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New Records of Free-Living Marine Nematodes (Nematoda: Enoplida) from East Coast of India

Zoology

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ABSTRACT

The present study provides information about the systematics of nematodes along the East coast of India for the first time. Altogether 92 nematode species were identified, represented by 55 genera, 24 families and 3 orders. Enoplus brevis, Enoplolaimus denticulatus, Oxystomina asetosa, Thalassoalaimus tardus, Metoncholaimus scanicus, Viscosia cobbi, Viscosia elegans and Trefusia longicauda belonging to the order Enoplida which happen to be first records from Indian waters. The detailed descriptions along with drawings of nematode species were presented in this paper.

INTRODUCTION

Nematodes are one of the most abundant groups in the marine meiobenthos. Recently it has been proposed that nematodes are one of the three major radiations in multi-celled organisms that have produced a large part of the world's species, the others being insects and fungi (May, 1988; Gaston, 1991). An important feature of nematode ecology is the presence of a large number of species in a single habitat, often in an order of magnitude higher than for any other taxon (Platt and Warwick, 1980). However, a majority of species in most of the areas of the world, especially in the deep sea and tropics, are still remained as un-described (Boucher and Lambshead, 1995). Comprehensive works on taxonomy or ecology of free-living marine nematodes from the Indian subcontinent are less as compared to other areas of the world. The marine biotopes around the British Isles already harbor 41 nematode families with 450 species. Another estimate for the North Sea sediments is 800 species while 1,625 species have been recorded in European seas (Costello *et al.,* 2006). The few reports on the systematic works on free-living marine nematodes from the Indian ocean were by Timm (1961; 1967a,b) from Sunderbans, northeast coast of India; Chinnadurai and Fernando (2006a, b) from Parangipettai artificial mangroves, southeast coast of India; Annapurna *et al.,* (2012) along the continental slope off north east coast of India and by Ansari *et al.,* (2012) from continental shelf regions of the south east coast of India.

MATERIALS AND METHODS

The study area extends along the coast line of Andhra Pradesh, East coast of India. Totally 260 sediment samples were collected from Visakhapatnam Harbour, Gangavaram coast, Pudimadaka and Nizampatnam Bay (Fig. 1). Samples were taken by using a Van veen grab having an area of 0.1m^2 (Hydrobios, Kiel Germany). Sub samples were collected at each station using a 10 cm long glass corer (3.6 diameter). The samples were anaesthetized with $MgCl_2$ and preserved in 4% buffered formalin. In the lab, nematode specimens were picked out by hand using a fine needle and transferred into pure glycerin (Seinhorst, 1959) and mounted on Cobb slides (Cobb, 1917). Taxonomic identifications were made based on the pictorial key of Platt and Warwick (1983; 1988); Warwick *et al.,* (1998) and the NeMys online identification key (Steyaert *et al.,* 2005). Drawings were made with the camera lucida. All measurements were carried out with the software ProgRes® Capture Pro.

The curved structures such as spicule length were measured along the arch.

The following measurements were taken

L: Total body length
a: Body length divided by maximum body diameter
b: Body length divided by oesophagus length
c: Body length divided by tail length
(a: b: c is deMan ratios)
a.b.d : anal body diameter

RESULTS

Totally 13,074 nematode specimens were isolated and 92 species belonging to 55 genera, 24 families and 3 orders were identified. Among these, eight species (*Enoplus brevis, Enoplolaimus denticulatus, Oxystomina asetosa, Thalassoalaimus tardus, Metoncholaimus scanicus, Viscosia cobbi, Viscosia elegans* and *Trefusia longicauda* belonging to the order Enoplida were found to be new reports for Indian waters. Detailed systematic account, material examined (number of specimens, place and date of collection), brief description, habitat and geographical distribution besides remarks of the above eight specimens are given here (Figs….).

Order: Enoplidae Dujardin, 1845
Family: Enoplidae Dujardin, 1845
Genus: *Enoplus* Dujardin, 1845

***Enoplus brevis* Bastain, 1865 (Plate I, Fig. a)**
1983. *Enoplus brevis* Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: One female and one male obtained from Visakhapatnam Harbour during August 2008.

Diagnosis: Buccal cavity with solid mandibles and tail is conical with small terminal setae.

Male: L= 700 µm; a=32.6; b= 37.7; c=44.7
Female: L=900 µm; a=34.4; b=44.4; c=52.6

Description: Buccal cavity with solid mandibles. Cuticle marked with small rounded punctuations. Six long cephalic setae, four shorter cephalic setae about two-thirds this length. Mandibles solid and bilobed anteriorly. The body setae are short and scattered and tail is conical with small terminal setae. The body length varied between 0.70-0.90 mm, the maximum diameter 22-35 µm, and tail in in female 1.0 a.b.d and male with 0.8 a.b.d., spicule 28 µm.

Distribution: India: Visakhapatnam Harbour, east coast of India.

Elsewhere: A common species in the muddy intertidal or shallow sublittoral recorded from several localities around the British Isles, often in areas of reduced salinity.

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length varied from 6.2-7.7 mm, the maximum diameter 130-170 µm, tail 2 a.b.d., and spicule 158-170 µm (Platt and Warwick, 1983).

Family: ***Thoracostomopsidae Filipjev, 1927***
Genus: ***Enoplolaimus*** DeMan, 1922

Enoplolaimus denticulatus **Warwick, 1970 (Plate I, Fig. b)**
1983. ***Enoplolaimus denticulatus*** Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: Two females obtained from Visakhapatnam Harbour during August 2008.

Diagnosis: Buccal cavity is cup shaped and presence of long cephalic and cervical setae. Cuticle is smooth and tail is conical.

Female: L=356-900 µm; a=28.0-36.5; b=24.0-30.7; c=23.2-35.8

Description: Cuticle smooth, inner surfaces of lips with semilunar striations. Six long cephalic setae fairly stout, equal in length, four shorter sub median setae which are more slender. Female with single ring of six short cervical setae and tail is conical. The body length of the present specimen ranged from 0.35-0.90 mm, the maximum diameter 13-25 µm and tail in female 0.9-1.1 a.b.d.

Distribution: India: Visakhapatnam Harbour, east coast of India.

Elsewhere: Exe estuary; Isles of Scilly (intertidal sand).

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length originally described varied from 3.4-4.6 mm, the maximum diameter 60-86 µm and tail 4.0-5.5 a.b.d (Platt and Warwick, 1983).

Family: **Oxystominidae Chitwood**, 1935
Genus: ***Oxystomina*** Filipjev, 1921

Oxystomina asetosa **Southern, 1914 (Plate I, Fig. c)**
1983. ***Oxystomina asetosa*** Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: Two females and six males (January and November 2007) three females and one male (April 2008) were recorded from Visakhapatnam Harbour. One male (October 2006); three females and one male (March and November 2007); one female (March 2008) were reported from Nizampatnam Bay.

Diagnosis: Buccal cavity is absent, Cuticle smooth and tail is clavate.

Male: L= 600-900 µm; a=24.0-36.0; b= 16.6-23.6; c=17.6-21.9
Female: L=400-1000 µm; a=42.8-50.0; b=27.9-30.6; c=26.0-31.2

Description: Cuticle is smooth and buccal cavity absent. There is a characteristic oval shaped amphid, with a curved structure round the anterior margin extending backwards as two projections. Cephalic and cervical setae are scarcely visible. The body length of the present specimens ranged from 0.4-1.0 mm, the maximum diameter 20-25 µm and tail in female with 1.0-1.5 a.b.d., in male 0.9-1.2 a.b.d., and spicule 8-14 µm, constricted near the proximal end.

Distribution: India: Visakhapatnam Harbour and Nizampatnam Bay, east coast of India.

Elsewhere: Clew Bay, West Ireland (sublittoral sand and shells).

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length varied from 3.4-4.0 mm, the maximum diameter 34-47 µm, tail with 3.7-3.9 a.b.d., and spicule 42 µm (Platt and Warwick, 1983).

Family: **Oxystominidae** Chitwood, 1935
Genus: ***Thalassoalaimus tardus*** DeMan, 1893

Thalassoalaimus tardus **DeMan, 1893 (Plate I, Fig. d)**
1983. ***Thalassoalaimus tardus*** Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: Two females (November 2007); thirteen females and eight males (April and August 2008) were collected from Visakhapatnam Harbour.

Diagnosis: Buccal cavity is absent and tail is conical and long.

Male: L= 890-930 µm; a=52.9- 57.1; b= 22.5- 26.6; c=20.9-26.0
Female: L=700-998 µm; a=42.0-50.0; b=22.8-23.8; c=20.0-22.2

Description: Buccal cavity is absent and smooth cuticle. Twelve cephalic setae arranged in two circles and four cervical setae slightly longer than cephalic setae. Oesophagus with a small posterior bulb. Tail is conical and long. The ovary of the female is reflexed with a small pre vulvar sac. The body length varied between 0.70-0.99 mm, the maximum diameter 16-20 µm, tail in female with 0.8-1.2 a.b.d., in male 0.4 -0.9 a.b.d., and spicule 0.6 a.b.d.

Distribution: India: Visakhapatnam Harbour, east coast of India.

Elsewhere: Plymouth (intertidal algae); Blyth estuary (intertidal mud); Skippers Island, Essex (intertidal mud); Exe estuary (intertidal mud and sand); Isles of Scilly (intertidal algae).

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The total body length varied from 1.5-3.2 mm, tail 2.2-3.0 a.b.d., and spicule 1 a.b.d. (Platt and Warwick, 1983).

Family: **Oncholaimidae** Filipjev, 1916
Genus: ***Metoncholaimus*** Filipjev, 1918

Metoncholaimus scanicus **Allgén, 1985 (Plate I, Fig. e)**
1983. ***Metoncholaimus scanicus*** Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: Four females and two males (January, 2007) obtained from Visakhapatnam Harbour. Two females and one male (March and November 2007) were reported from the Nizampatnam Bay.

Diagnosis: Buccal cavity large with dorsal tooth and ventral tooth and tail is conical.

Male: L= 800-1200 µm; a=26.0-33.3; b= 24.0-41.6; c=30.0-46.5
Female: L=910-1356 µm; a=28.0- 30.8; b= 42.1-45.8; c= 40.0-44.6

Description: Buccal cavity large with three teeth, left sub ventral being the largest. Cuticle smooth with six labial papillae. Amphid level with dorsal tooth and oesophagus widens posteriorly. Spicules slender and straight. Small gubernaculums present at tip of spicules. Two pairs of short sub ventral setae about two-thirds of tail length from cloaca. The body length was 0.8-1.3 mm, the maximum diameter 31-36 µm, tail in female with 0.6-1.3 a.b.d., in male 0.6-1.0 a.b.d., and spicule 30-37 µm.

Distribution: India: Visakhapatnam Harbour and Nizampatnam Bay, east coast of India.

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Elsewhere: Isles of Scilly (subtidal sand and among hydroids, bryozoa, etc.).

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length varied from 9.4-10.9 mm, the maximum diameter 110-118 µm, tail with 3.2-3.5 a.b.d., and spicule 93-110 µm (Platt and Warwick, 1983).

Family: **Oncholaimidae** Filipjev, 1927
Genus: ***Viscosia*** DeMan, 1890

Viscosia cobbi **Filipjev, 1918 (Plate I, Fig. f)**
1983. ***Viscosia cobbi*** Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: Four females and two males (January 2007); seven females and seven males (April and August 2008) were reported from Visakhapatnam Harbour. Two females and one male (October, 2006); three females (March, 2008) were reported from Nizampatnam Bay. Two females and one male (March, 2009) were reported from Pudimadaka coast. One female and two males (December 2004) were collected from Gangavaram coast.

Diagnosis: Buccal cavity with dorsal and ventral tooth. Tail is conical with anterior quarter tapering and posterior part cylindrical.

Male: L= 896-980 µm; a=45.0-50.0; b= 20.9-26.0; c=20.0-25.0
Female: L=1190-1340 µm; a=48.0-53.0; b=21.0-27.4; c=24.0-29.0

Description: Buccal cavity with dorsal and ventral tooth. Cuticle smooth with six short and four longer cephalic setae. Right subventral tooth larger than remaining two, which are both prominent and single tipped. Tail 0.8 a.b.d., anterior quarter tapering, posterior part cylindrical or often appearing cylindrical throughout. The body length was 0.89-1.3 mm, the maximum diameter 20-26 µm, and tail in female with 0.8-2.1 a.b.d., in male 0.6-1.5 a.b.d., and spicule 13-15 µm.

Distribution: India: Visakhapatnam Harbour, Nizampatnam Bay, Pudimaka and Gangavaram Coast, east coast of India.

Elsewhere: Exe estuary; Strangford Lough, Northern Ireland (intertidal sand).

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length varied from 2.3-2.8 mm, the maximum diameter 33-45 µm, tail with 7 a.b.d., and spicule 22-27 µm (Platt and Warwick, 1983).

Family: **Oncholaimidae** Filipjev, 1916
Genus: ***Viscosia*** DeMan, 1890

Viscosia elegans **Kreis, 1924 (Plate II, Fig. a)**
1983. ***Viscosia elegans*** Platt and Warwick, Synopses of British Fauna (New series) Part.1

Material examined: Three females and two males (November 2007) four females and three males (April and August 2008) were reported from Visakhapatnam Harbour.Three females and two males (March 2007) from Nizampatnam Bay. One female and one male (December 2004) were reported from Gangavaram coast.

Diagnosis: Buccal cavity with dorsal and ventral tooth. Tail is conical with bulbous tip and with small setae.

Male: L= 600-1200 µm; a=30.0-50.0; b= 13.9-26.0; c=13.3-25.0
Female: L=800-1000 µm; a= 36.0-40.0; b= 20.0 -20.4; c=16.0-18.1

Description: Six labial papillae are present. Six longer cephalic setae and four slightly shorter are present. Lateral cervical setae are placed at the base of the buccal cavity. Large right and smaller double tipped left sub ventral teeth; dorsal tooth represented by slight ridge only. Tail is tapering, with a bulbous tip. Sub dorsal terminal setae absent. The body length ranged from 0.62-1.0 mm, the maximum diameter 20-25 µm, tail in female with 0.8- 1.3 a.b.d., in male 0.6-1.0 a.b.d., and spicule 8-15 µm.

Distribution: India: Visakhapatnam Harbour**,** Nizampatnam Bay and Gangavaram Coast, east coast of India.

Elsewhere: Isles of Scilly (sublittoral sand, 12-27m depth).

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length varied from 2.0-3.1 mm, the maximum diameter 30-50 µm, tail with 6-9 a.b.d., and spicule 20-27 µm (Platt and Warwick, 1983).

Family: Trefusiidae Lorenzen, 1981
Genus: ***Trefusia*** DeMan**,** 1893

Trefusia longicaudata **DeMan, 1893 (Plate II, Fig. b)**
1983. ***Trefusia longicaudata*** Platt and Warwick, Synopses of British Fauna (New series) Part.1.

Material examined: Twelve females and ten males (November 2007); nine females and five males (April and August 2008) were collected from the Visakhapatnam harbour.

Diagnosis: Buccal cavity is absent (or) minute with jointed cephalic setae. Tail extremely long and filiform.

Male: L= 900-1190 µm; a=64.2-98.0; b= 16.9-28.0; c=18.6-26.2
Female: L=1200-1360 µm; a=92.3-109; b=30.0-42.8; c=20.6-34.6

Description: Cuticle is faintly striated. Six cephalic setae are long, each with a filiform tip. Buccal cavity is small and conical shaped. Amphids are pocket like. Oesophagus is cylindrical. Tail is long filiform. The body length ranged from 0.9-1.3 mm, the maximum diameter 12-15 µm, and tail in female with 1.0-6.0 a.b.d., in male 0.8-4.5 a.b.d., and spicule 8-12 µm.

Distribution: India: Visakhapatnam Harbour, east coast of India.

Elsewhere: Recorded from intertidal and shallow subtidal sediments and holdfasts at several localities around the British Isles, with a preference for muddy sands.

Remarks: The material examined conforms well to the earlier description, except for minor variation in the relative measurements of the body. The body length varied from 1.9-2.6 mm, the maximum diameter 26-33 µm, tail with 40 a.b.d., and spicule 24-27 µm. (Platt and Warwick, 1983).

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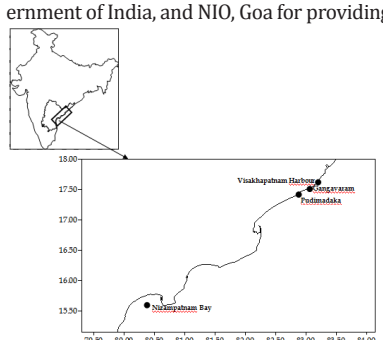

Figure 1: Study area with four transects along East coast of India

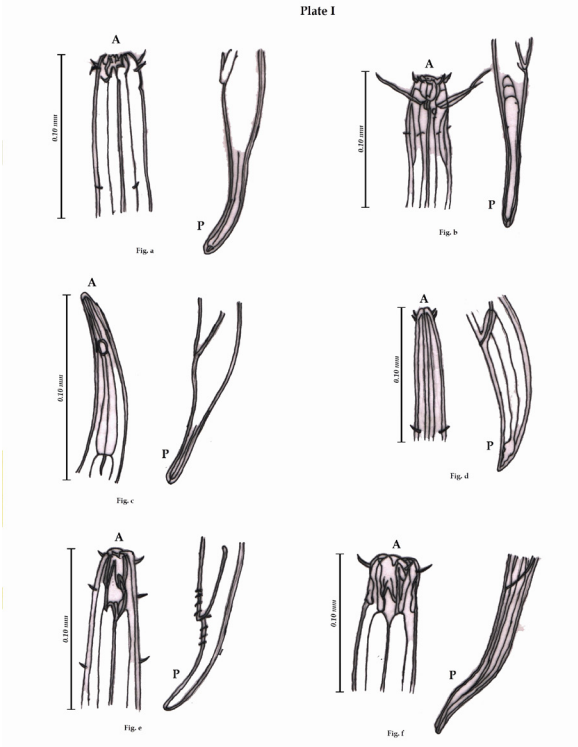

Plate I: Figure a - *Enoplus brevis* ♀; b – *Enoplolaimus denticulatus* ♀; c – *Oxystomina asetosa* ♀; d – *Thalassoalaimus tardus* ♀; e – *Metoncholaimus scanicus* ♂; f – *Viscosia cobbi* ♀

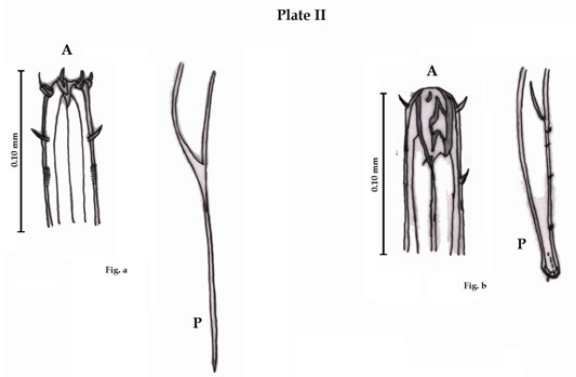

Plate II: Figure a – Viscosia elegans ♀; *b – Trefusia longicaudata* ♀

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