



## A new species of *Pseudostomella* (Gastrotricha: Macrodasysida: Thaumastodermatidae) from a sandy beach of Kerala, India

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### Abstract

During an interstitial faunal survey along the south-west coast of Kerala, India, gastrotrich fauna were found in abundance. Together with species of the genera *Xenotrichula*, *Halichaetonotus* and *Tetranchyroderma*, were present several undescribed thaumastodermatid gastrotrichs belonging to the buccal palp bearing genus *Pseudostomella*. Adults of the new species are characterized by the following traits: total body length of about 300 µm; cuticular armature made up of medium sized pentancretes covering the entire dorsolateral surface; pre-buccal, grasping palps bearing five, large papillae dorsally and 4–6 smaller papillae ventrally; adhesive apparatus made up of six anterior, 22–24 ventrolateral, two dorsolateral and six posterior adhesive tubes; caudal organ pear-shaped; frontal organ spherical. *Pseudostomella cheraensis* sp. nov. is the fourth taxon of the genus known from India; however, all the previous species reported hitherto from India have tetrancretes instead of pentancretes.

**Key words:** interstitial; meiofauna; taxonomy; gastrotrichs; Arabian Sea

### Introduction

Gastrotricha constitutes one of the most interesting and taxonomically challenging groups of meiobenthic marine and freshwater invertebrates. Traditionally gastrotrichs are considered, on morphological basis, either to be a separate phylum or to belong to the Aschelminthes, and are believed to be closely related to Rotifera (Brusca & Brusca, 1990) or the Nematoda (Ruppert & Barnes, 1994). More recently, they have been associated on molecular ground with the Platyzoa (Todaro *et al.* 2006a). In aquatic ecology, gastrotrichs are known as important components of the permanent meiofauna (Todaro *et al.*, 2006b).

Marine gastrotrichs are mainly interstitial, occurring both in the intertidal and subtidal realms. They are more abundant in fine to medium grained sediments in unpolluted and less turbid waters of coastal areas (Todaro & Rocha, 2004). However, submarine caves, dysoxic sand and deep, muddy sediments may also be colonised by gastrotrichs (Leasi *et al.*, 2006; Todaro *et al.*, 2006b, c; Balsamo *et al.*, 2007). In the sandy marine interstices, gastrotrichs rank third in abundance among the meiofaunal taxa following Nematoda and the harpacticoid Copepoda; their numerical abundance may reach a density up to 364 ind./10 cm<sup>2</sup> (Todaro, 1998).

The phylum is cosmopolitan and includes about 700 species grouped into two orders: Macrodasysida, with 250 strap-shaped species, all but two marine, and Chaetonotida, with 450 tenpin-shaped species, of which only 150 are marine or brackish.

The gastrotrich fauna of India have been recently reviewed by Naidu & Rao (2004). The present report is on a new species of *Pseudostomella* found during an interstitial faunal survey along the south west coast of Kerala, India. The genus *Pseudostomella* was first created by Swedmark (1956) based on a specimen discovered from Roscoff in France, thirteen species have subsequently been described (Clausen, 2004); of these four are endemic or occur also along the Indian coasts; they are: *P. roscovita* Swedmark, 1956, *P. malayica* Renaud-Mornant, 1967, *P. indica* Rao, 1970, *P. andamanica* Rao, 1993. All these species possess only tetrancreas whereas the species described here is characterized by the presence of pentancreas uniformly distributed dorsally.

## Material and methods

Sediment sampling employing a corer was done in the Cherai beach (lat.12° 97' N; long.77° 56' E), Kerala State, located on the south-west coast of India (Fig.1). The core samples were obtained from the mid tide level at a depth of 17 cm. Temperature (28°C) and salinity (31‰) of the interstitial water were recorded. The animals were narcotized *in situ* by adding 7% magnesium chloride solution and subsequently fixed in 5% sea water formalin. The fauna was extracted by decantation following the technique adopted by Pfannkuche & Thiel (1988). The specimens of gastrotrichs were dehydrated through graded ethanol series and mounted on slides using glycerol and the slides were sealed with a sealant. Specimens were examined under a Magnus 100× oil immersion objective (India) or with Nomarski differential interference contrast optics using an Eclipse 90i Nikon microscope (Italy). During DIC observation, the specimens were photographed with a DS-5Mc Nikon digital camera. Measurements were taken using an ocular micrometer or derived directly from microphotographs.

ABBREVIATIONS (after Ruppert, 1991; Hummon *et al.*, 1993; Clausen, 2000).

Co = caudal organ; CP = caudal pedicle; DP = dorsal papilla; E = egg; eg = Epidermal gland; Fo = frontal organ; Lt = total length from the anterior tip of pre-buccal extension to posterior tip of caudum or pedicles including adhesive tubes; U = percentage unit of total length used for the location (U-) from anterior to posterior; pb = Pre-buccal apparatus; PhIJ = junction between pharynx and intestine; Pp = pharyngeal pore; T = testis; TbA = anterior adhesive tube ; TbL = lateral adhesive tube ; TbVL = ventro-lateral adhesive tube; TbDL = dorso-lateral adhesive tube; TbP = posterior adhesive tube; VP = ventral papilla.

## Systematics

### Order Macrodasyida Remane, 1925 [Rao & Clausen, 1970]

### Family Thaumastodermatidae Remane, 1926

### Genus *Pseudostomella* Swedmark, 1956

### *Pseudostomella cheraensis* sp. nov.

(Figs 2, 3)

**Type locality.** Cherai beach, (lat.12° 97' N, long. 77° 56' E) Kerala, India. Mid-tide region in clean medium sand, moderately well sorted.

**Materials examined.** Twelve specimens were examined by light microscopy.



**FIGURE 1.** Map showing the sampling site on the south-west coast of India.

**Holotype.** One specimen of total length (Lt) 295  $\mu\text{m}$  collected on 15-12-2005; glycerol wholemounts on microslide, deposited at Marine Biodiversity Museum, CMFRI (Government of India), Kochi, India; ref. No: MBM – 1.1.1.1

**Paratype.** Two specimens of length 276  $\mu\text{m}$  and 223  $\mu\text{m}$  respectively collected from the type locality; glycerol wholemounts on microslides, deposited at the same museum as; ref. No: Paratype1: MBM – 1.1.1.1.1; Paratype 2: MBM – 1.1.1.1.2

**Etymology.** Named after the type locality which is a well known sandy beach frequented by both domestic and foreign tourists.

**Diagnosis.** *Pseudostomella* up to 295  $\mu\text{m}$  in total body length, with a distinct anterior pre-buccal apparatus and an elongate bilobed caudum. Buccal palps bearing five dorsal cephalic papillae with sensory hair and four-six minute ventral papillae. Cuticular armature of pentancre extending from the margin of oral cavity to the base of pedicles (caudum) ornaments the entire dorsal surface. Adhesive tubes: pedicles with three distal adhesive tubes (TbP) of unequal length and an adhesive tube at the base. TbA, six in number, in 2+2+2 pattern; TbL, 10-12 per side between U39 and U89. Nine pairs of granular epidermal glands between U25 and U87.5. Sensory hairs on the pre-buccal palps and trunk. Tactile cilia border the margin of the buccal cavity. Caudal organ pear shaped; frontal organ spherical. Oocytes located in the mid body.

**Description.** The description is based on an adult specimen, 295  $\mu\text{m}$  in total length. Width at oral cavity, neck (slightly swollen), trunk (6<sup>th</sup> pair of epidermal gland) and caudal base: 39/ 46/ 40/ 15  $\mu\text{m}$  at U12, U21, U67 and U93 respectively. Head with well-developed and extended pre-buccal apparatus (pb) incurving anteromedially, characterizing the genus *Pseudostomella*. Their dorsal margin project out a little beyond the ventral margin. Pre-buccal apparatus has five fleshy dorsal papillae ranging in length from 6  $\mu\text{m}$  to 12  $\mu\text{m}$ , symmetrically arranged in 2+1+2 pattern. All papillae are with tactile cilia at the tip. Four to six smaller papillae are present along the ventral margin of the buccal palps, arranged in 2+2 or 3+3 pattern. Several sensory hairs (3

µm) present on the outer lateral margins of pre-buccal apparatus among which, a longer one measured 16 µm. Sensory hairs or lateral bristles (10 µm long) of uncertain numbers seen on the lateral margins of the body as well (U22-U91).

**Epidermal glands:** Eight to nine pairs of granular epidermal glands arranged along the lateral margins of the body originate at about U25 and extent up to U87.5. Their size range between 7.5–10 µm × 7.5–15 µm. The middle glands located at 8 µm apart from each other.

**Cuticular armature:** The entire dorsal surface from the base of buccal apparatus to the pedicles covered by rows of closely packed pentancreas with an average size of 3.5-5 µm. They are arranged in 13-14 longitudinal columns in the mid-trunk region with each column containing around 58 to 60 pentancreas antero-posteriorly. The tines of the ancreas project out almost masking the posterior border of the body.

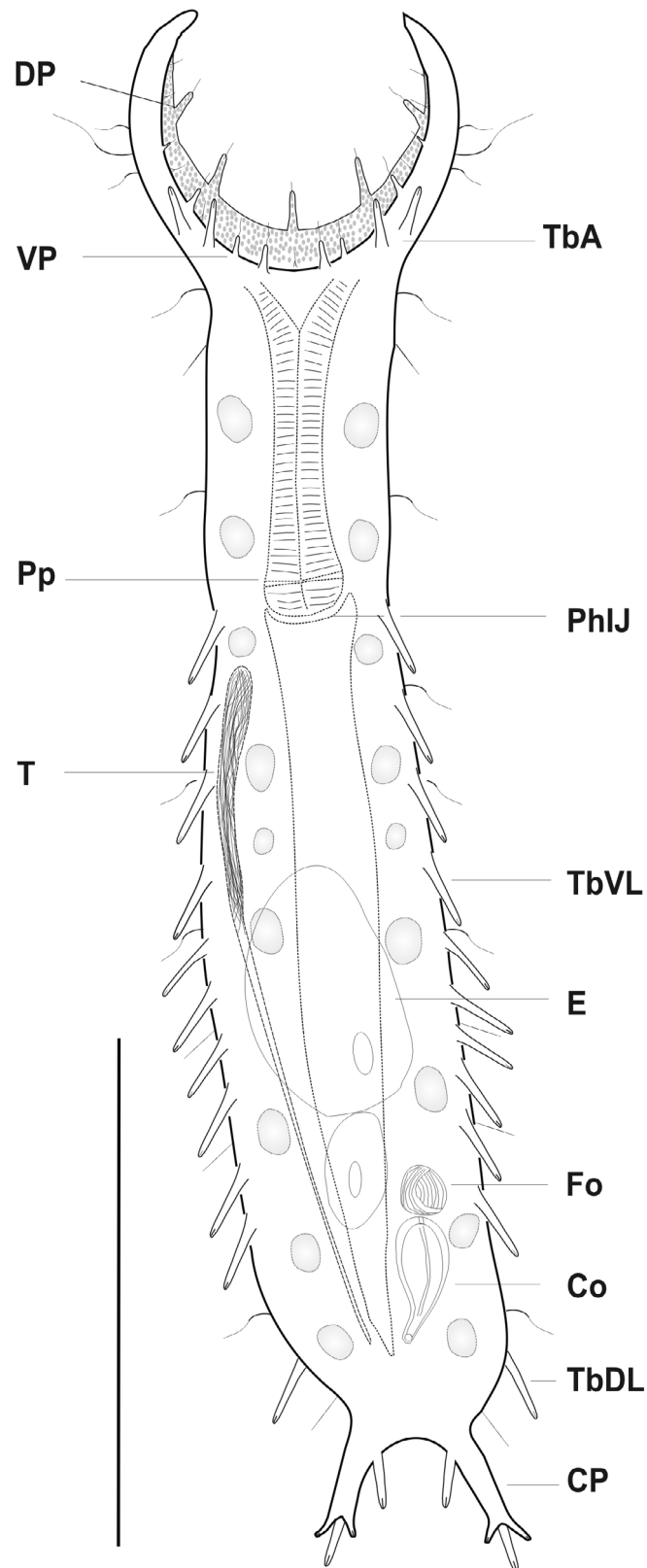
**Adhesive tubes:** Four of the six anterior adhesive tubes (TbA) seen ventrally at the base of the pre-buccal apparatus in 2+2+2 pattern measure 4 µm each. The remaining pair at the farthest end are longer. The number and pattern of TbA seem to vary. In one of the paratypes, an additional pair is seen associated with the distal pair, indicating variability in the number of TbA. Eleven pairs of lateral adhesive tubes (TbL) originate at U39 and extent up to U89, with an average length of about 7-8 µm. Of these, the anterior ten pairs are TbVL, evenly spaced and extent up to U77.6. The last pair, dorso-lateral in position is located at U89. Pedicles (20 µm long) furnished with three distal tubes (TbP), the median one (8 µm) directed slightly dorsally, while the others (5 µm) are directed slightly ventrally. Two posteriorly directed adhesive tubes, 8-9 µm long, are positioned at the base of the pedicles.

**Ventral ciliation:** Locomotory cilia form a continuous field of transverse rows from behind the margin of mouth and extent up to the caudal base.

**Digestive system:** The digestive tract begins with a terminal mouth, covered dorsally by a hood like extension and opens into the pharynx, behind the pre-buccal apparatus. The pharyngeal pores could not be located in the holotype but were seen at the base in the paratypes. The entire digestive tract not well discernable in the holotype. The paratype showed PhIJ at U37- U38. The intestine is broad anteriorly and narrows down posteriorly. The anus opens ventrally at U89.

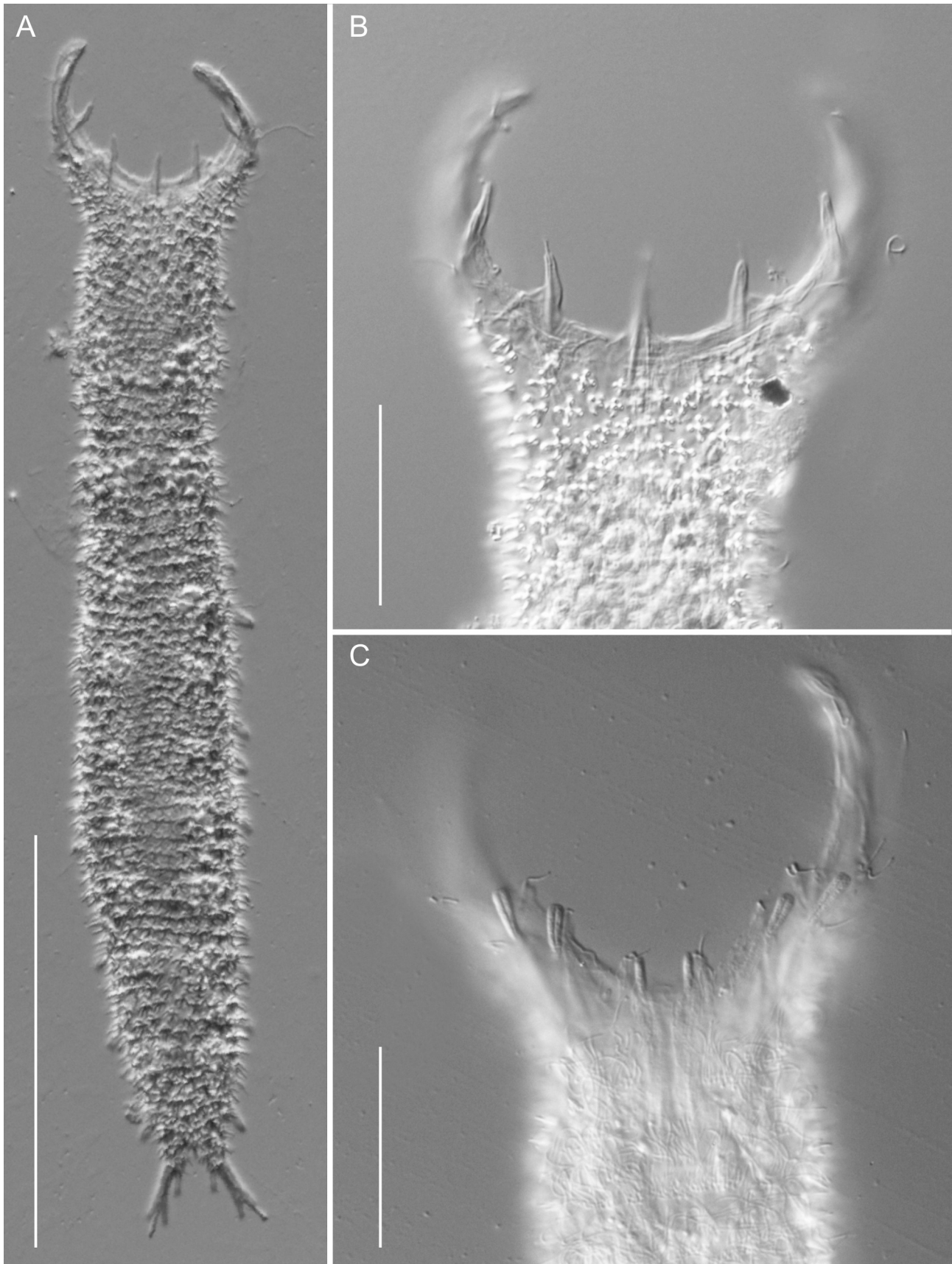
**Reproductive system:** Simultaneous hermaphrodites. A single elongate testis on the right side (as seen from above) begins behind the pharyngo-intestinal junction and leads caudally into a narrow elongate vas deferens. The caudal organ located at U78 is pear shaped and is connected to a spherical frontal organ located at U74.8. The paratype showed two oval oocytes in the mid posterior body, of which the upper larger one measured 38×19 µm.

**Taxonomic affinities.** The genus *Pseudostomella* includes 13 described species; of these four: *P. plumosa* Ruppert, 1970, *P. klauserae* Hochberg, 2002, *P. megapalpatator* Hochberg, 2002 and *P. faroensis* Clausen, 2004 carry scaled triancreas; six: *P. roscovita* Swedmark, 1956, *P. malayica* Renaud-Mornant, 1967, *P. indica* Rao, 1970, *P. andamanica* Rao, 1993, *P. koreana* Lee & Chang, 2002 and *P. longifurca* Lee & Chang, 2002 bear tetrancreas whereas the remaining three: *P. cataphracta* Ruppert, 1970, *Pseudostomella* sp. 1 [Valbonesi & Luporini, 1984] and *P. etrusca* Hummon, Todaro & Tongiorgi, 1993 have a cuticular armature made up of pentancreas. Based on the type of the cuticular covering the new species from India resembles most closely to the latter three taxa.



**FIGURE 2.** *Pseudostomella cheraensis* sp. nov. – Drawing of the habitus as seen from the ventral side. Scale bar: 100  $\mu$ m.





**FIGURE 3.** *Pseudostomella cheraensis* sp. nov. – DIC optics - A, habitus, dorsal view; B, anterior end, dorsal view, showing the arrangement of the pentaneres and papillae of the pre-buccal palps; C, anterior end, ventral view, showing the arrangement of the anterior adhesive tubes. Scale bars: A, 100  $\mu$ m; B, C, 25  $\mu$ m.

*Pseudostomella cataphracta* can be distinguished from the other pentrancre-bearing species, including the new one from India, principally because it possesses a pair of ventral feet (each foot made up of four adhesive tubes), located in posterior region of the trunk. *P. etrusca* is the only one that bears a pair of dorsal adhesive tubes on the base of the pre-buccal palp, moreover it has a much higher number of anterior adhesive tubes compared to *P. cheraensis* sp. nov. (14 vs 6). *Pseudostomella* sp. 1 from Somalia in contrast with the new species from India shows a pair of ventro-lateral adhesive tubes in the anterior region of the pharynx, a higher number of anterior adhesive tubes, (10 vs 6), shorter caudal pedicles and the dorsal tubes at the end of each caudal pedicle that is shorter of the two tubes that flank it.

The pattern of distribution of the representative species belonging to the genus *Pseudostomella* hitherto known clearly indicates cosmopolitanism. However, the species as such appear to have a rather narrow range, on the other hand the general absence of biogeographic records testifying the simultaneous presence of two or more species at a single beach (e.g. as it happens for *Tetranchyroderma*) let to hypothesize that biogeography may be influenced also by interspecific competition. In this general framework the finding of three species of *Pseudostomella* from a North Carolina beach (Ruppert, 1970) and the occurrence of *P. roscovita* in the Atlantic Ocean (and connected seas) and the Indian Ocean appear particularly interesting and certainly call for further investigations.

## References

- Brusca, R.C. & Brusca, G.J. (1990) *Invertebrates*. Sunderland, Massachusetts: Sinauer Publication), 922 pp.
- Balsamo, M., Guidi, L., Pierboni, L., Marotta, R., Todaro, M.A. & Ferraguti, M. (2007) Living without mitochondria: spermatozoa and spermatogenesis in two species of *Urodasya* (Gastrotricha, Macrodasysida) from dysoxic sediments. *Invertebrate Biology*, 126, 1–9.
- Clausen, C. (2000) Gastrotricha Macrodasysida from the Tromsø region, Norway. *Sarsia*, 85, 357–384.
- Causen, C. (2004) Gastrotricha from the Faroe Bank. *Sarsia*, 89, 423–458.
- Hochberg, R. (2002) Two new species of *Pseudostomella* (Gastrotricha: Macrodasysida) with scaled triancre from the east coast of Australia. *New Zealand Journal of Marine and Freshwater Research*, 36, 571–579.
- Hummon, W.D., Todaro, M.A. & Tongiorgi, P. (1993) Italian marine Gastrotricha: II. One new genus and 10 new species of Macrodasysida. *Bollettino di Zoologia*, 60, 109–127.
- Lee, J.M. & Chang, C.Y. (2002) *Pseudostomella* Gastrotrichs (Macrodasysida, Thaumastodermatidae) from South Korea, with a brief Review of the genus. *Korean Journal of Biological Science*, 6, 207–213.
- Leasi, F., Virno-Lamberti, C. & Todaro, M. A. (2006) First record of *Musellifer profundus* (Gastrotricha) in the Italian seas. *Biologia Marina Mediterranea*, 13, 190–191.
- Naidu, K.V. & Rao, G.C. (2004) *Gastrotricha. Fauna of India and the adjacent countries*. Zoological Survey of India, Kolkata, pp 1–169.
- Pfannkuche, O. & Thiel, H. (1988) Sample processing. In: Higgins, R. P. & Thiel, H. (Eds.), *Introduction to the study of meiofauna*. Washington, DC: Smithsonian Institution Press, pp. 134–145.
- Rao, G. C. (1970) Three new interstitial gastrotrichs from Andhra coast, India. *Cahiers de Biologie Marine*, 11, 109–120.
- Rao, G. C. (1993) Little meiofauna of little Andaman. *Records of Zoological Survey of India*, 155, 1–120.
- Renaud-Mornant, J. (1967) *Pseudostomella malayica* n. sp., Gastrotriche nouveau de la cote orientale de Malaise. *Bulletin du Museum National d'Historie Naturelle*, 39, 209–212.
- Ruppert, E.E. (1970) On *Pseudostomella* Swedmark 1956 with descriptions of *P. plumose* nov. spec., *P. cataphracta* nov. spec., and a form of *P. roscovita* Swedmark 1956 from the West Atlantic coast. *Cahiers de Biologie Marine*, 11, 121–143.
- Ruppert, E.E. (1991) Gastrotricha. In: Harrison, F. W. & Ruppert, E.E. (Eds.), *Microscopic Anatomy of Invertebrates*. 4: Aschelminthes. John Wiley & Sons, New York, pp. 41–109.
- Ruppert, E.E. & Barnes, R.D. (1994) *Invertebrate Zoology* 6<sup>th</sup> ed. (Fort Worth, Texas: Saunders College Publishing), 1054 pp.
- Swedmark, B. (1956) Nouveaux Gastrotriches Macrodasysoides de la region de Roscoff. *Archives de Zoologie Experimentale et Generale*, 94, 43–57.
- Todaro, M.A. (1998) Meiofauna from the Meloria Shoals: Gastrotricha, biodiversity and seasonal dynamics, *Biologia Marina Mediterranea*, 5, 587–590.
- Todaro, M.A. & Rocha, C. F. (2004) Diversity and distribution of marine Gastrotricha along the northern beaches of the

- state of Sao Paulo (Brazil), with description of a new species of *Macrodasys* (Macrodasysida, Macrodasysidae). *Journal of Natural History*, 38, 1605–1634.
- Todaro, M.A., Telford, M.J., Lockyer, A.E. & Littlewood, D.T.J. (2006a) Interrelationships of the Gastrotricha and their place among the Metazoa inferred from 18S rRNA genes. *Zoologica Scripta*, 35, 251–259.
- Todaro, M.A., Leasi, F., Bizzarri, N. & Tongiorgi, P. (2006b) Meiofauna densities and gastrotrich community composition in a Mediterranean sea cave. *Marine Biology*, 149, 1079–1091.
- Todaro, M.A., Guidi, L., Leasi, F. & Tongiorgi, P. (2006c) Morphology of *Xenodasys* (Gastrotricha): the first species from the Mediterranean Sea and the establishment of *Chordodasiopsis* gen. nov. and Xenodasyidae fam. nov. *Journal of the Marine Biological Association of the United Kingdom*, 86, 1005–1015.
- Valbonesi, A. & Luporini, P. (1984) Researches on the coast of Somalia. Gastrotricha, Macrodasysoidea. *Monitore Zoologico Italiano, Supplemento*, 1, 1–24.