a) sensu stricto
This species was originally defined by Vejdovský (1879a) through just a couple of traits, to distinguish it from *A. eiseni* Vejdovský, 1878, the only other congener then known. In *A. bohemica* the ‘chaetal glands’ (=flask-shaped glands) occurred only dorsally, against dorsal + ventral in *A. eiseni*, and the septal glands (=pharyngeal glands) were developed only in two segments, against three in *A. eiseni*. Five years later, in his ‘System und Morphologie der Oligochaeten’, the same author illustrated other features diagnostic of *A. bohemica*: the flask-shaped glands starting in IV, two secondary pharyngeal glands occurring ventrally in V and VI, the conspicuous oesophageal outer ridge (‘salivary glands’) dorsal on III–V, the dorsal vessel originating in VI, the intestine beginning in VII, nephridia present at 6/7 and with an expanded terminal vesicle (Vejdovský 1884, plate 7, figure 1). Vejdovský never mentioned the reproductive organization of *A. bohemica*, except for the reciprocal position and paired condition of the testes and ovaries Anlagen.

Michaelsen (1889, p. 48 and figures 5–7; 1900) recorded *A. bohemica* in Hamburg (specimens about 15 mm long) and provided the first reproductive details: the clitellum (Figure 2A) interrupted dorsally and containing very large hyaline cells dorsolaterally, the male ducts opening ventrally through adjacent glandular bodies (Figure 2A), the spermathecae also opening close to the midventral line and consisting of an elongate pear-shaped ampulla separated from the ectal duct by a valve-like occlusion. Černosvitov (1928), based on material from the Carpathians, extended the account of *A. bohemica* to include: cuticle 3.8 μm thick, clitellum over 1/2XII–1/2XIII, sperm funnels very long (l:w = 5–6:1), spermathecae reaching backwards X–XI and with ectal portion in V expanding before opening to the exterior through a perpendicular, ventrally directed thickened duct. Černosvitov (1928), however, reported the pharyngeal glands as three pairs at 4/5–6/7.

The picture emerging from the above accounts, provided that Vejdovský, Michaelsen and Černosvitov referred to one and the same species, corresponds virtually in all details to *Achaeta vesiculata* Nielsen and Christensen (1959), rightly declared a junior synonym of *A. bohemica* (Vejdovský, 1879a) by Schmelz and Collado (2010). I collected and personally studied material of *A. vesiculata* in Ireland and Sweden (records already existed, respectively, by Healy (1979) and Backlund (1947 as *A. bohemica*)), and I observed in both countries the series of flask-shaped glands to start invariably in IV, the pharyngeal glands as well as the other somatic structures to be arranged as indicated by Vejdovský, and each penial organ to consist of a main glandular body plus minor glands in a longitudinal row. Schmelz and Collado (2010) suggest that the synonymy of *A. bohemica* sensu stricto should be extended to *A. microcosmi* Heck and Römbke, 1991, because the latter’s type material shows only two pairs of primary pharyngeal glands and nephridia at 6/7. It would be interesting to know where the flask-shaped glands start in the types of *A. microcosmi* (they were pictured in III by Heck and Römbke 1991, figure 1A).

**Remarks on Achaeta bohemica sensu Nielsen and Christensen (1959) non Vejdovský**

*Achaeta bohemica* as intended by Nielsen and Christensen (1959) differs from Vejdovský’s taxon by having three pairs of well-developed primary pharyngeal glands, no secondary glands, dorsal vessel originating in VII (Nielsen and Christensen 1959, table 4), no seminal vesicle, and spermathecae shorter and with ectal duct parallel to the long body axis. This combination of characters has gradually become recognized as
Achaeta bohemica sensu Nielsen and Christensen, 1959 (Healy 1980; Rota and Healy 1994; Rota 1995; Standen et al. 2009; Schmelz and Collado 2010). Lately, however, while re-approaching the taxonomy of Achaeta in search of new information from permanent mounts, I discovered that two separate species occur in Italy that correspond to the above diagnosis and that I had confounded under one name. One species – probably identical to the form ‘healyae’ of German authors (see Schmelz and Collado 2010), and that I leave unnamed – is similar to A. bohemica s.s. in all but the above-mentioned features. Thus, based on my material, its short portrait could be written as such: flask-shaped glands present dorsally from IV on, including XII, and absent ventrally. Clitellum one segment long (1/3XII–2/3XIII), dorsally interrupted, ventrally continuous, dorsolaterally made of 22 transverse rows of much enlarged hyaline gland cells, interspersed with few, small granular cells; the dorsal

Figure 2. Achaeta bohemica (Vejdovský, 1879a) as illustrated by Michaelsen (1889). (A) Cross-section through segment XII, showing the conspicuous hyaline gland cells on the dorsolateral sides of the clitellum, the flask-shaped glands (b), and the glands surrounding the male openings (p); (B) arrangement of the longitudinal muscle fibres in the body wall; (C) intestinal epithelial cells of segment IX, showing their fine intracellular canals in cross (q) and longitudinal (l) section.
edges consist of a palisade of hyaline cells; only granular cells occur ventrolaterally. Male pores opening ventrally in XII, about 60 µm apart from one another, while spermathecal pores open ventrally at 4/5, 87 µm apart from one another. Oesophageal outer ridge seen dorsal on V. Two pairs of preclitellar nephridia, 6/7–7/8 constricted by septum. Coelomocytes 25–35 µm long, roundish or oval, with rugose surface, finely granular, pale but brownish when accumulated. Oesophagus expanding into intestine in 1/2VIII or at 8/9. Intestinal inner ridge ventral in XVIII–XXII. Sperm funnels 150–275 by 50–70 µm. Vasa deferentia 9–10 µm thick. Spermatozoa 60 µm long, heads 20–25 µm long. Penial bulbs compact, enclosed in a muscular sheath, 70 µm long. Spermathecal ampullae in VII–IX. *Achaeta bohemica* sensu Nielsen and Christensen, 1959 is common around Siena (Rota 1995, sites Tuscany 5, 21, 25; Santi et al. 2010, sites 10 and 12; Rota et al. 2013, Villa Patrizia) and seems widely distributed throughout Europe. Judging from my slide collection it occurs at least also in Ireland (Co. Dublin: Larch Hill, UCD Campus, Killernan; pers. obs.) and Algeria (Rota and Healy 1994, p. 54).

Of the second species – herein described as *A. giustii* sp. nov. and distinguished by having a complete series of dorsal flask-shaped glands (i.e. from segment II to tail) and clitellum longer and reticulate – I have collected specimens only in Italian regions, and it could indeed be a Mediterranean endemic.

*Achaeta giustii* sp. nov.  
(Figure 3)

‘*Achaeta bohemica* (Vejdovský, 1879a) sensu Nielsen and Christ. 1959’, Rota 1995, p. 196 (partim),  
‘*Achaeta cf. bohemica* sensu Nielsen and Christ. 1959’, Rota et al. 2013, table 1 (species ‘s2’); Rota et al. 2014, tables 1, 2 and Suppl. 1 (partim).

**Type material**

*Holotype.* MCZR Oligochaeta 0176, whole-mounted specimen, fully mature.

*Type locality*

Italy, Tuscany (Tu-1), La Verna (Arezzo), centuries-old *Abies alba* and beech forest with young maple, *Helleborus* and *Viola* on bryozoal limestone (43.7065°N, 11.9319° E, 1120 m asl). Brown sandy humus and wood litter under rotten logs, moist, pH 5.9, 02.05.1996, E. Rota coll.

*Paratypes.* MCZR Oligochaeta 0177–0178, two whole-mounted specimens from Italy, Latium (La-1), 22.05.1994. SMNH-Types 8721–8722, two whole-mounted specimens from Italy, Latium (La-2), 25.03.1992.

*Other material.* One whole-mounted specimen from Italy, Tuscany (Tu-2), 29.10.1993. One alcohol-preserved specimen from Italy, Campania (Ca-1), 14.05.2009, in the author’s collection.
**Etymology**

The new species is named for Prof. Folco Giusti, outstanding malacologist and dedicated zoogeographer, for his contributions to the knowledge of Mediterranean endemism.

**Diagnosis**

Medium-sized species, with large flask-shaped glands occurring dorsally from II to tail, including XII; clittellum over XII–1/2XIII, absent middorsally, hyaline and granular gland cells forming dorsolaterally a reticulate pattern; male pores in XII, penial bulbs compact, preclitellar nephridia two pairs at 6/7–7/8, spermathecae opening ventrally, ampullae reaching VII–IX.

**Description**

Live body length 6–8 mm, width 0.28–0.36 mm at XII; after fixation, length 4.2–5.8 mm, width 0.23–0.30 mm at XII. Segments 28–37. Large flask-shaped glands dorsally paired from II to tail, including XII (Figure 3A, F), absent ventrally; in vivo measured length throughout up to 120 μm, fixed 85–100 μm, glands smaller (50–75 μm) in II; dorsal distance between left and right glands 100–120 μm (fixed). Knob-like glands and lentiform glands absent. Clitellum in XII–1/2 XIII, dorsally interrupted (gap 90 μm wide), elsewhere continuous; dorsolateral sides made of polygonal granular and not much larger hyaline cells forming a reticulate pattern; dorsal edge consisting of granular cells (Figure 3C); only granular cells ventrally (Figure 3E, F); thickness of clitellum at midpoint 16–32 μm (fixed).

Head pore on prostomium. Spermathecal pores ventral at 4/5, 65–70 μm (fix) distant from one another. Male pores in XII, 50–70 μm apart, somewhat closer than spermathecal pores.

Cuticle at least 2.5 μm thick, in places reaching 6.0 μm, larger dorsally than ventrally. Brain about 150 μm long in vivo, 125–135 μm when fixed. Oesophageal outer ridge dorsal on III–V, inconspicuous. Pharyngeal glands three primary pairs at 4/5–6/7, each merging dorsally, no secondary lobes (Figure 3B). Two pairs of preclitellar nephridia at 6/7–7/8 constricted by septum, without swollen terminal vesicle; nephridia generally absent from first five postclitellar segments.

Coelomocytes of various size, with grooved but not granular cytoplasm, roundish, often with one to five marginal prominences, brownish when accumulated. Gut linear, without loops. Oesophagus gradually expanding into intestine at 7/8. Intestinal inner ridge extending over three segments between XVIII–XXIII (ventral intestinal ridge). Chloragogenous cells filled with fine granules. Dorsal blood vessel arising in VII (Figure 3B).

Seminal vesicle absent or small. Sperm funnels elongate equal to or shorter than body width, broadest point slightly below collar, length:width 3–4:1 (180–230 by 50–80 μm in vivo), generally bent at midlength; collar distinct, as wide or narrower than funnel (Figure 3H). Spermatozoa 50 μm long, heads 20 μm long. Vasa deferentia long and narrow (8–10 μm), tightly coiled. Penial bulbs small, compact, enclosed in a muscular sheath, 53–64 μm long in fixed worms (Figure 3E, F). One egg mature. Spermathecal ampullae reaching to VII–IX, ectal ducts almost parallel to long body axis in vivo, more
Figure 3. *Achaeta giustii* sp. nov. (A) Cephalic region (lateral view); (B) dorsolateral view of segments I–VIII, showing the well-developed pharyngeal glands; (C) dorsal view of clitellum. Note the granular cells bordering the middorsal interruption (dg); (D) shallow lateral view of body wall (segment IX), revealing the lozenge pattern of the longitudinal muscle fibres; (E) lateral view of clitellum, showing the reticulate pattern of the gland cells; (F) lateral view of same clitellum in a deeper optical section, documenting its midventral continuity and middorsal gap; (G) ectal portion of the spermatheca; (H) sperm funnel. All from permanent whole-mounted specimens, anterior to the left.
contracted on one side (thus bent at an obtuse angle) in fixed specimens (Figure 3G); ectal ducts not tapering towards pore, rather appearing glandular at junction with body wall.

**Remarks**

This species belongs to the group of *Achaeta* with only dorsal flask-shaped glands and spermathecae opening ventrally. While alive it looks similar to *Achaeta bohemica* sensu Nielsen and Christensen, 1959, it can be recognized (more easily after fixation) by having a complete series of dorsal flask-shaped glands (i.e. from segment II to tail) and clitellum longer and reticulate, with granular gland cells bordering the dorsal edges (see above).

**Distribution**

Apparently endemic to the Mediterranean region, recorded in Italy from Tuscany to Campania.

*Achaeta etrusca* Rota, 1995

(Figure 4)

*Achaeta etrusca* Rota, 1995, pp. 197–198, figure 8A–C.

*Achaeta etrusca*, Rota et al. 2013, table 1 and figure 3 (species ‘s5’); Rota et al. 2014, tables 1, 2 and Suppl. 1.

**Material examined**

*Type material.* MCZR Oligochaeta 0049–0050, Holotype and one paratype from Italy, Tuscany (Tu-3), Rovine di Castelvecchio (43.4320°N, 11.0052°E, 400 m asl), about 4 km N of Castel S. Gimignano, 8 km SW of San Gimignano (Siena). Oak wood on limestone, pH 7.1–7.3, 23.05.1994, E. Rota coll.

New material (in the author’s collection). About 150 specimens from Italy, Campania (Ca-2), plots N1–N3, 13.05.2009 and 26.10.2009. Nine specimens from Italy, Tuscany (Tu-4), 8–16.06.2004. Seven specimens from Italy, Tuscany (Tu-5), 24.04.2009 and 05.11.2009.

**Augmented diagnosis**

Live body length 2.0–3.5 mm, width 0.15–0.21 mm at XII. Segments 21–24. Paired knob-like cutaneous gland structures dorsolateral in II–VI (Figure 4A). Clitellum laterodorsally made of hyaline cells irregularly scattered among granular cells, with a narrow middorsal interruption (25 μm); ventrolaterally only granular cells occur; clitellum absent midventrally (gap as wide as the distance between male pores, 64 μm). Secondary pharyngeal glands in V and VI. Pronounced oesophageal loops in IV and VII, visible both *in vivo* (Figure 4B, C) and in fixed material. Dorsal blood vessel originating in VII and entering directly into VI, i.e. bypassing the oesophageal loop of VII. Three pairs of preclitellar nephridia (6/7–8/9). Sperm funnels 48–53 by
27–35 μm. Sperm heads about 15 μm long, tails 25 μm. Penial bulbs in XII, compact, oval, 32 μm long. One egg mature.

Remarks
The validity of this species has recently been questioned by Graefe (2007), and its synonymization with *A. iberica* has been proposed (Schmelz and Collado 2010, 2012). The original description (Rota 1995) mentioned ‘inconspicuous lens-shaped epithelial cells observed dorsolaterally from II’. These words have been misinterpreted as if referring to the lentiform gland cells segmentally punctuating the sides of the body of *A. iberica* at three distinct levels, but the structures of *A. etrusca* swell inwards, occur as one dorsolateral pair per segment and are limited to segments II–VI (in segment I, more dorsal and bilobed structures occur, probably of a different nature) (Figure 4A). Thus they would rather seem homologous to the ‘dorsolateral epidermal follicles slightly protruding into the body cavity’ characterizing segments I, III–VI in *A. antefolliculata* Dózsa-Farkas and Boros, 2005. Differences between *A. etrusca* and the latter include the number of secondary pharyngeal glands (two vs. one pair) and the pairs of preclitellar nephridia (three vs. two).
Distribution
This species was discovered originally in oak woodland soil on limestone in central Tuscany. The present new records in the outskirts of Siena and in Capodimonte Park, Naples city, confirm its association to evergreen Mediterranean woodland and scrub-land on neutral soils. In Capodimonte Park it appeared equally abundant in spring and autumn.

Genus Fridericia Michaelsen, 1889
Fridericia bargaglii sp.nov.
(Figures 5–6)

Fridericia polychaeta, Rota 1995, p. 215 (partim)
Fridericia sp. 3, Rota et al. 2013, tables 1 and figure 3 (species ‘s27’); Rota et al. 2014, tables 1, 2 and Suppl. 1.

Type material
Holotype. MCZR Oligochaeta 0179, whole-mounted specimen, fully mature.

Type locality
Italy, Tuscany (Tu-6), Siena city, Orti dei Tolomei (43.3146°N, 11.3324°E, 330 m asl), grass under Laurus nobilis shrubs on yellowish-brown sandy soil, 31.03.2004, E. Rota coll.

Paratypes. MCZR Oligochaeta 0180, one whole-mounted submature specimen, from Italy, Tuscany (Tu-8), 01.04.1992. MCZR Oligochaeta 0181, one whole-mounted specimen, submature, from Italy, Tuscany (Tu-5), 04.11.1993. SMNH-Types 8723–8724, two whole-mounted specimens, submature, from type locality and date.

Other material. Several specimens, whole mounted or fluid preserved, from Italy, Tuscany, loc. Tu-3, Tu-5, Tu-6, Tu-7, Tu-8, Tu-9, Tu-10, in the author’s collection.

Etymology
Named for Prof. Roberto Bargagli, for his dedication and achievements in environmental research, and with thankfulness for his enduring friendship and support.

Diagnosis
Large multisetose species (4÷7 – 6÷2 : 4÷7 – 6÷2), clitellar gland cells in indefinite rows, ventrally reduced to a narrow strip behind male pores, extra lobes of pharyngeal glands ventrally in VII, nucleated coelomocytes large and pale, peptonephridia multi-branched at two distinct levels, five pairs of preclitellar nephridia, chylus cells in XIII–XV, dorsal blood vessel from XVIII–XX, large seminal vesicle, sperm funnels elongate conical, male slits I-shaped (longitudinal), subneural glands in XIII–XV, spermathecae large, elongate, with two toe-shaped aciliated diverticula and no distinct ectal gland.
Description

Colour white-yellowish, paler after storage in alcohol. Live body length 17–28 mm, width about 0.67–0.83 mm at XII; dimensions can be large also in fixed specimens: length 25 mm, width 0.55–0.60 mm at V, 0.8 mm at XII. Segment number 56–73, \( \bar{x} = 63.5, \ s = 6.2 \ (n = 31) \). Prostomium 1.2 times longer than peristomium, frontally rounded, blunt conical in a lateral view, dorsally depressed in front of head pore, pointing forwards (Figure 5A). Epidermal sensory buds abundant on prostomium, segments I–II and pygidium. Epidermal glands small, dot-shaped, arranged in four complete transverse rows per trunk segment. Clitellum (Figure 5B) slightly elevated (30 \( \mu \)m), interrupted ventrally except immediately behind male openings in XII where a strip of both hyaline and granular cells occurs; both types of gland cells small, 12–18 by 8–12 \( \mu \)m, arranged in indefinite rows, the granular type twice as numerous as the hyaline type. Subneural glands on nerve cord midventral in IV (Figure 5B) and in XIII–XV, located either at the segment equator, or between the ventral chaetal bundles, or in the intersegment. Sometimes also a papilla midventral at 12/13.

Head pore at 0/1, oval (50 \( \mu \)m long). Dorsal pores from VII. Spermathecal pores in ‘lateral lines’ at 4/5, surrounded by glandular epidermis. Male pores as I-shaped longitudinal slits, with distinct, asymmetrical, transverse extensions.

Chaetae weakly hooked entally, 4÷7 – 6÷2 : 4÷7 – 6÷2, but specimens with maximally six chaetae in preclitellar bundles are very frequent. Caudal bundles reducing to two or three chaetae only in last 10 segments. In fixed specimens, ectal tips of chaetae pointing posteriorly in anterior 25 segments, thereafter showing the opposite orientation. Length of chaetae maximal caudally, reaching 120–150 \( \mu \)m.

Cuticle thin, less than 2 \( \mu \)m thick throughout. Body wall thick but soft and relatively transparent. No thickened septa. Brain (Figure 5A) oval, with shallow anterior convexity, in vivo 190–204 by 135–146 \( \mu \)m. Peptonephridia ending in VI or VII, each consisting of a stout stem giving off many thin, long, equal-sized, straight branches at two distinct levels, proximally (or at midlength) and terminally (type c sensu Nielsen and Christensen, 1959) (Figure 6D). Pharyngeal glands four pairs, three of which partly merging dorsally at 4/5–6/7, plus extra lobes ventral in VII (Figure 6A). Five pairs of preclitellar nephridia (6/7–10/11), with efferent ducts arising antero- to midventrally from postseptal.

Coelomocytes: nucleated cells in vivo opaque when accumulated, filled with fine pale granules, up to 50–60 \( \mu \)m long, with very small nucleus; anucleate corpuscles small, 5–10 \( \mu \)m long. The worms discharge abundant coelomic fluid that coagulates at fixation. Chloragogen cells from V. Chylus cells in XIII–XV or XIII–1/2XVI. Ventral intestinal ridge not clearly visible. Dorsal vessel most frequently originating in XVIII–XX, with four pairs of thin lateral commissures: two starting from a common root in III, one in IV and one in V.

Seminal vesicle occupying 2–3 segments within X–XIII (Figure 5C), forming paired bulgings at both ends. Sperm funnels (Figure 5C) elongate conical, tapering toward vas deferens, each 600–900 \( \mu \)m long and 180–250 \( \mu \)m broad in its proximal one-third (which in vivo appears opaque). Collar distinctly set off, 7 \( \mu \)m high, slightly narrower or as wide as funnel. Heads of spermatozoa about 130 \( \mu \)m long. Vasa deferentia 11 \( \mu \)m thick in vivo. Each penial bulb 150–170 \( \mu \)m long (fixed). Up to two eggs mature.

Spermathecae (Figure 6A–C) independently communicating with the dorsal side of gut entally at 5/6; ampulla elongate with two stalked diverticula (resembling big
toes) apically converging toward the ectal duct. Total width of ampulla and diverticula 204–235 μm. Each diverticulum 83–105 μm wide, ending with a large hemispherical (toe-nail shaped) sperm chamber (Figure 6B, C). Inner wall of ampulla pimpled throughout. Inner wall of diverticula not ciliated. Sperm mass not rotating inside the diverticula. Ectal duct 500–550 μm long (1.5–2 times the ampulla) and only 25–30 μm thick in vivo; duct canal straight, of uniform width (2.5 μm); duct projecting into ampulla as a broad bulb lined by tall cells. Some small, indistinct gland cells at spermathecal ectal pores.

Remarks
This species has been earlier (Rota 1995) confounded under the name of *F. polychaeta* Bretscher augm. Southern (1907). After the improved characterization and recognition of the latter taxon as a new distinct species, *F. healyae*, by Schmelz
(2003), and following personal observations on Swedish material of *F. healyae* (see Erséus et al. 2005), I was able to separate the Italian material compiled in Rota (1995) into specimens belonging to *F. healyae* (sample from site Tuscany 17) and specimens belonging to the present new species (all remaining Tuscan samples). In *F. healyae* the clitellum is girdle-shaped and the gland cells are arranged to form an irregular honeycomb tiling, with a ratio between hyaline and granular cells of 1:4 (pers. obs.). In *F. bargaglii* sp. nov. the two types of cells occur with a ratio of about 1:2 and the clitellum is nearly absent ventrally. Other important differences from *F. healyae* are the two-level branching of peptonephridia, the always well-developed seminal vesicle, the extra pair of pharyngeal glands in VII, the many

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**Figure 6.** *Fridericia bargaglii* sp. nov. (A) Semi-schematic drawing of segments IV–VII in a live specimen (dorsal view), showing the spermathecae and the pharyngeal glands; (B and C) spermathecae from whole-mounted specimens (in (C) diverticula seen in a side view); (D) peptonephridia (free-hand sketches) in living specimens; (E) shape and reciprocal distance of the male openings (ventral view). In all, anterior to the top.
subneural glands and the absence of inner ciliation in the spermathecal diverticula. *F. bargaglii* sp. nov. differs from *F. polychaeta* Bretscher, 1900 as originally defined (whether or not one accepts the latter as a valid taxon), by its brain shape, the number of pharyngeal glands, the origin of the dorsal vessel, and the habitat (unlike *F. bargaglii* sp. nov., both *F. healyae* and *F. polychaeta* appear to be associated with wet soils).

**Distribution**

Apparently endemic to Tuscany, associated with neutral soils. Recent studies (Rota et al. 2013, 2014) have confirmed the abundance of this species in urban (Villa Patrizia, plots S2 and S3) and suburban (Belcaro) districts in Siena.

*Fridericia meridiana* sp. nov.  
(Figure 7; Table 1)

*Fridericia* sp. 1, Rota et al. 2013, tables 1 and figure 3 (species ‘s17’); Rota et al. 2014, tables 1, 2 and Suppl. 1.

**Type material**

*Holotype.* MCZR Oligochaeta 0182, whole-mounted specimen, fully mature.

*Type locality*

Italy, Campania (Ca-2), Naples city, Capodimonte Park, a 134 ha historical urban park, positioned on the top of a hill in the northern part of the city (40.8717°N, 14.2519°E, 50 m asl). Holm oak trees with underbrush of *Ruscus aculeatus*, *Hedera helix* and, occasionally, *Tradescantia fluminalis*. Litter and dark humus on loose, coarse-textured soil with fragments of pyroclastic origin, moist, plot N3, pH 6.4, 13.05.2009, E. Rota coll.

*Paratypes.* MCZR Oligochaeta 0183–0184 and SMNH Types 8725–8727, five whole-mounted specimens from type locality and date.

*Other material examined.* Several specimens from type locality, 26.10.2009 and 20.06.2014, in the author’s collection.

**Etymology**

From the Latin ‘meridius’ (meaning = of midday, noon, southern), due to its apparent geographic distribution.

**Diagnosis**

Small quadrisetose species with four chaetae only present in some preclitellar ventral bundles, other bundles containing two or three chaetae; behind clitellum, bundles
Figure 7. *Fridericia meridiana* sp. nov. (A) Anterior body segments (dorsal view). The white arrow points to the small spur of the last pharyngeal glands into VII; (B) clitellum (dorsal view); (C) male pores and midventral interruption of clitellum between and before them; (D) lateral view of clitellum and male opening after fixation; (E) coelomic cavity of segments XI–XII, showing the minute sperm funnel; (F) dorsolateral view of segments IV–V, showing first two pairs of pharyngeal glands and the right spermatheca; (G) coelomocytes; (H) peptonephridium. (A) and (D) from permanent whole-mounted specimens; all others from live specimens. In all, anterior to the right.
Table 1. Key morphological characters distinguishing *Fridericia meridiana* sp. nov. from the known quadrisetose congeners possessing adverticulate spermathecae, peripherally granular coelomocytes and short, simple peptonephridia. Measurements in this table refer to live specimens, except where specified by (f), meaning fixed material.

| Species | *F. meridiana* sp. nov. | *F. bretscheri* Southern, 1907 | *F. schmelzi* Cech & Dózsa-Farkas, 2005 | *F. composti* Schmelz, 2003 | *F. semisetosa* Dózsa-Farkas, 1970 |
|---------|-------------------------|-------------------------------|--------------------------------------|------------------------------|-----------------------------------|
| Length  | 5–6 mm                  | 5–10 mm                       | 5–7.7 mm                             | 6–8 mm                      | 5–7 mm                           |
| Width (at clitellum) | 0.19–0.20 mm | 0.25–0.32 μm | 0.22–0.29 mm & 34–37 | 0.30 mm | 0.15–0.24 μm & 24–34 |
| Segments | 28–36 | 30–42 | (2.3)4 or (3) : 2,3,4; 4 : 2,3 | 33–36 | 1,0 – 0 : 2,3,4 – (3),2,1 |
| Chaetal formula | 2,3 : 2,3,4 | (2,3)4 or (3) : 2,3,4 or (4) : 2 | up to 29 μm | up to 40 μm | up to 50 μm |
| Chaetal length precl. | 25–40 μm | up to 40 μm | (2)4 or (3) : 2,3,4 | 24–34 | up to 30 μm |
| Max length postcl. | 50 μm | 65 μm | (2,3)4 or (3) : 2,3,4 | 20–30 μm | (2,3)4 or (3) : 2,3,4 |
| Clitellar pattern | regular rows, interrupted ventrally in XII; cells mostly hyaline, large | irregular; complete; rows of granular cells between male pores | regular rows, often double, interrupted ventr. in XII; hyaline cells large | irregular; complete; rows of granular cells between male pores | regular rows, interrupted dorsally and ventrally; hyaline cells larger |
| Male openings | T-shaped | longitudinal (staple) | transversal | L or T-shaped | T-shaped |
| Peptonephridia | Type a | Type a | Type a | Type a | Type a |
| Coelomocytes: nucleated | Type b, 18–30 μm long small (5–10 μm) | Type b, 30–36 μm long small (6–10 μm) | Type b, 24–34 μm large (8–12 μm) | Type b, 22–25 μm large (8–12 μm) | Type b, 20 μm(f) large (9–12 μm(f)) |
| Coelomocytes: anucleate | IX–X or X–XI | XII–XV | IX–X, X–XI or X–XII | XIV–XVI | XII–XIII or XI–XII |
| Chylus cells | XIV–XVIII | 5 pairs (6/7–10/11) | 5 pairs (6/7–10/11) | 5 pairs (6/7–10/11) | 5 pairs (6/7–10/11) |
| Dorsal vessel from Preclitellar nephridia | 4 pairs (6/7–9/10) | 4 pairs (6/7–9/10) | 4 pairs (6/7–10/11) | 4 pairs (6/7–10/11) | 4 pairs (6/7–10/11) |
| Sperm funnels l: w | 75: 38 μm | 90–200: 50–100 μm | 48–62: 29–34 μm | 80: 35 μm | 70–110: 37–65 μm |
| Penial bulb length | 55 μm | 80–120 μm | 110 μm | 62 μm | 70–90 μm(f) |
| Spermatic ampulla w; ental ducts; ectal duct l: w | 20 μm(f); separate or adjacent; 175 μm | 43–49 μm; adjacent or merging; 250: 15 μm | 22–25 μm; merging dorsally; 130–160: 10 μm | 25–28 μm(f); merging dorsally; 100–120: 10 μm(f) | 22 μm; merging dorsally; 100: 10 μm(f) |
| glands at pore | 1, small, 8–10 μm long(f) | 1 or 2, large, 60 μm long | 1, 20–30 μm | 1, 20 μm long(f) | 1, 20–22 μm long |
with three chaetae occurring ventrally in XIII–XIV, all other bundles bisetose. Segments 28–36, citellar gland cells absent ventrally between and before male pores. Coelomocytes type $b$, peptonephridia type $a$, four pairs of preclitellar nephridia (6/7–9/10), chylus cells preclitellar. Male slits T-shaped, spermathecae with a small, sessile ectal gland, and bulb-shaped ampullae attached separately, on same or opposite sides of gut.

**Description**

Colour whitish. Live body length 5–6 mm, width about 0.16–0.17 mm at V, up to 0.19–0.20 mm at clitellum; fixed length 2.8–4.1 mm, width 0.14–0.17 mm at clitellum. Segment number 28–36, $x = 31.8$, $s = 2.3$ ($n = 17$). Prostomium (Figure 7A) rounded both in frontal and lateral views, pointing forwards, just as long as peristomium (40 μm after fixation), 50 μm high. Epidermal glands of irregular shape, inconspicuous, arranged in four transverse rows in anterior segments. Clitellum (Figure 7B, D) thin (6 μm), transparent, interrupted between and in front of male pores, annular elsewhere. Clitellar gland cells arranged in about 15 regular rows; dorsal and lateral sides mostly made of large hyalocytes (measuring 16–20 μm across when fixed); only granular cells on ventral side. Subneural glands on nerve cord absent.

Head pore at 0/1. Dorsal pores from VII. Spermathecal pores in ‘lateral lines’ at 4/5. Male pores as T-shaped slits with all three ‘arms’ of equal length (Figure 7C).

Chaetae 2,3 : $2÷4 – (3),2$, length in preclitellar bundles 25–40 μm, reaching maximal values caudally (50 μm). In fixed specimens, ectal tips of chaetae pointing posteriorly in anterior 15 segments, thereafter showing the opposite orientation. Only occasional detached chaetae in coelomic cavity.

Cuticle and body wall thin. No thickened septa. Brain (Figure 7A) soft-tissued, egg-shaped, *in vivo* up to 123 μm long, fixed 70–80 by 40 μm. Peptonephridia (Figure 7H) simple, unbranched, ending in anterior half of V (type $a$ sensu Nielsen and Christensen, 1959). Pharyngeal glands three pairs, merging dorsally at 4/5 (widely) and 5/6 (partly), separate at 6/7, the latter pair with a small spur into VII (Figure 7A). Ventral lobes very small in IV, elongate in V, largest and bent upwards in VI. Four pairs of preclitellar nephridia (6/7–9/10), with efferent ducts arising midventrally from postseptal.

Coelomocytes (Figure 7F, G): *in vivo* nucleated cells with peripheral vesicles (type $b$), 18–32 μm long, anucleated corpuscles of various size, 5–12 μm long. Chloragogen cells from V, *in vivo* opaque, yellow-greenish. Chylus cells in IX–X or X–XI. Intestinal inner ridge extending over 4–6 segments between XIX–XXVIII (ventral intestinal ridge). Dorsal vessel originating in XIII–XIV. Four pairs of thin lateral commissures connect the dorsal vessel with the circumoesophageal commissures and the ventral vessel: two in III, one in IV and one in V.

Seminal vesicle absent. Sperm funnels (Figure 7E) very small, *in vivo* totally 75 μm long, 38 μm broad in proximal two-thirds, tapering distally. Collar narrower than body of funnel. Heads of spermatozoa about 24 μm long *in vivo*. Vasa deferentia 5–7 μm thick *in vivo* (narrower in distal course). Penial bulbs small, 55 μm long *in vivo*, 45 μm after fixation. One egg mature.

Spermathecae attached separately to gut, on same or opposite side of dorsal vessel (Figure 7F). Each spermatheca consists of a simple bulb-shaped ampulla (24 μm wide *in vivo*, 20 μm after fixation) and an ectal duct (160–175 μm long and 9 μm thick *in vivo*, 80
by 8–10 μm after fixation) endowed with a small sessile gland (16 μm long, 8–10 μm after fixation) at the external orifice. Sperm mass in a circle inside ectal lumen of ampulla.

**Remarks**

This species belongs to a group of small, quadrisetose *Fridericia* with bulb-shaped spermathecal ampulla, characterized by peripherally granular coelomocytes and short unbranched peptonephridia (see Cech and Dózsa-Farkas 2005). In particular, it resembles *F. bretscheri* Southern, 1907 in the texture of coelomocytes and number of preclitellar nephridia, but differs from it by the thinner body wall, the small spermathecal gland, the different chaetal formula, clitellar pattern, position of the chylus cells and shape of the male slits. In the latter features, it rather resembles *F. composti* Schmelz, 2003, *F. schmelzi* Cech and Dózsa-Farkas, 2005 and *F. semisetosa* Dózsa-Farkas, 1970, all of which however possess five pairs of preclitellar nephridia, comparatively larger anucleated coelomocytes and different chaetal formulae and clitellar patterns (Table 1).

**Distribution**

The material described comes exclusively from Naples, Capodimonte, plot N3 (sexually mature both in spring and autumn). According to some old notes, possibly also found in Erice (Sicily).

*Fridericia bulbosa* (Rosa, 1887) sensu stricto

(Figure 8; Table 2)

*Neoenchytraeus bulbosus* Rosa, 1887, p. 2.

*Fridericia bulbosa* (Rosa, 1887) sensu stricto, Rota 1995, pp. 204–205; Rota et al. 2013, table 1 and figure 3 (species ‘s18’); Rota et al. 2014, tables 1, 2 and Suppl. 1.

**Material examined**

Published material. Specimens from Tuscany, Calabria and Sicily (Rota 1995).

New material (in the author’s collection). Some 50 specimens from Italy, Tuscany (Tu-7), plot S1, 24.04.2009 and 05.11.2009, and a total of about 400 specimens from Tuscany (Tu-5), 24.04.2009 and 05.11.2009. About 75 specimens from Italy, Campania (Ca-2), plots 1 and 3, 13.05.2009 and 26.10.2009.

**Augmented diagnosis**

Small worms (5–7 mm long, 0.18 mm wide at V, 0.22–0.26 mm wide at XII), transparent, slow moving. Segments 24–42 (investigation of urban populations has widened the variation range towards small values; see Table 2). Prostomium dorsally depressed in front of head pore (Figure 8A, B). Epidermal gland cells large, rectangular, in 3–5 rows, only some complete (Figure 8F). Clitellar gland cells (Figure 8C, D, G) arranged in a chequered pattern (in fixed specimens the hyaline cells dominate
Figure 8. *Fridericia bulbosa* (Rosa, 1887) sensu stricto. (A) Anterior body segments (dorsal view); (B) lateral view of segments I–V. (C and D) Clitellum in dorsal (C) and ventrolateral views (D); the elliptical contour in (D) shows the midventral granular field behind the male pores; (E) chylus cells in segment XIV; (F) shallow dorsolateral view of segments IV–V, showing the conspicuous epidermal gland cells; (G) midventral close-up of clitellum revealing the I-shaped male slits and the granular field behind them (contour); (H) dorsal view of segments IV–VI, showing the bent tail of a peptonephridium, the spermathecae and the pharyngeal glands. I, coelomocytes. (A) to (D) from permanent whole-mounted specimens, (E) to (I) from live specimens. Anterior to the right, except in (G) and (H) where anterior is to the top.
Table 2. Key morphological characters distinguishing *Fridericia rara* sp. nov. from *F. bulbosa* sensu stricto, the only known quadrisetose congener possessing addiverticulate spermathecae, hyaline coelomocytes and short, simple peptonephridia. Measurements in this table refer to live specimens, except where specified by (f), meaning fixed material.

| Species          | *F. rara* sp. n. | *F. bulbosa* sensu Rota, 1995 | *F. bulbosa* – urban SI | *F. bulbosa* – urban NA |
|------------------|------------------|-------------------------------|------------------------|------------------------|
| Length           | 5 mm             | 7–9 mm                        | 6 mm                   | 5–7 mm                 |
| Width (at clitellum) | 0.25 mm         | 0.23–0.28 mm                   | 0.23 mm                | 0.22–0.26 mm           |
| Segments         | 27–32            | 39–41                         | 27–37                  | 24–36                  |
| Chaetal formula  | 0.2 : 2,3,4 : 2  | 2,3,4–4,3 : 2,3,4–4,3,2       | 2,3,4–2 : 2,3,4–(4,3)2 | 2,3,4–2 : 2,3,4–4,3,2  |
| Chaetal length precl. | 24–27 μm       | up to 45 μm                   | up to 42 μm            | up to 40 μm            |
| Clitellar pattern | regular rows, chequered, interr. ventrally in XII; cells mostly hyaline, large | regular rows, absent between pores, granular behind them, mosaic in XIII; hyaline cells large | regular rows, absent between pores, granular behind them, mosaic in XIII; hyaline cells large |
| Male openings    | longitudinal, glandular duct end | longitudinal                | longitudinal           | longitudinal           |
| Peptonephridia   | Type a           | Type a                        | Type a                 | Type a                 |
| Coelomocytes:    | nucleated        | Type a, 24–30 μm long(f)      | Type a, up to 30 μm long | Type a, 32–40 μm long |
|                  | anucleate        | small (2.5–6 μm)(f)           | small (4–10 μm)        | small (4–6 μm)         |
| Chylus cells     | XII–XIV          | XIII–XIV                      | XIII–XIV              | XIII–XIV              |
| Dorsal vessel from | XV               | XVI–XVII                     | XVI                   | XV–XVII               |
| Precitellar nephridia | 3 pairs (6/7–8/9) midventral | 5 pairs (6/7–10/11)          | 5 pairs (6/7–10/11) subterminal | 5 pairs (6/7–10/11) |
| Sperm funnels l : w | 88 : 50 μm      | 152–184 : 65 μm              | 80 : 32 μm (f)        | 75–100 : 42–50 μm     |
| Penial bulb length | 50 μm(f)         | 120 μm, soft, 80(f)           | 50–58 μm(f)           | 60–64 μm(f)           |
| Spermathecal ampulla w; | 45 μm; 32(f) | 30 μm; 26(f) | 30 μm; 26–28(f) | 32 μm; 24–29(f) |
| ental ducts;     | adjacent;        | adjacent;                     | adjacent, on one side; | merging;               |
| ectal duct 1 : w; | 112 : 10 μm(f); | 245 : 12 μm;                  | 225 : 15 μm;          | 175 : 15 μm;          |
| glands at pore   | one, small, 8 μm long(f) | one, 28 μm long              | one, small, 13 μm long | one, small, 10 μm long(f) |
in size and number) except in some ventral areas: between and before male pores, where glands are completely absent, and in posterior ventral part of XII where a field of granular cells occurs. Subneural glands on nerve cord absent. Male slits longitudinal (Figure 8G).

Chaetal formula $2\div 4 - 2 : 2\div 4 - (4,3), 2$. Behind the clitellum, lateral bundles are generally all bisetose, whereas ventral bundles become bisetose starting from XV–XVII. Size of chaetae in precilitellar lateral bundles one fourth smaller than in ventral ones (Figure 8B) (e.g. in urban populations in Siena and Naples, measuring 24–32 $\mu$m in lateral bundles and 29–42 $\mu$m in ventral bundles, thickness 2–2.5 $\mu$m). Postclitellar chaetae, both lateral and ventral, beginning with minimal sizes in segments XIII–XVII (in urban populations: 26–30 $\mu$m long, 2.5 $\mu$m thick), then gradually increasing to reach an identical maximum in caudal segments (in urban populations: 40–42 $\mu$m long, 3–3.5 $\mu$m thick).

Peptonephridia short, unbranched (Figure 8H). Pharyngeal glands (Figure 8A) dorsally merging at 4/5 (widely) and 5/6 (narrowly), dorsally free at 6/7; ventral lobes small in IV, middle-sized in V, as large as dorsal lobes in VI. Five pairs of precilitellar nephridia (6/7–10/11), efferent ducts originating posteroventrally.

Coelomocytes (Figure 8I): nucleated cells hyaline (type $a$), 32–40 $\mu$m long, anucleated small (4–9 $\mu$m). Chloragogen cells yellow-gold or yellow-green. Chylus cells in XIII–XIV, XIII–XV or XIV–XV with long intracellular canals (Figure 8E). Ventral intestinal ridge poorly discerned, in one specimen seen in XXII–XXVII. Dorsal blood vessel from XVI–XVII, with four paired lateral commissures to ventral vessel, first two pairs (in III) rising from a common root.

Sperm funnels barrel-shaped, l:w = 2.5:1, in live urban specimens: 75–100 $\mu$m long and 43–50 $\mu$m wide, collar 2/3 as wide as funnel, covered with long spermatozoa (heads 75 $\mu$m long, tails about 100 $\mu$m in Naples worms), vas deferens 5–7.5 $\mu$m thick (narrower in distal course). Penial bulb oval, soft, 50–80 $\mu$m long after fixation. Ovary bush-like (Figure 8C). One egg mature at a time. Spermathecal ectal ducts (Figure 8H) very long (175–225 $\mu$m, 15 $\mu$m thick in vivo), each with an inconspicuous to small (13–23 $\mu$m long), sessile ectal gland; ampullae small and bulb-shaped, 30–32 $\mu$m across, containing a circle of sperm, attached close or jointly to one side of gut (Figure 8H).

Remarks

Rosa (1887) described his Neoenchytraeus bulbosus from woodland soil near Turin, in the north of Italy, providing few details but still a precise combination of characters. The new species could be recognized by (i) its relatively small size (4–8 mm, segments 32–42); (ii) chessboard-like clitellum, made of large, irregularly squared, granular cells (‘areole’) on a smooth background (i.e. against the hyaline cells), the latter, however, becoming dominant by size after fixation; (iii) chaetae in bundles of four or three in the anterior half of the body, in couples in the posterior region, the ventral chaetae being longer than the dorsal; (iv) peptonephridia elongate, thin-walled, poorly branched, generally just bifurcated, likened for their simplicity to those illustrated by Vejdovský for F. leydigi; (v) dorsal vessel originating in XVI–XVIII, with the first two lateral commissures originating from a common root; (vi) spermathecal ampullae bulb-shaped, adiverticulate, with ental portion elongate and firm, and ectal
duct long and devoid of glands; (vii) nephridia with subterminal efferent ducts; (viii) coelomocytes medium-sized.

Unfortunately, for long time *F. bulbosa* has been diagnosed in the absence of an adequate correspondence with Rosa’s description as detailed above, the species identification being rather based mostly on the possession of ad diverticulate, bulb-shaped spermathecal ampullae. This resulted in an accumulation of records worldwide and an overrating of intraspecific variation (in 1929 Ude allowed *F. bulbosa* up to six chaetae per bundle and as many as 70 segments). Nielsen and Christensen (1959) were the first to suspect that the species might have lost its genuine identity, but were inclined to believe that Rosa’s account concerned a mixture of species or that some characters varied geographically, rather than to accept that Rosa’s (1887) original account, taken in its entirety, unequivocally matched a taxon occurring in Italy.

In 1995, based on material collected in central and southern Italy, I rectified the morphological diagnosis of *F. bulbosa* sensu stricto in adhering to the original description (Rota 1995). Thanks to a recent high-intensity sampling (Rota et al. 2013, 2014), I could go more in depth and examine the intra- and interpopulation variation on a regional scale (see Table 2), so as to expand the list of consistent features characterizing the Italian taxon. *F. bulbosa* s.s. now appears to be morphologically fairly homogeneous. The description of the present new material collected in a central and a southern region of Italy agrees with the account of Rosa from northern Italy in virtually all points.

The same account is sufficiently detailed to exclude all the European ad diverticulate species that (while yet undescribed) at one stage or another may have been included in *F. bulbosa*: species with fewer or missing chaetae (e.g. *F. benti*, *F. composti*, *F. cusanica*, *F. semisetosa*), as well as those with more than four chaetae or larger body sizes (e.g. *F. caprensis*, *F. tuberosa*, *F. striata*, *F. ilvana*), species possessing peptonephridia of type b (e.g. *F. bulboides*), and species with large spermathecal glands (e.g. *F. bretscheri*). Indeed, at the current level of taxonomic resolution, each of the above-mentioned species differs not in one, but in several critical traits from *F. bulbosa* in its strict original acception. Thus, Nielsen and Christensen (1959) and other authors’ statements that a clear conception of its morphology has never existed appears incorrect, and Schmelz’s (2003) proposal to consider *F. bulbosa* a nomen dubium is not acceptable.

As concerns the presence of spermathecal ectal glands and the shape of peptonephridia, conflicting interpretations can be reconciled if early descriptions are understood in the appropriate historical context: in 1887, still few enchytraeid species were known to possess dorsal pores and multiple chaetae growing pairwise in a bundle (that group would be allocated by Michaelsen to *Fridericia*, in 1889). The sole other species known in that group to possess ad diverticulate spermathecae (*F. striata*) was a very different worm (much bigger, with more chaetae, peptonephridia much branched, with two large spermathecal ectal glands; Levinsen 1884). Spermathecal ectal glands among the earliest known *Fridericia* spp. (*F. bisetosa*, *F. striata* or *F. hegemon*) were always conspicuous, while in *F. bulbosa* s.s. these glands range from small to a simple thickening of the distal end of the spermathecal duct, and may have been easily overlooked. Likewise, Vejdovsky’s (1879b) drawing of a peptonephridium in *F. leydigii* showed the simplest shape of that organ in the group. Inferring from that comparison an elongate branching of the peptonephridia
for *F. bulbosa* (e.g. Schmelz 2003) is questionable. In fact, it all depends on the length of branches. The same *Fridericia* species with short peptonephridia can vary between having peptonephridia unbranched or with few stump-like terminal branches. Among species of similar body size to *F. bulbosa* s.str., one finds *F. benti* having these organs either unbranched, or occasionally with 2–3 terminal stump-like branches (Schmelz 2003). In *F. bretscheri* peptonephridia are generally unbranched, but Schmelz (2003) detected a terminal bifurcation in an Irish specimen. In *F. paroniana*, the short peptonephridia are either unbranched or shortly bifurcated distally. (For the authorities of species mentioned in the above remarks, see Rota 1995; Schmelz 2003).

**Distribution**

The occurrence of *F. bulbosa* s.s. outside Italy remains to be ascertained. In any case, the species appears very selective in its habitat, being exclusive of oak woods and meadows on limestone (Rota 1995). During my survey of urban holm oak stands in Siena and Naples (Rota et al. 2013, 2014), it showed peaks of abundance in samples from Villa Patrizia (plot S1) and Belcaro, where the soil was characterized by heavy carbonate precipitation (either as a horizontal accumulation layer or as nodular concretions). In Naples it was found in Capodimonte (plots N1 and N3), whereas it appeared absent from Astroni (N4), a site with subacidic soils and poor in calcium (Rota et al. 2013).

*Fridericia rara* sp. nov.  
(Figure 9; Table 2)

*Fridericia* sp. 2, Rota et al. 2013, table 1 (species ‘s19’); Rota et al. 2014, tables 1, 2 and Suppl. 1.

**Type material**

*Holotype.* MCZR Oligochaeta 0185, whole-mounted specimen, fully mature.

*Type locality*

Italy, Campania (Ca-2), Naples city, Capodimonte Park, a 134 ha historical urban park, positioned on the top of a hill in the northern part of the city (40.8717°N, 14.2519°E, 50 m asl). Holm oak trees with underbrush of *Ruscus aculeatus*, *Hedera helix* and, occasionally, *Tradescantia fluminalis*. Litter and dark humus on loose, coarse-textured soil with fragments of pyroclastic origin, moist, pH 7.0, plot N1, 13.05.2009, E. Rota coll.

*Paratypes.* MCZR Oligochaeta 0186–0187, two whole-mounted specimens, fully mature, from type locality and date.

**Etymology**

Named for its very unusual features, including the unique chaetal formula and the small complement of preclitellar nephridia.
Figure 9. *Fridericia rara* sp. nov. (A) Anterior body segments (dorsolateral view), showing the pharyngeal glands, the left spermatheca and the preclitellar nephridia; (B and C) details of clitellum on its dorsal (B) and ventrolateral sides (C). Note the absence of gland cells ventrally in XII. Squared contour on midventral interruption indicates the position of (D). (D) Close-up of male pore; (E) sperm funnel; (F) lateral view of segments IV–V, showing the left spermatheca; (G) chylus cells showing through intestinal wall in segments XIII–XIV. All from permanent whole-mounted specimens, anterior to the left.
Diagnosis
Small quadrisetose species with a unique chaetal formula \((0,2 – 2 : 2\div4 – 2)\), clitellar gland cells mostly hyaline and large, completely absent ventrally between and before male pores, coelomocytes hyaline (type \(a\)), peptonephridia type \(a\), only three pairs of preclitellar nephridia, chylus cells in \(XII–XIV\), dorsal blood vessel from \(XV\), sperm funnels small, barrel-shaped, male slits longitudinal, each resembling a squared parenthesis, enclosing on its inner side the glandularized male pore, which appear as a small star-like formation (modiolus in Schmelz’s terminology), spermathecae with bulb-shaped ampullae and a small sessile ectal gland.

Description
Colour whitish. Live body length 5 mm, width 0.25 mm at clitellum; fixed length 3.0–3.8 mm, width 0.15–0.16 mm at clitellum. Segment number 27–32 \((n = 3)\).

Prostomium (Figure 9A) rounded both in frontal and lateral views, pointing forwards, just as long as peristomium \((35 \mu m\) after fixation), 50 \(\mu m\) high. Epidermal glands arranged in three rows, more developed lateroventrally (only one seen in dorsal view). Clitellum (Figure 9B, C) up to 10–14 \(\mu m\) thick, interrupted between and in front of male pores, annular elsewhere. Hyaline and granular gland cells in about 20 chequered rows, hyaline cells larger \((13–19 \times 11–13 \mu m)\), elongate transversely, present also behind male pores. Subneural glands on nerve cord absent.

Head pore at 0/1. Dorsal pores from VII. Spermathecal pores in ‘lateral lines’ at 4/5. Male pores \(in vivo\) as longitudinal slits, each resembling a squared parenthesis, enclosing on its inner side the glandularized male pore, which appears as a small but distinct star-like formation (modiolus in Schmelz’s terminology); in fixed specimens each male pore appears simply surrounded by a small rosette (Figure 9C, D).

Chaetal formula \(0,2 – 2 : 2\div4 – 2\), i.e. lateral bundles absent in II, bisetose elsewhere; ventral bundles with three or four chaetae in some preclitellar bundles, bisetose elsewhere. Maximal chaetal length 32–35 \(\mu m\), both before and after clitellum. In fixed specimens, ectal tips of chaetae pointing posteriorly before clitellum, thereafter showing the opposite orientation. Only occasional detached chaetae in coelomic cavity.

Cuticle and body wall thin. No thickened septa. Brain (Figure 9A) 80 \(\mu m\) long when fixed \((n = 3)\). Peptonephridia simple, unbranched, ending in anterior part of V (type \(a\ sensu\) Nielsen and Christensen 1959). Pharyngeal glands (Figure 9A) three pairs, merging dorsally at 4/5 (widely) and 5/6 (partly), adjacent at 6/7. Ventral lobes absent in IV, middle-sized in V–VI. Only three pairs of preclitellar nephridia \((6/7–8/9)\), with efferent ducts arising midventrally from postseptal (Figure 9A).

Coelomocytes: \(in vivo\) nucleated cells hyaline (type \(a\)), fixed length 24–30 \(\mu m\), anucleated corpuscles medium to small, fixed length 2.5–6 \(\mu m\). Chloragogen cells from V. Chylus cells in XII–XIV (Figure 9G). Intestinal inner ridge ventral in XXII–XXVI. Dorsal vessel originating in XV. Four pairs of thin lateral commissures connect the dorsal vessel with the circumoesophageal commissures and the ventral vessel: two (with close roots) in III, one in IV and one in V.

Seminal vesicle absent. Sperm funnels (Figure 9D) barrel-shaped, 88 \(\mu m\) long and 50 \(\mu m\) wide \(in vivo\), 56–67 by 45–56 \(\mu m\) after fixation. No distinct collar. Heads of
spermatozoa about 40 μm long in vivo. Vasa deferentia 5 μm thick when fixed. Penial bulbs 50 μm long after fixation. One egg mature.

Spermathecae (Figure 9F) with ectal ducts 112 by 10 μm after fixation (diameter 14 μm in vivo), each with a small (8 μm fixed), sessile ectal gland and bulb-shaped ampullae, 45 μm across (32 μm after fixation), containing a circle of sperm, attached close to one another to gut. In one paratype, spermatheca on the right attached to gut in VI.

Remarks
Among all Fridericia species, F. rara sp. nov. is distinguished by a set of unusual traits: a unique chaetal formula, an unprecedented reduction of preclitellar nephridia (also F. lacii Dózsa-Farkas, 2009 has only three pairs of preclitellar nephridia, but positioned at 7/8–9/10), and a peculiar shape of the male openings. Compared with the other Fridericia species with bulb-like spermathecal ampullae, simple peptonephridia and hyaline coelomocytes, F. rara appears closest to F. bulbosa s.s., with which it shares the quadrisetose ventral pattern (Table 2).

Distribution
Only known from Naples, Capodimonte plot 1, in spring.

Fridericia miraflores Sesma and Dózsa-Farkas, 1993

Fridericia miraflores Sesma and Dózsa-Farkas, 1993, pp. 252–254, figures 8–14.
Fridericia miraflores, Rota 1995, pp. 211–212, tables 5–6; Rota and Healy 1999, p. 58; Rota et al. 2013, table 1 and figure 3 (species 's25'); Rota et al. 2014, tables 1, 2 and Suppl. 1.
Fridericia sylvatica, Schmelz 2003, pp. 330–333, figure 65A–H; Schmelz and Collado 2010, pp. 130, 142.

Material examined
Published material. Specimens from Tuscany, Latium and Calabria (Rota 1995).
New material (in the author’s collection). 12 specimens from Italy, Campania (Ca-1), 14.05.2009 and 27.10.2009. 32 specimens from Campania (Ca-2), plots N2 and N3, 13.05.2009 and 26.10.2009.

Remarks
This is one of few species in Fridericia having the clitellum interrupted both dorsally and ventrally (Rota and Healy 1999, p. 58; see also Schmelz 2003, as F. sylvatica). This feature and the occurrence of ventral pharyngeal glands in VII (Schmelz 2003, as F. sylvatica) is confirmed for the present and previous material from Italy (as well as for specimens from Algeria), including those with short diverticula.

The synonymy of this species with the poorly defined F. sylvatica Healy, 1979 was established by Schmelz (2003), on the basis of the similar chaetal formula and the
laterally projecting spermathecal diverticula, and despite important differences in the
two original descriptions (size of chaetae, origin of the dorsal vessel, variation in size
of the spermathecal gland) and the lack of type material of *F. sylvatica*. Schmelz
(2003) himself discovered that the sole specimen (submature and incomplete) labelled
as type of *F. sylvatica* was not compatible with any of the key characters in the
original diagnosis. Although *F. miraflores* can be collected at the type locality of *F.
sylvatica* (UCD campus, Dublin) (Rota 1995), I believe the circumstances rather
suggest that *F. sylvatica* should be considered a nomen dubium, in that (1) ‘the
taxonomic identity of the taxon cannot be determined from its existing name-bearing
type’ (ICZN 1999: Art. 75.6), and (2) the original description of *F. sylvatica* probably
involved one or more different species (in particular, the reported variation in the
spermatheca towards more globular ampullar diverticula and larger ectal gland point
to *F. globuligera* Rota, 1995, a species also present in the UCD area; own unpub-
lished record). In conclusion, the originally better described and type-based *F. mira-
flores* is to be regarded as a valid name. This choice is consistent with the reasoning
by Schmelz (2003) on the analogous cases involving *F. tirolensis* Schmidegg, 1938 and
*F. discifera* Healy, 1975.

**Distribution**

Euro-Mediterranean. Present in both seasons at Naples sites.

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