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Italian marine Gastrotricha: V. Four new and one redescribed species of Macrodasyida in the Dactylopodolidae and Thaumastodermatidae

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ABSTRACT

Four species new to science are described and figured from the Italian coastline of the Mediterranean Sea and its adjacent waters: the Mediterranean *Dactylopodola mesotyphle* n. sp. in the family Dactylopodolidae, a neotenous sibling species of the more geographically ubiquitous *D. typhle* Remane, 1927, is differentiated from the latter both morphologically and biogeographically. Of three species of *Tetranchyroderma*: *T. aphenothigmum* n. sp., *T. psilotopum* n. sp., and *T. symphorochetum* n. sp. in the family Thaumastodermatidae, the first and third have a complete dorsal covering of tetrancres, while the second has an incomplete covering of pentancres. The species *Dendrodasys affinis* Wilke, 1954 in the family Dactylopodolidae is redescribed, and figured for the first time, from specimens collected in littoral and shallow sublittoral sediments near Naples.

KEY WORDS: Gastrotricha - Macrodasyida - Italy - Greece - Cyprus - Egypt - Mediterranean meiofauna - Benthos - Taxonomy - New species.

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INTRODUCTION

This is the fifth of a series of papers that describe or redescribe several new species of marine gastrotrichs from Italian coasts, which our group discovered in sandy samples collected during the summers of 1989-1991. Here we concentrate on the redescription of one species and the description of four new species of Macrodasyida. The four previous papers have reported the redescription of one species and description of eleven new species of chaetonotids (Hummon *et al.*, 1992; Balsamo *et al.*, 1997) and one new genus and fourteen new species of macrodasyids (Hummon *et al.*, 1993, 1996).

MATERIALS AND METHODS

The readers should refer to ours previous papers of this series (Hummon *et al.*, 1992, 1993) for collecting sites and study methods. Two additional sites are here added to the previous list: CAMPANIA, Palazzo Donn'Anna at Posillipo (lat. 40°49' N; long. 14°13' E) (SL), Gulf of Naples; APULIA, Cala della Pergola (lat. 41°46' N; long. 16°11' E), Gargano.

Abbreviations and conventions

Lt, total body length from the fore most part of the head to posterior tip of caudum and its adhesive tubes; Hd, head; Nk, neck; Tr, trunk; FB, furcal base; PhJIn, junction between pharynx and intestine; LPh, length from foremost part of mouth to PhJIn; TbA, adhesive tubes of the anterior series; TbL, adhesive tubes of the lateral series at or anterior to the anus, including dorso- and ventrolateral elements, but not tubes of strictly dorsal (TbD) or ventral (TbV) series; TbP, adhesive tubes of the posterior series associated with the caudum, as well as those of the lateral series that lie posterior to the anus; Cirrata, non adhesive cirriform projections, which occur dorsally in some Thaumastodermatidae; Columns, longitudinal in orientation; Rows, transverse in orientation; U, percentage units of Lt from anterior to posterior.

Key to ecological characteristics: L, littoral sample; SL, sublittoral sample.

Frequency of a species from among a sample series: Sparse, less than 10% of samples; Occasional, 10-30% of samples; Common, 30-60% of samples; Usual: more than 60% of samples.

Abundance of a species among other species of a sample: Rare, less than 1% of a sample; Scarce: 3-5% of a sample; Numerous: 10-20% of a sample (often a sub-dominant); Prevalent, more than 30% of a sample (usually a co-dominant or dominant).

TAXONOMIC ACCOUNT

Order MACRODASYIDA Remane, 1925
[Rao & Clausen, 1970]
Family DACTYLOPODOLIDAE Strand, 1929
Genus *Dactylopodola* Strand, 1929

Dactylopodola mesotyphle n. sp.

Fig. 1, Table I

Dactylopodola typhle in Hummon & Roidou, 1995: p. 283, Table 1.

Diagnosis - A *Dactylopodola*, to 285 µm in length; PhJIn at U26; head rounded, with medial bulge forward, well-delineated into

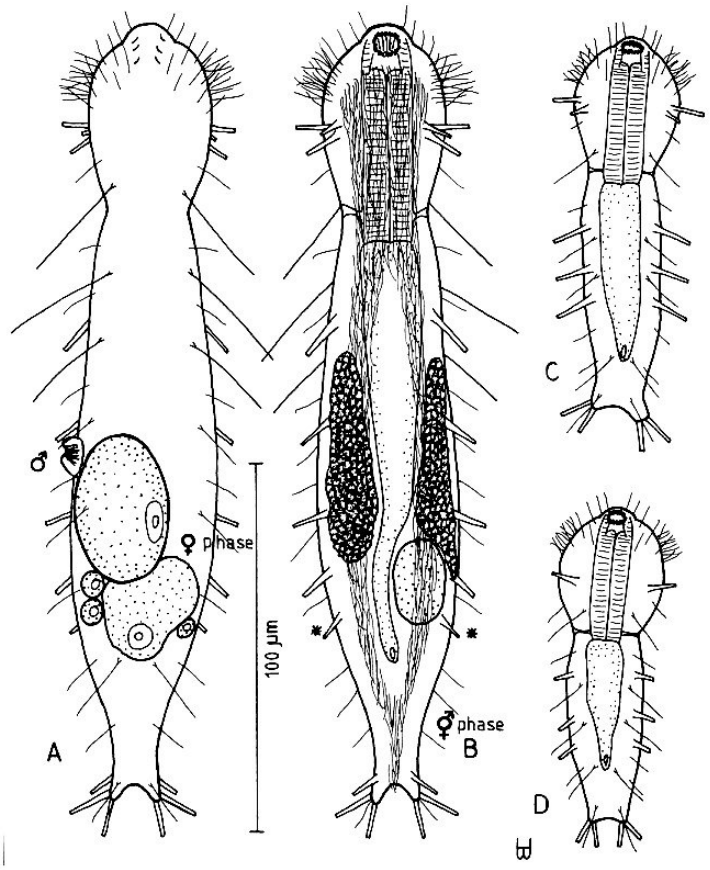

Fig. 1 - *Dactylopodola mesotyphle* n. sp. A, dorsal view with superimposed the female reproductive tract of a larger specimen. B, ventral view. The last TbL, marked with an asterisk (*), may not be present. C, an adolescent specimen. D, a post-hatching juvenile specimen.

head/neck/trunk/caudum regions. Sensory hairs, abundant on head especially its lateral surfaces, occur in dorsolateral and dorsal columns down the body length, the first 3 of the dorsal columns being longer than the others. Glands absent. Adhesive tubes: TbA, 3 per side, elongate; TbL arranged as 1+1+3 (or 1+1+2); TbP, 3 per side, 2 arising distally from caudal lobes and 1 arising laterally in front of these. Ventral locomotor ciliation: a longitudinal field runs nearly the length of the body, being split throughout the intestinal region. Reproductive system: protandrous, simultaneous or alternating hermaphrodites; testes paired in mid-intestinal region; ovaries paired in posterior intestinal region, eggs developing toward the anterior in a more medial position.

Etymology - The name refers to the sibling relationship of this middle sized *Dactylopodola* with the larger *D. typhle* (*mesos*, Gk. middle; *typhlos*, Gk. blind).

Description - The description is based on an adult specimen, 220 µm in total length (Lt). Pharynx 57 µm in length, measured from the anterior margin of the mouth to the pharyngo-intestinal junction (PhJIn) at U26. Head rounded anteriorly, with a slight medial bulge forward in conjunction with the mouth, well-delineated into head/neck/trunk/caudum regions, broadening laterally to 33 µm in width at U11; body then narrows gradually to form a neck of 23 µm width at U24, where the pharyngeal pores open, then expands over much of the intestinal region, reaching 39 m width at U61, beyond which it tapers to 12 µm width at the base of the caudum (U91); caudum consists of a relatively short, broad peduncle that ends in paired lobes that indent medially to U93. Head bears numerous sensory hairs of mixed length (6-13 µm), most occurring laterally; other sensory hairs include 10 per side (8-13 µm) evenly spaced in dorso-lateral columns from U17 to U95, and 7 per side (the first three 25-33 µm in length, the last four 13-19 µm) unevenly spaced in dorsal columns from U20 to U40 and from U48 to U93. Glands not noted. Longitudinal muscles are striated, as is characteristic of members of this family.

Adhesive tubes: there are three adhesive tubes (TbA) per side, inserting directly on the body surface and radiating from a more-or-less common base at U12, the first projecting laterally, and the other two projecting posterio-laterally, with lengths of 9-10, 10-11 and 6-8

µm, respectively. There are five lateral tubes (TbL) per side, arranged as 1+1+3 at U36+U48+U60/U67/U72, the last group being almost as widely spaced from one another as the others are from themselves and from its first tube, the lengths of the first three tubes being 10-13 µm and the lengths of the final two tubes being progressively shorter. There are three posterior tubes (TbP), two 11-12 µm long arising distally from the caudal lobes and a third 9 µm long arising laterally in front of these.

Ventral ciliation: a longitudinal field extends from U05 to U92, splitting into two bands throughout the intestinal region, U28-U83, being 17-24 µm wide in the pharyngeal region, 4-6 µm in the separated intestinal region and 6 narrowing to 3 µm in the caudal region; individual cilia of the bands are short (6-8 µm).

Digestive tract: the mouth is beaded at its surface and is 6 µm in diameter; the buccal cavity broadens to 8 µm in the rear at U06; the pharynx, which begins at the mouth and surrounds the buccal cavity is 13-14 µm wide over most of its length, its pores opening anteriolaterally at U23; the intestine is broadest (15 µm) in front, narrowing slowly over the first two-thirds of its length and then quickly, being narrowest (5 µm) in the rear; the anus is longitudinally oval and opens ventrally at U78.

Reproductive tract: protandrous, simultaneous or alternating hermaphrodites; testes occur as irregular paired clusters of grape-like spermatocytes in the midintestinal region, 56-60 µm in length by 6-14 µm in width, with individual cells ca. 1 µm in diameter, yielding several hundreds per side; ovaries are paired in the posterior intestinal region, with one or sometimes two maturing eggs attaining their development by shifting anteriorly in a more medial position; caudal and frontal organs not seen.

Distribution - Type locality - GREECE, ATTICA: Loutsa Beach (lat. 37°56' N; long. 24°01' E) (L), east of Athens (WDH recorded and drawn in 1974; Hummon & Roidou, 1995 as *D. typhle*). Italian locations include: San Remo (SL) in Liguria, and Castiglione della Pescaia (SL), Marina di Donoratico (SL), Tombolo di Feniglia (SL) and Tombolo di Giannella (L) at Orbetello in Tuscany [see Tables 1 and Figs 1 of Hummon *et al.*, 1992, 1993]. This new species is also now known from several localities in Cyprus and the Mediterranean coast of Egypt (Hummon, unpubl. data).

Ecology - Frequency of occurrence - sparse, regionally occasional, in fine, generally well-sorted sand from the lower littoral to sublittoral depths of at least 3 m water depth; Abundance - scarce to numerous where found.

Remarks - Many animals reaching maturity show only testes, while the one described above was bisexual. We know that the spherules are spermatocytes because we have seen sperm with minutely-spiraled heads emerge from them. Among the larger specimens are a few, for example one 265 µm long from San Remo, that show a female but no apparent male reproductive system; the female system of this specimen has been superimposed on the dorsal view of the specimen from Loutsa Beach in Figure 1A. Present are three young eggs, two on the left and one on the right, along with two maturing ones (44 x 32 µm). It also shows what we tentatively interpret as a conical-shaped entrance mound for a spermatophore (for the production and function of spermatophores in *D. baltica*, see Teuchert, 1968: 352, figs 3, 4). Photographs of a specimen of 242 µm total length, from Giannella, shows the same conical protuberance in the same location. Mature Italian specimens analysed below all but one lacked the last TbL, giving them a formula of 1+1+2, rather than the 1+1+3 of the type material from Greece. The juveniles in Figure 1C and 1D from Loutsa Beach were 114 and 92 µm in total length, respectively.

Taxonomic affinities - The species most closely related to *Dactylopodola mesotyphle* is its sibling species *D. typhle* (Remane, 1927), including the junior synonym of that species, *D. weilli* (d'Hondt, 1965). For the discussion regarding *D. weilli*, see Luporini *et al.* (1973), Kisielewski (1987), and Todaro *et al.* (1992). It is likely that the specimens from the region of Arcachon (France) represent a morphological variant of *D. typhle*, but it is not clear that it is a separate species.

The geographical distribution of *Dactylopodola typhle* is as follows: Italy (Remane, 1927; Wilke, 1954; Luporini *et al.*, 1973; Todaro *et al.*, 1992; Balsamo *et al.* 1995; Balsamo *et al.*, 1996); Germany (Remane, 1927, 1929, 1951; Forneris, 1961; Schmidt & Teuchert, 1969; Hummon, unpubl. data); the Netherlands (Zaneveld, 1938); France (Lévi, 1950; Swedmark, 1955, 1956a, b; Dragesco, 1960; d'Hondt, 1965, 1967, 1970 as *Dactylopodola weilli*; Kisielewski, 1987 as *D. weilli*; Hummon & Todaro, unpubl. data); Sweden (Swedmark, 1950); Denmark (Remane, 1951, 1954; Forneris, 1961); Romania (Rudescu, 1967); Algeria (d'Hondt, 1974); the United States of America (McGeary, 1974; Todaro *et al.*, 1995; Hummon, unpubl. data; Todaro, unpubl. data); Belgium (Jouk *et al.*, 1992); Greece (Hummon & Roidou, 1995, except Loutsa Beach); the British Isles (Hummon, 1997 and unpubl. data); Cyprus (Hummon, unpubl. data); and Egypt (Hummon, unpubl. data).

Within Italy published reports of *D. typhle* have come from: Campania: Harbor of Procida, Island of Procida and Capo Posillipo; Sardinia: Castelsardo, Torre Corsari, Piscina Rei, Marina di Gairo and Cala Liberotto; Sicily: Trappeto at Palermo, Manfria at Gela, Punta Braccetto at Marina di Ragusa, Sant'Ambrogio at Cefalù and the Island of Favignana; Tuscany: Bagno Gorgona at Marina di Pisa, Bagni Pancaldi at Livorno, and Meloria shoals off Livorno; Zuccale on the Island of Elba, and Cala della Mortola on the Island of Capraia. To these can be added previously unpublished findings we have made:

at Friuli: mouth of the Isonzo River[1], and Tuscany: Castiglione della Pescaia [G # 1, 2]; at Campania: Chiaia (Island of Ischia) [G # 3]; and at Apulia: Cala della Pergola [G # 10], and Latium: Circeo, Lido dei Pini, Montalto Marina and Serapo [G # 11].

The German data come from both the Baltic and the North Seas; the French from both the North Atlantic and the Mediterranean Sea; Sweden and Denmark only from the western Baltic Sea; the USA from North Atlantic of New Hampshire and Massachusetts, from the Gulf of Mexico of Florida, and from the North Pacific of Alaska; the UK from the Celtic Sea of England and Wales, the Irish Sea of Wales and the Isle of Man, and the Little Minch and the Norwegian and North Seas of Scotland; and Egypt only from the Mediterranean Sea.

Dactylopodola mesotyphle differs from *D. typhle* in the overall range of body length, the size range of reproductively mature specimens, the relative pharynx to total body length for different body sizes, and the numbers of adhesive tubes in the TbA, TbL and TbP series as well as the body sizes at which they are added. A developmental series was measured for *D. mesotyphle* (Table I, left), with full data from 19 specimens and partial data from 16, representing all five locations in Italy from which thus far it is known; a comparable series was measured for *D. typhle* (Table I, right), with full data for 28 specimens and partial data from 9, all from Castiglione della Pescaia. Specimens of *D. mesotyphle* typically mature as males of Lt ca. 215 µm, with the largest known specimen being 380 µm; those of *D. typhle* mature as hermaphrodites of Lt ca. 360 µm, with the largest known specimen being 530 µm. For any given size category the two species differ in the number or development of their adhesive tubes, the length of pharynx, and the widths of head, neck, trunk and caudal base. This enables one to distinguish any specific individual, except perhaps the very youngest, with a 90-95% chance of being correct.

[1] Inadvertently omitted from Evans *et al.*, 1993 (collector group number G # 2 from the list for this location in Hummon *et al.*, 1992). Groups of collectors (G #) are listed in Hummon *et al.*, 1992, Table I, and Hummon *et al.*, 1993, Table I.

Genus *Dendrodasys* Wilke, 1954

Dendrodasys affinis Wilke, 1954
Fig. 2

Dendrodasys affinis Wilke, 1954: p. 511; no fig.

Emended diagnosis – A *Dendrodasys*, to 300 µm in length; PhJIn at U19; head bears rounded cephalic lobes laterally and ventrolateral pestle organs; sides of the body narrow gradually, extending into a long pedunculate caudum that is bifurcate. Sensory hairs are thickly placed on the cephalic lobes; they are numerous per side in lateral, dorsolateral and dorsal columns down the body length. Glands small, numerous, of two types, with a solitary gland located medially at the main furcal split on the caudal peduncle. Adhesive tubes: TbA, 1 per side, elongate; TbL absent; TbP, 3 per side, one arising proximally from the caudal peduncle, the others located at the apices of the 70 µm-long bifurcate caudum. Ventral locomotor ciliation: paired longitudinal bands merge behind the anus and continue rearward beneath the

TABLE I - *Summary table of comparative morphology between* Dactylopodola mesotyphle *n.sp. and* D. typhle *(Remane, 1927).*

D. mesotyphle 90-380 µm					*D. typhle* 114-528 µm				
Lt/LPh	No.Tb	Widths (µm)	RS	*n*	Lt/LPh	No.Tb	Widths (µm)	RS	*n*
	A - L - P	Hd/Nk/Tr/FB				A - L - P	Hd/Nk/Tr/FB		
90/36	2-111-2	28/15/20/10	I	1	–/–				
115/42	2-112-2	28/16/22/11	I	2	114/ 41	2-111-2	29/17/21/10	I	1
148/50	2-112-2	33/19/24/13	I	1	148/ 52	2-111-2	36/20/27/14	I	3
–/–					180/ 55	2-111-2	36/21/28/14	I	2
211/58	3-112-3	40/23/28/12	I	4	207/ 62	2-111-2	37/22/30/13	I	5
241/64	3-112-3	41/24/32/13	M	18	233/ 66	2-112-2	40/25/32/13	I	4
255/66	3-112-3	43/24/32/13	M,B	3	255/ 75	2-112-3	46/29/41/14	I	2
274/67	3-112-3	43/24/30/13	B,F	5	282/ 78	3-113-3	46/30/43/15	I	2
–/–					328/ 84	4-113-4	48/31/44/16	I	6
380/74	3-113-4	45/26/34/14	B	1	395/ 87	4-113-4	48/31/56/18	B	2
					448/ 91	4-113-4	48/35/57/18	B	3
					480/ 94	4-113-4	51/36/56/18	B	5
					520/ 99	4-113-4	55/38/53/20	B	2

Key to reproductive status (RS): I, Immature; M, Male; F, Female; B, Both.

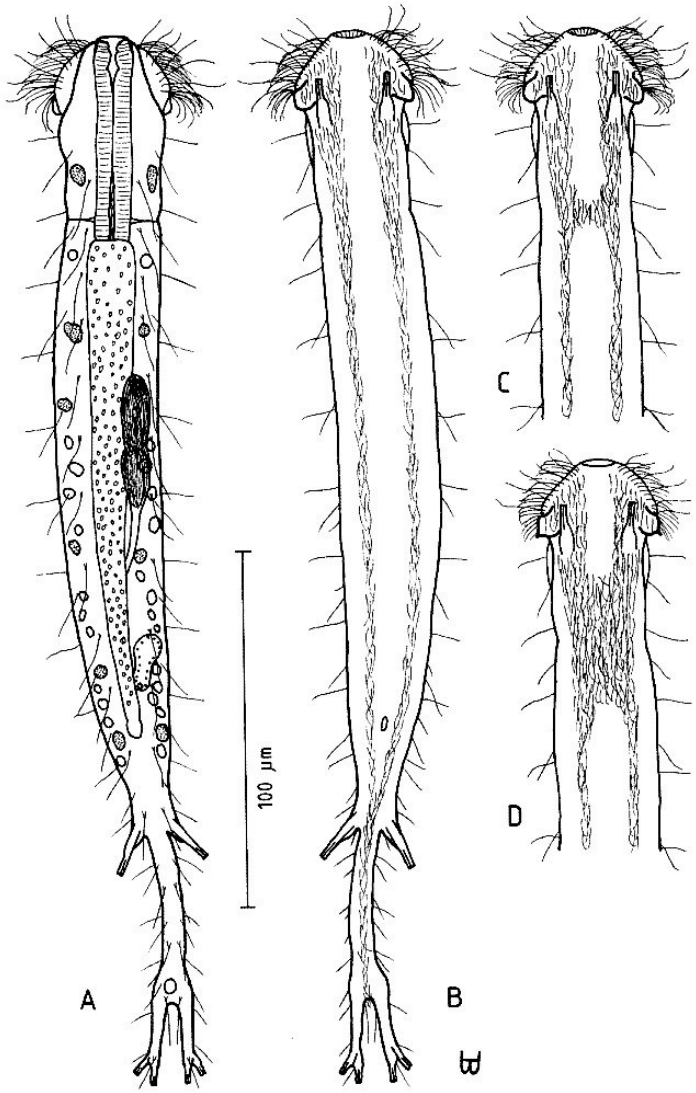

Fig. 2 - *Dendrodasys affinis*. A, dorsal view. B, ventral view. C, ventral view, showing an alternative pattern for the locomotor ciliary field. D, for comparison, *D. gracilis* in ventral view.

caudal peduncle onto the furcal base. Reproductive system: testis solitary, on one side only; ovaries paired.

Redescription - The description is based on three specimens, the largest of which was 295 µm in total length. Pharynx 67 µm in length; pharyngeo-intestinal junction (PhJIn) at U19. Head, narrower above than below, is rounded anteriorly, with a slight swelling at U10, reaching 45 µm in width; head bears curved flap-like lobes laterally, which slant from the mouth outwards and to the rear at U02 and then, often crenulated along their outer margins, broaden from 58 to 63 µm in overall width before terminating at U09; body then narrows gradually to 36 µm at the PhJIn and 27 µm at U74, with a slight broadening in the mid-intestinal region, after which it tapers more rapidly to 14 µm width at the base of the caudum (U77); caudum well-defined, consisting of an elongate, relatively broad peduncle (8-14 µm wide by 68 µm long), which forks at U95. Head lobes bear numerous cilia of mixed length frontally; sensory hairs 16 per side in lateral columns (14-18 µm on head and trunk, but only 8-16 µm on the peduncle), with a similar number of longer hairs forming matched dorsal columns (20-24 µm on head and trunk, but only 14-18 µm on the peduncle), all being evenly spaced from about U10 to U96. Glands small, of two types, one slightly larger (3-6 µm) and more opaque than the other (1-4 µm); a solitary gland, 3 µm in diameter, is located

medially at the main furcal split on the caudal peduncle. Longitudinal muscles are striated, as is characteristic of members of this family.

Adhesive tubes: there is one anterior tube (TbA) per side (15 µm), comprised of a 7 µm-long duo-gland tube that extends from a heavy tapering base, which inserts directly on the body surface at U09. Lateral and dorsal tubes (TbL/TbD) are not present. Posterior tubes (TbP) three per side: one, 15 µm in length, arises proximally from the caudal peduncle, the others, 6-8 µm long, are located at the apices of a bifurcate distal end of the 75 µm-long caudal peduncle.

Ventral ciliation: paired longitudinal bands extend from U01 to U74, beyond which they merge and continue rearward beneath the caudal peduncle onto the furcal base at U93; the bands are narrow in breadth (3-4 µm), except in the pharyngeal region where they expand laterally both in front of and behind the anterior adhesive tubes; the bands usually remain quite separate from one another anterior to the anal aperture, though in some individuals the bands may merge briefly in the posterior pharyngeal region; individual cilia of the bands are short (6-8 µm).

Digestive tract: the buccal cavity is narrow, goblet-shaped; the pharynx is narrow, its pores opening at U18; short cilia line the rear portion of the pharyngeal lumen; the intestine is of medium breadth (13 µm) anteriorly, narrowing somewhat to the rear (4-5 µm); the anus is longitudinally oval and opens ventrally at U66.

Reproductive tract: protandrous to simultaneous hermaphrodites; testis solitary on the right side of the anterior trunk region; ovaries paired; caudal organ pyriform (14 × 6 µm), with opening at the rear.

Distribution – Type locality - CAMPANIA: off the Palazzo Donn'Anna at Posillipo (lat. 40°49' N; long. 14°13' E) (SL); Spiaggia di Ischia Porto (SL) on the Isola d'Ischia.

Ecology – Frequency of occurrence - sparse in medium sublittoral sand, at 1.5 to 10 m water depth; Abundance - scarce where found.

Remarks – *Dendrodasys affinis* was considered to be so similar to *D. gracilis* that Wilke (1954) at first thought they belonged to the same species. While she gave no size for *D. affinis*, it must have overlapped in size with *D. gracilis*, at 300-320 µm. The total separation of the ventral ciliary bands and the unpaired nature of the male reproductive system in *D. affinis* both indicated to her that this was a species separate from *D. gracilis*.

Our largest specimen of *D. affinis* was slightly smaller than the range of sizes that Wilke gave for *D. gracilis*, a species which in our studies was found only at the Lido di Napoli in Pozzuoli. Based on photographic evidence, however, we now believe that the unidentified specimen of *Dendrodasys* which was reported by Todaro *et al.* (1992) from Zuccale on the Island of Elba was in fact *D. gracilis*. In our specimens of *D. affinis* the longitudinal bands of ventral locomotor cilia, while separated anteriorly, joined one another behind the anus and continued as a single band beneath the caudal peduncle as far as the base of the main furcal separation (Fig. 2B); moreover, in one of our specimens the bands merged briefly in the posterior pharyngeal region (Fig. 3C), but never as much as in *D. gracilis* (Fig. 3D). The caudal peduncle in *D. affinis* is also somewhat broader than in *D. gracilis*, the first of the posterior adhesive tubes arises from the proximal end of the peduncle rather than from the distal end of the trunk as occurs in *D. pacificus* (Schmidt, 1974), and the two pairs of posterior adhesive tubes that are borne distally on the furca are somewhat smaller than in *D. gracilis*. Furthermore, following the lead of Valbonesi & Luporini (1984), we have found pestle organs in both *D. gracilis* and *D. affinis*, their being hidden under the lateral cephalic lobes accounting for the fact that they were not noticed before this. The shape of these organs is rounded exteriorly in *D. affinis* and pointed exteriorly in *D. gracilis*.

Taxonomic affinities – The presence of lateral head lobes and pestle organs separates both *D. affinis* and *D. gracilis* from *D. pacificus* Schmidt, 1974, and the flap-like shape of the lateral head lobes separates them from *D. ponticus* Valkanov, 1957. Whether or not *D. ponticus* has pestle organs cannot be stated at this time.

Family THAUMASTODERMATIDAE Remane, 1929
Genus *Tetranchyroderma* Remane, 1926

Tetranchyroderma aphenothigmum n. sp.
Fig. 3

Diagnosis – A *Tetranchyroderma*, with an adult length to at least 255 µm; PhJIn at U40; head broadly rounded; body short, of medium width, narrowing in the rear pharyngeal region and at the base of the caudum, which bears small paired feet. A pair of long tentacles occur dorsally on the oral hood; ca. 9 pairs of trunk cirrata, of varying lengths, occur dorsolaterally from U33 to U93, more closely spaced toward the rear; 2 pairs of sensory papillae occur ventrally on the mouth; paired lateral pestle organs, of medium length, project forward ventrally. Sensory hairs, dense on the margin of the oral hood, are sparse but evenly spaced on the body, forming lateral, dorsolateral and ventrolateral columns from U07 to U95. Glands several, mixed in size, are scattered along the body from U18 to U91. Cuticular armature is of tetrancres. Adhesive tubes: TbA, 3 per side, inserting at U11-U12; TbL, ca. 7 per side, of different lengths, scattered throughout the intestinal regions from U49 to U81; TbD absent; TbV one per side at U84; TbP, 4 per side, 2 forming terminal toes of the foot, with 1 each medially and laterally. Ventral locomotor cilia: a continuous field of transverse rows covering the entire ventral surface. Reproductive system: testis on the right side, egg in dorsal mid-intestinal region, caudal organ elongate oval, frontal organ not seen.

Etymology – The name refers to the large number of paired dorsal sensory cirrata that occur along the length of its body (*aphenos*, Gk. riches; *thigma*, Gk. touch).

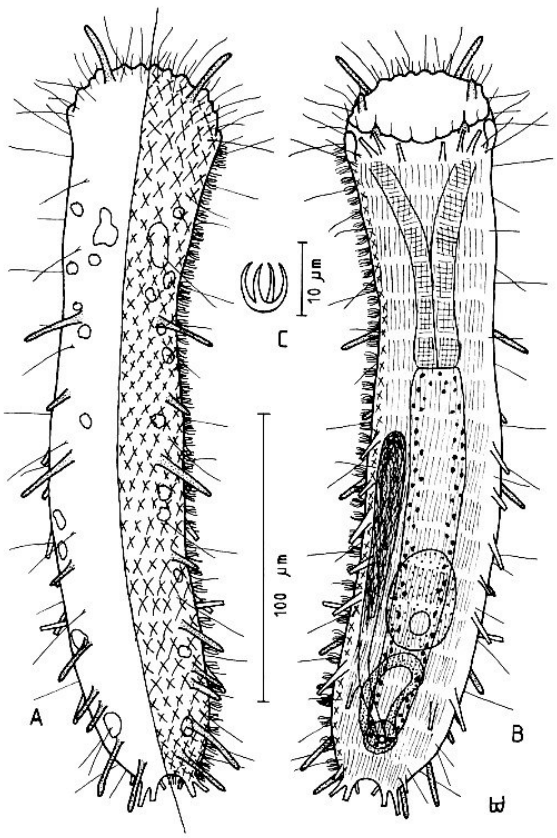

Fig. 3 - *Tetranchyroderma aphenothigmum* n. sp. A, dorsal view; trunk cirrata (stippled). B, ventral view. C, a tetrancre.

Description – The description is based on a single adult specimen, 255 µm in total length. Pharynx 103 µm in length, in this family to be measured from the ventral border of the oral opening to the pharyngeo-intestinal junction (PhJIn) at U40. Head broadly rounded anteriorly, with undulating border; body short and of medium width, narrowing slightly in the posterior pharyngeal region and near the base of the caudum, which bears small paired feet; widths of oral opening, and at mid-pharynx/PhJIn/mid-trunk/caudal base are as follows: 52,43/41/47/19 µm at U10,U21/U40/U68/U97, respectively. A pair of 22 µm-long tentacles are borne dorsally on the oral hood at U02; ca. nine pairs of trunk cirrata, of varying lengths, occur dorsolaterally from U33 to U93, with long (22 µm) and short (10 µm) ones alternating in front, but becoming more complexly arranged and more closely spaced toward the rear; two pairs of short sensory papillae occur ventrally in conjunction with the mouth, one on the under side of the oral hood and the other along the lower surface of the oral opening, both pairs bearing apical sensory bristles; paired lateral pestle organs, of medium length (10 µm), project forward from the ventrolateral surfaces. Sensory hairs include a fringe around the oral opening ventrally (ca. 3 µm) and a dense fringe just behind the leading edge of the oral hood dorsally (ca. 8-20 µm); other sensory hairs form lateral (7 per side, U10-U92), dorsolateral (7 per side, U15-U89) and ventrolateral (7 per side, U11-U94) columns that are more or less evenly spaced within columns; individual hairs are ca. 16 µm long in the lateral columns, 18 µm in the dorsolateral columns and 14 µm in the ventrolateral columns. Glands are several, 10-12 per side, mixed in size (from 3 m diameter up to 15 × 6 µm), round to oval or irregular in shape; they are scattered laterally along the body length from U19 to U91.

Cuticular armature: the dorsal/lateral covering of tetrancres is complete, forming ca. 13-19 columns, each having up to 34 ancres; thick ancres, with incurved tines, are as tall as wide (6 µm) in the mid-pharynx and mid trunk regions, but somewhat smaller (4 µm) at both ends of the body and above the pharyngo-intestinal junction; anterior-most border of ancres is closely pressed to the border of the oral hood, posterior-most ancres do not extend onto the caudum.

Adhesive tubes: there are three anterior tubes (TbA) per side, inserting directly on the body surface at U11-U12; one (7 µm) occurs medially, and two (8-9 µm) occur laterally. There are ca. seven lateral tubes (TbL) per side, none in the pharyngeal region, with six more or less evenly spaced having lengths of 7 to 15 µm (mostly 9-15 µm) inserting ventrolaterally in the trunk region from U49 to U81, and a seventh one (9 µm) inserting laterally at U74. Dorsal tubes (TbD) are not present. One ventral tube (TbV), 9 µm in length, occurs on either side at U84, adjacent to the reproductive caudal organ. The caudum, indenting medially to U96, is formed by two small feet each of which is comprised of two posterior tubes (TbP), 7-8 µm in length; these are fused at their bases and lack fleshy lobes; the feet lack the thinner mid-dorsal tube which projects beyond them from between and is characteristic of many species in the genus; two additional TbP (4-6 µm) flank each foot, one laterally and one medially.

Ventral ciliation: a continuous field of cilia arranged in transverse rows that covers the entire ventral surface, from just behind the forward row of anterior adhesive tubes to the base of the caudum; individual cilia are ca. 10 µm in length.

Digestive tract: the oral opening is broad (49 µm in width), with oral hood extending forward above the mouth from U00 to U10; the pharynx narrows over its anterior two-thirds to 13 µm before swelling again to 16 µm at its base, its pores opening basally at U38; the intestine is broadest in the front half (19 µm), narrowing gradually over its length (to 11 µm); the anus opens ventrally at U91.

Reproductive tract: simultaneous hermaphrodites; a solitary elongate testis occurs on the right side, the vas deferens opens into the posterior end of a thick-walled oblong caudal organ, which probably connects with

the adjacent bladder-like frontal organ; the egg (36 by 24 µm; germinal vesicle round 7 µm diam.), not fully developed, is situated dorsally in the mid-intestinal region.

Distribution - Type locality - CAMPANIA: Posillipo, Lido Ideal (lat. 40°49' N; long. 14°12' E) (SL), approached by the via Posillipo just before reaching the Palazzo Donn'Anna. Other locations: Bagnetielli (SL) on the Isola d'Ischia.

Ecology – Frequency of occurrence - sparse in medium sublittoral sand, at 1.5 to 6 m water depth; Abundance - scarce where found.

Remarks – The cuticular armature of tetrancres approaches more closely to the border of the oral hood than in most species of the genus. The dorsal head tentacles appear to be homologous with the dorsolateral trunk cirrata tubes; the papillae on the under side of the oral hood and those on the ventral lip of the mouth differ from the head tentacles and trunk cirrata in that each bears a short sensory hair, reminding one of those papillae that lie between the preoral palps in species of the genus *Pseudostomella*. None of these tentacles/cirrata /papillae seem to have adhesive components.

Taxonomic affinities – *Tetranchyroderma aphenothigmum* is the only species in the genus that has elongate dorsal cephalic tentacles on the front of the oral hood, combined with seven or more pairs of dorsolateral trunk cirrata. Its tetrancres, pestle organs, short caudum, and small body size further serve to separate it from any other presently known species.

Tetranchyroderma psilotopum n. sp.

Fig. 4

Diagnosis – A *Tetranchyroderma*, with an adult length to at least 400 µm; PhJIn at U34; head bulbous anteriorly, oral hood scalloped; body of middle length, with nearly parallel sides and a short caudum that bears paired feet. Specialized sensory organs, such as tentacles, pestle organs or cirrata are absent. Sensory hairs form an oral fringe, with longer hairs on the oral hood; other hairs form lateral and dorsolateral columns, with 11-12 each per side, from U08 to U97. Glands numerous, mostly lateral and unevenly spaced along the body from U06 to U93. Dorsal/lateral covering of pentancres is never complete, with bare patches or stripes on either side of the body, sometimes communicating across the midline; ancres smaller at both ends of the body. Adhesive tubes: TbA, 5 per side, inserting at U07-U11; TbL ca. 22 per side, 1 behind the mouth at U14, 4 in the rear pharyngeal region, and the other ca. 17 evenly spaced in the intestinal region at U37-U92; TbD/TbV absent; TbP with 2 tubes on each caudal foot, and a smaller one inserting between them, with 8 TbP lying medially between the feet, and 3 per side lying laterally behind the anus that continues the TbL series to the rear. Ventral locomotor cilia: a continuous field of transverse rows covering the entire ventral surface. Reproductive system: testis on the right; egg in dorso-lateral mid-intestinal region; caudal organ ovate, frontal organ spherical.

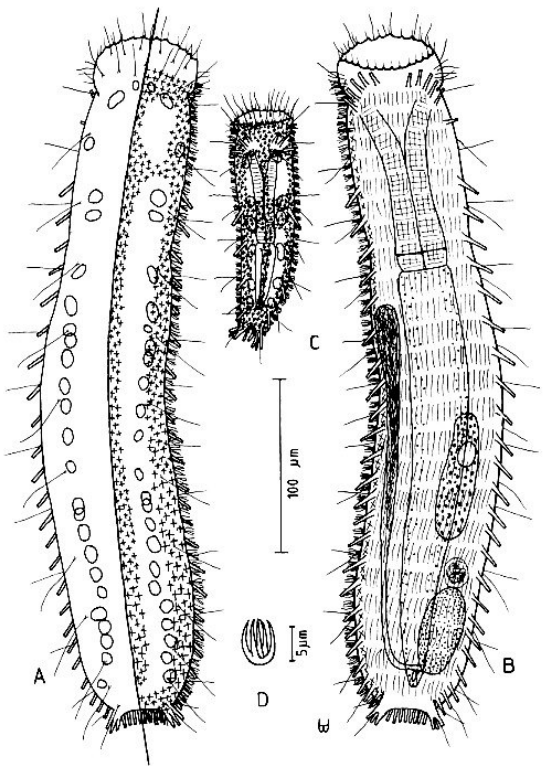

Fig. 4 - *Tetranchyroderma psilotopum* n. sp. A, dorsal view. B, ventral view. C, a juvenile. D, a pentancre.

Etymology – The name refers to bareness that results from a reduction in hooked spines (in this case pentancres) on the dorsal body surface (*psilos*, Gk. bare; *topos*, Gk. place).

Description – The description is based on an adult specimen 400 µm in total length. Pharynx 118 µm in length; pharyngo-intestinal junction (PhJIn) at U34. Head bulbous anteriorly, oral hood scalloped both above and below; body of medium length, with nearly parallel sides that narrow abruptly at the rear and terminate in a short caudum, which bears small paired feet; widths of oral opening, at the constriction behind the mouth, along the body, and at the caudal base are as follows: 60/54/58-72/32 µm at U05/U08/U19-U93/U98, respectively. There are no specialized sensory organs, such as tentacles, pestle organs or cirrata. Sensory hairs (4-6 µm) form an oral fringe with a scattering of longer hairs (24 µm) on the oral hood; other hairs form lateral (U08-U97) and dorsolateral (U14-U96) columns of 11-12 per side each, with individual hairs being evenly spaced and 16-20 and 29-38 µm long, respectively. Glands are numerous, ca. 25 per side, mixed in size (5 diameter to 12 × 6 µm long), round to oval or irregular in shape; they are scattered laterally

along the body length, being irregularly spaced from U06 to U93.

Cuticular armature: the dorsal/lateral covering of pentancres is never complete, but would form ca. 23 columns, each having ca. 50 ancres if all were present; naked tracts occur somewhere on the body, generally in the form of bare patches or longitudinal stripes on either side in the pharyngeal and/or trunk region, sometimes communicating with one another across the midline; thick ancres, with incurving tines, are taller than wide (6.6 × 5 µm), being slightly smaller (4 × 3 µm) at both ends of the body; anterior-most border of ancres begins at the rear of the oral hood, posterior-most ancres extend onto the short caudum.

Adhesive tubes: there are five anterior tubes (TbA) per side, inserting directly on the body surface, and forming an arc, at U07-U11; the medial-most (8 µm) inserts slightly behind the next one outside it, with the other four (9-11 µm) occuring more laterally and forming the main part of the arc; all are directed obliquely forward. There are ca. 22 lateral tubes (TbL) per side, one (7 µm) in the anterior pharyngeal region at U14, four (12-16 µm) in the posterior pharyngeal region, and the remaining ca. 17 (12-15 µm) being fairly evenly spaced in the intestinal region at U37-U92. Dorsal and ventral tubes (TbD/TbV) are not present. The caudum, indenting medially to U98, is formed by two feet borne on short lobes, each comprised of two posterior tubes (TbP), 6 µm in length, that are fused at their bases, along with a third thinner mid-dorsal tube that inserts between them; a total of eight additional TbP (6-8 µm) lie medially between the feet, with three (12 µm) per side lying laterally behind the anus that continue the TbL series to the rear.

Ventral ciliation: a continuous field of cilia arranged in transverse rows that covers the entire ventral surface, from just behind the forward row of anterior adhesive tubes to the base of the caudum; individual cilia are ca. 12 µm long.

Digestive tract: the oral opening is broad (52 µm in width), with oral hood extending forward above the mouth from U00 to U05; the pharynx narrows over its anterior half to 23 µm before swelling again to 29 µm at its base, its pores opening basally at U32; the intestine is of similar width over its front half (32 µm), narrowing gradually over its latter half (to 9 µm); the anus opens ventrally at U93.

Reproductive tract: simultaneous hermaphrodites; solitary elongate testis on the right side; the vas deferens opens into the rear of an ovate caudal organ (51 × 23 µm), which connects with a bladder-like frontal organ (15 µm diameter) that bears sperm; the egg (74 × 20 µm; germinal vesicle 15 × 10 µm) is situated dorsally in the mid-intestinal region.

Distribution – Type locality - FRIULI: Mouth of the Isonzo River (lat. 45°45' N; long. 13°31' E) (SL).

Ecology: Frequency of occurence - sparse in fine sublittoral sands, at 1-2 m water depth; Abundance - scarce where found.

Remarks – Tetranchyroderma psilotopum is a member of an enigmatic group of species that are scantily clad with ancres and are thus far restricted to the central Mediterranean region. Ancre distribution generally includes more than half of the dorsal/lateral surfaces, but specimens vary widely in the pattern of ancre distribution. The juvenile in Fig. 4D is Lt 130 µm.

Taxonomic affinities – Tetranchyroderma psilotopum is the only mid-sized species in the genus having an incomplete covering of pentancres, that also has 5 TbA per side, has ca. 22 TbL, with 1 of these fore and 4 aft in the pharyngeal region and ca. 17 along the gut, has 8 TbP between the caudal feet, and lacks TbD/TbV, dorsal cirrata and filaments that trail from the rear trunk region.

Tetranchyroderma symphorochetum n. sp.

Fig. 5

Diagnosis - A *Tetranchyroderma*, with an adult length to 590 µm; PhJIn at at U29; oral hood bluntly flattened in front; body elongate, ribbon-like, with nearly parallel sides and a short caudum that bears paired feet. A sensory ridge lies ventrolaterally on either side of the mouth. Sensory hairs form an oral fringe, with longer hairs and a pair of heavier flagellae located upon the oral hood; other hairs form regularly spaced lateral and dorsolateral columns, with 12-15 each per side, from U03 to U97. Glands vary in size and shape, occurring irregularly along either side from U07 to U96. Cuticular armature is of tetrancres of similar size over most of the body, ancres delicate and bending toward the rear. Adhesive tubes: TbA, 6 per side, inserting at U05-U06; TbL ca. 8 per side, 1 behind the mouth at U13, none in the rear pharyngeal region, and the other ca. 7 with 5 evenly spaced in the mid-intestinal region at U44-U60 and 2 near the anus at U88 and U91; TbD/TbV absent; TbP with 2 tubes on each caudal foot, and a longer one inserting between them, with 4-5 TbP lying medially between the feet, and 2 per side lying laterally behind the anus that continues the TbL series to the rear. Ventral locomotor cilia: a continuous field of transverse rows covering the entire ventral surface. Reproductive system: testis on the right; egg in lateral mid-intestinal region; caudal organ not seen, frontal organ ovate.

Etymology – The name refers to the adhesive tubes that are borne in groups (*sym*, Gk. together; *phore*, Gk. bearer; *ochetos*, Gk. tube).

Description – The description is based on an adult specimen 587 µm in total length. Pharynx 146 µm in length; pharyngo-intestinal junction at U29. Head shows little lateral swelling; oral hood bluntly flattened anteriorly; body elongate, ribbon-like, with nearly parallel sides that narrow gradually at the rear and terminate in a short caudum, which bears small paired feet; widths of oral opening, at PhJIn/trunk/caudal base are as follows: 53/69/84-87/40 µm at U03/U29/U48-U64/U96, respectively. A specialized sensory ridge lies ventrolateral-

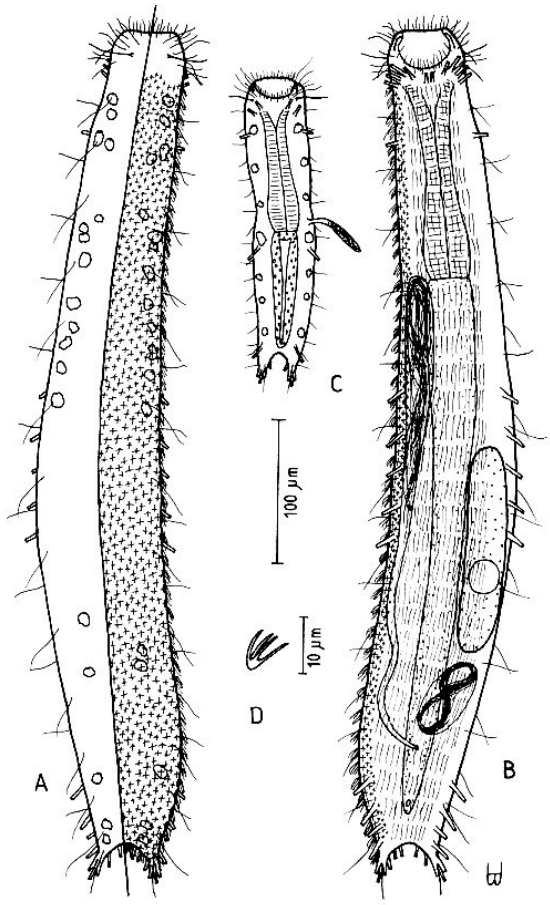

Fig. 5 - *Tetranchyroderma symphorochetum* n. sp. A, dorsal view. B, ventral view. C, a juvenile, bearing a parasite on the right side at the base of the pharynx. D, a tetrancre.

ly on either side of the mouth opening. Sensory hairs (7-11 µm) form an oral fringe with a scattering of longer hairs (21-26 µm) and a pair of heavier flagellae (28 µm) dorsally on the oral hood; other hairs form lateral (U03-U92) and dorsolateral (U04-U97) columns, 12-15 per side each, with individual hairs being evenly spaced and 24-36 µm in length. Glands, ca. 18 per side, varying in size (5-10 µm) and shape, occur irregularly in dorsolateral and lateral columns on each side at U07-U96.

Cuticular armature: the dorsal/lateral covering of tetrancres is complete, forming ca. 17 columns, each having up to 55 ancres, and 3 columns per side as the ancre-field wraps around onto the ventrolateral surface; thin, delicate ancres, with tines that expand slightly from the center and bend toward the rear, are taller than wide (8 × 5 µm) and are of similar size over most of the body, but are smaller (4 × 2.5 µm) at the fore and rear ends of the body and are even smaller (3 × 2 µm) ventrolaterally; anterior-most border of ancres undulates above the rear of the oral hood at U05-U06, posterior-most ancres extend onto the caudum.

Adhesive tubes: there are six anterior tubes (TbA) per side, inserting directly on the body surface at U05-U06; one (7 µm) occurs medially, while five (10-12 µm) form an arc laterally, the medial-most of these inserting slightly behind the next one outside it, with the other four forming the main part of the arc, which is directed obliquely forward. There are ca. eight lateral tubes (TbL) per side, one (11 µm) in anterior pharyngeal region at U13, none in the posterior pharyngeal region, five (15-19 µm) regularly spaced ventrolaterally along the trunk at U44-U60, and two (17 and 19 µm) are at U88 and U91. Dorsal and ventral tubes (TbD/TbV) are not present. The caudum, indenting medially to U96, is formed by two feet borne on short lobes, each comprised of two posterior tubes (TbP), 9 µm in length, that are fused at their bases, along with a third thinner mid-dorsal tube that projects beyond them and inserts between them; a total of four to five additional TbP (8-10 µm) occur medially between the feet, with two per side (11 and 14 µm) lying laterally behind the anus at U94 and U96 that continue the TbL series to the rear.

Ventral ciliation: a continuous field of cilia arranged in transverse rows that covers the entire mid-ventral surface, from just behind the anterior adhesive tubes to the base of the caudum; individual cilia are ca. 16 µm in length.

Digestive tract: the oral opening is of mid-breadth (36 µm), with oral hood extending forward above the mouth from U00 to U04; the pharynx narrows over its anterior half to 17 µm before swelling again to 32 µm at its base, its pores opening inconspicuously at U26; the intestine is broad in the front third (32 µm), narrowing gradually over its length (to 8 µm); the anus opens ventrally at U91.

Reproductive tract: simultaneous hermaphrodites; a solitary elongate testis occurs on the right side reaching forward to the PhJIn; the sinuous vas deferens opens in front of the anus at U85; caudal organ not seen; frontal organ oblong (60 x 30 µm), hyaline, bladder-like and canted forward to the left, often with sperm; the egg (144 by 27 µm; germinal vesicle round 23 µm), not fully developed, is situated on the left in the mid-intestinal region.

Distribution – Type locality - LUCANIA: Lido di Policoro (lat. 40°11' N; long. 16°44' E) (SL). Other locations: Casamicciola (SL) and Citara (SL) on the Isola d'Ischia.

Ecology – Frequency of occurrence - occasional in fine sublittoral sand at 1.5-3.0 m water depth; Abundance - rare to scarce where found.

Remarks – The cuticular armature of tetrancres begins further from the border of the oral hood and is more

homogeneous in size over the dorsal surface than in most species of the genus. The juvenile in Figure 5D is 205 µm in total length, and appears to have been infected by a parasite, probably a microsporidian.

Taxonomic affinities – Tetranchyroderma symphorochetum is the only large ribbon-shaped species in the genus having a complete covering of tetrancres that are taller than wide and whose tines bend to the rear, which also has a flattened oral hood anteriorly, has 6 TbA per side, has 8 TbL per side, with 1 at U13, none in the post pharyngeal region, 5 at U44-U60 and 2 at U88-U91, with 2 TbP beside each caudal foot continuing the series behind the anus.

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