Distribution of Polychaetes in Manakkudy Backwater, South West Coast of India

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Research

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Abstract

Background: Polychaetes are an important component of the estuarine and mangrove ecosystem especially in fisheries perspective. The polychaete fauna of the Manakkudy estuary barmouth and mangrove was examined for species composition and taxonomic classification. A total of 27 species belonging to 16 genera under 12 families were collected.

Results: Of these 27 species, 16 are new records to Manakudy estuary. Out of which, those coming under the group Errantia were dominant (9 species) when compared to Sedentaria group (7 species). Among the 12 families identified, the species diversity of Nereidae and Capitellidae were found to be high.

Conclusions: Salinity and nature of substrata, two main factors which govern the distribution of polychaetes, are also given along with species description.

Background

The phylum Annelida exhibits high morphological diversity, as well as a lot of ecological diversity [1]. Polychaete species distributions have been profoundly affected by earlier period climate change, and are expected to change considerably in response to future environmental change [2]. As global climate change continues, extreme weather events such as heat waves are becoming more common, long-lasting, and intense, affecting marine biodiversity patterns around the world. Increased risks of overheating and mortality across major taxa have been recurrently observed [3]. Also the ocean acidification (OA) can negatively affect early-life stages of marine organisms, with the key processes of larval settlement and metamorphosis potentially vulnerable to reduced seawater pH [4]. Manakudy is a pristine eco-sensitive zone where the river Pazhayar joins the sea forming a big estuarine ecosystem with mangrove forest and bird sanctuary. Near to the estuary there is a salt pan, sand dune, turtle nesting ground and have two thickly populated coastal villages, Melamanakudy and Keelamanakudy. Because of this unique nature of the ecosystem, Manakudy site was selected for the study of polychaete taxonomy. Further, a detailed systematic work on the polychaete fauna of the Manakkudy mangrove is lacking and hence an attempt was made here. In this study species composition and taxonomic description of polychaete fauna of the Manakkudy estuary barmouth and mangrove were examined during April 2018.

Methods

Sampling of Specimens

For the present study polychaete sampling were made from 3 stations (Fig. 17) of barmouth including seaweed bed in rocks (Lat. 8°5’14.04”N, Long. 77°29’8.42”E), estuary (Lat. 8°5’22.00”N, Long. 77°29’4.00”E) and mangrove sediments (Lat. 8°6’11.34”N, Long. 77°28’59.69”E). Sediment samples were collected by using scoop with an effective sampling area of 0.1m^2 diameter.

Sample fixation and preservation

Collected samples were sieved using 500 micron mesh sieve and brought to the laboratory. The sieved samples were washed in seawater and fixed in 7% formalin diluted with seawater and later transferred to 70% ethanol.

Specimen drawing

Specimens were examined under a light microscope, the external and internal body features of the polychaetes were drawn for this Prism type Camera Lucida used. The body features measurements were taken using a micro-occulometer with 10X magnification. Species were identified using standard keys [23-28].

Results

Among the polychaetes collected, 27 species belonging to 16 genera under 12 families were identified based on morphological key characteristics. Of these 27 species, 16 were new records to the study area and they are shown in Table 1.

Table 1
List of species identified from Manakkudy mangrove, South West Coast of India

Sl. No.	Family	Identified species	References
1	Orbiniidae	*Schroederella pauliani*	Laubier, 1962
2	Cossuridae	*Cossura coasta*	Kitamori, 1960
3	Spionidae	*Scololepis squamata*	Muller, 1806
4	Capitellidae	*Capitella capitata*	Fabricius, 1780
5	Capitellidae	*Notomastus aberans*	Day, 1957
6	Maldanidae	*Euclymene annandalei*	Southern, 1921
7	Pilargidae	*Ancistrosyllis robusta*	Ehlers, 1908
8	Nereidae	*Dendronereides zululandica*	Day, 1951
9	Nereidae	*Laeonereis ankyloseta*	Day, 1957
10	Nereidae	*Platynereis dumerilli*	Audouin and Milne-Edwards, 1833
11	Nereidae	*Perinereis cultrifera*	Grube, 1840
12	Glyceridae	*Glycera alba*	Muller, 1788
13	Goniadidae	*Goniada emeriti*	Audouin and Milne-Edwards, 1833
14	Nephtyidae	*Nephtys capensis*	Day, 1953
15	Eunicidae	*Eunice indica*	Kinberg, 1865
16	Oweniidae	*Owenia fusiformis*	Delle Chiaje, 1844

Systematics

Schroederella pauliani (Laubier, 1962) (Plate 1; Figs. 1A-F)

Schroederella pauliani Laubier, 1962: 231, Figs. 1–2.

Body 3–4 mm length having 40 segments with a very pointed lengthy prostomium separated into two annuli. Pair of eyes was present. Thorax segments were seen without branchiae. Post setal lobe of notopodium small and visible on setiger 7. Thoracic neuropodia was observed without foot papillae. Four to five segments were seen between thorax and abdomen (Figs. 1A & B). Abdomen with digitiform dorsal branchiae and small postsetal notopodial lobes were observed. Foot was developed (Fig. 1C). Notosetae were crenulated. Thoracic unicinus developed (Fig. 1D). Thoracic neurosetae with a few crenulated,

capillaries and several serrated acicular uncini were observed (Fig. 1E). Abdominal neurosetae and foot (Fig. 1F) include two crenulated capillaries and a single hunt acicular seta. Mandibles were white in colour and calcified distally. Gills were simple and begin on chaetiger 9 and continuing to near the end of the body. First two parapodia consist of winged capillary chaetae and simple stout hooks were observed.

Cossura coasta (Kitamori, 1960) (Plate 2; Figs. 2A-E)

Cossura coasta Kitamori, 1960: I082, fig, I a-f; Day, 1963: 427.

This worm was small, (Figs. 2A, B & D) thread like, measuring 12 to 15 mm in length with 98 to 106 segments. Body of the animal was long, cylindrical and pointed at both ends. Prostomium was present with three long anal cirri. Pharynx was lobed and eversible. Appendages were absent in first two segments. Parapodia was absent in this species and the setae arise from the middle dorsal part of the third setigerous segment and measures 8, 10, 12 mm in size. Two types of setae were present, preacicular setae barred transversely. Chaetae of first three segments were longer and broader which reduce its thickness in successive segments. Two types of post acicular chaetae were present. Majority were long, smooth and slender capillaries (Fig. 2E) and a few were shorter with finely serrated and flattened blades. Parapodial aciculae were slightly projected and are curved. Prostomium was conical with two nuchal organs. Eye spots were absent. Pygidium was well developed. Noto aciculae were very small in size. Neurosetae are bifurcate, with prongs of different length. Foot was large in size except anterior and posterior regions (Fig. 2C).

Scololepis squamata (Muller, 1806) (Plate 3; Figs. 3A-H)

Lumbricus squamatus Muller, 1806:39.

Lumbricus cirratulus Delle Chiaje, 1825: 196.

Nerine cirratulus: Fauvel, 1927: 36, Fig. 11g-n; Day, 1955: 412, fig. l, j.

Size of the species was 138 mm with 200 segments. Prostomium was pointed anteriorly (Figs. 3A &B), with four to six eyes in a row. Triangular caruncle was present. Notopodial lamellae jointed to the branchiae anteriorly. But free posteriorly with the inferior margin produced downwards towards the neuropodium. Notopodial hooded hooks were developed (Fig. 3G). Postchaetal lobes are segmented in the following segments and were small and ovoid in shape. Post chaetal lobes in anterior segments were short and rounded from segment 18–20 onwards and were weak and bilobed. A maximum of twelve neuropodial hooks were present. Cirriform longer than prolonged gills, start at segment 2. Anterior parapodia have capillary chaetae (Fig. 3D) was only from neuropodium. Hooded hooks (Fig. 3E) were present. Notosetae were formed from notopodia (Fig. 3C). Pygidium has a single lobe (Fig. 3H). Capillary notosetae were seen (Fig. 3F). Hooded hooks were usually bidentate, unidentate or with two small accessory teeth. The worm was bluish green in colour.

Capitella capitata (Fabricius, 1780) (Plate 4; Figs. 4A-E)

Lumbricus capitatus Fabricius, 1780: 279.

Capitella capitata : Fauvel, 1927: 154, Fig. 55a-h; Hartman, 1947: 404, pl.43; Fig. 1–2.

Body was lengthy, oval, flimsy, tapered at each end, wider anteriorly, thread like, 110–120 mm long for hundred segments and dark red in colour. In the anterior region of the body (Fig. 4A) prostomium of the species was conical in shape, with two small eyes ventrally and with two - nuchal organs behind eyes. Thorax has 9 chaetigers. The segments of thorax were biannulate. Both rami consist of capillaries from the first segment. Peristomial segment of sixth to seventh have capillaries and hooks. In the female, the 8th and 9th segments (Fig. 4B, C) have hooks in both rami, but in male there were 4 stout genital hooks (Fig. 4D) and dorsally positioned inwards towards the genital opening. Normal hooks (Fig. 4E) were ventrally arranged in a diagonal cross. A single genital pore opens mid–dorsally between chaetigers 8 and 9. Very large sized proboscis was present and is muscular in nature. Proboscis has a pair of chitinous jaws. Parapodia is biramous with divergent setigerous lobes, each bearing delicate anterior and posterior lamellae. Simple setae were arranged on two rows. The anterior row has laddered capillaries and the posterior rows, have long capillaries. Forked setae were also present. Abdominal neurosetae was narrow. Winged capillaries were seen. Pygidial eye spots were present. Pair of internal eyes was present in the collar segment. Winged capillaries were present on thoracic notosetae.

Notomastus aberans (Day, 1957) (Plate 5; Figs. 5A-D)

Notomastus aberans Sars, 1851.

Notomastus aberans : Day, 1957: 105, Fig. 7a-b.

Notomastus fauvelii Day, 1955:422, Fig. 2h-l.

Notomastus giganteus Fauvel, 1932:194.

Notomastus latericeus Sars,1851:199; Fauvel, 1927:143,Fig. 49a-h.

Body is 60 mm long and have 120 segments. Thorax with an achaetous peristomium was followed by 11 setigerous segments. The first setigerous segment has notopodial capillaries and neuropodial capillaries and the remaining setigers bear capillaries in both notopodia and neuropodia. Prostomium (Fig. 5A) bears an elongate cone with eyes. Peristome is achaetous. First thoracic setiger has notopodial capillaries. No neurosetae was found. Abdominal segments (Fig. 5B) have short rows of hooks (Figs. 5C & D) in both notopodia and neuropodia. Gills were present on the outer edge of the abdominal notopodia and the superior edges of the neuropodia. The first row has four teeth; the second row has five teeth were observed. Posterior abdominal segments are seen companulate when shrinked. Branchiae was triangular. Median antenna with large dark coloured ceratophore was present. Lateral antennae consist of short pigmented ceratophore. Palps were 3 times longer than prostomium with some pigments. Tentacular segment has basal lobes.

Euclymene annandalei (Southern, 1921) (Plate 6; Figs. 6A-G)

Euclymene annandalei Southern, 1921:648, pl.28 Fig. 22A-G, pl.29 Fig. 22H-K.

Body length 80 mm, oval, longer and wider was observed. Encircling rim, higher anteriorly, laterally and posteriorly were found (Fig. 6B). Prostomium was (Figs. 6A&E) blunt, triangular with numerous ocelli, oval, longer than wide, with an encircling rim, higher anteriorly. Nuchal grooves straight and two third of the length of the cephalic lobe, and parallel extending posteriorly to the beginning of the lateral incision with many ocelli. Cephalic rim high anteriorly but lower and divided into about eight crenulations posteriorly, 21 setigerous bodies, two achaetous preanals followed by the pygidial ring and anal funnel (Fig. 6F). Anterior segments shorter and posterior ones were lengthy. Segments have strongly reduced ventral hooks. Acicular spines were seen on aciculum (Fig. 6D). Posteriorly 3 segments were seen without chaetae. Pygidium funnel shaped. Subsequent neurosetae have numerous hooks. Dorsal tubercles were also present on 3rd and 6th segment. Straight winged setae were seen (Fig. 6G). The elytra were oval in shape and elongated. Hooks were normal in size (Fig. 6C).

Ancistrosyllis robusta (Ehlers, 1908) (Plate. 7; Figs. 7A-I)

Ancistrosyllis robusta Ehlers, 1908: 59, pl. 6 Figs. 4–7.

Body was elongated, slender, 54 mm long with 182 segments. Prostomium has three slender antennae and two biarticulate palps having small palpostyles (Figs. 7A&B). The median antenna is reaching back to setiger 5. Heavy palps with knob shaped palpostyles, pharynx short and stout and the mouth entrance was surrounded by 16 ovoid papillae. Peristome has two pairs of tentacular cirri. Dorsal cirrus of setiger was twice the length of the tentacular cirri (Fig. 7H). Parapodial lobe and forked setae (Fig. 7I) was present. Ventral cirrus much shorter and neuropodial setae (Figs. 7E&F) were of varying length, the shorter ones finely serrated the longer ones regular. Capillary chaetae arose with fine teeth at the tip on notopodia (Fig. 7D). Prominent on neuropodia from the 2nd chaetiger, long on thorax, short on abdomen. 44th segment was broader (Fig. 7C). Uncini present in double rows on segments 11–20. Large pygidium (Fig. 7G) was present with appendages. Eye spots were absent. Three pairs of gills are present and each composed of numerous simple filaments.

Dendronereides zululandica (Day, 1951) (Plate 8; Figs. 8A-H)

Dendronereides zululandica Day, 1951: 30, Fig. 5a-j.

Body stretched to 70 mm by 1.5 mm, width for 100 segments. In the anterior region prostomium (Fig. 8A) with two antennae was observed. Parapodium was absent. Large cirrophores and short tentacular cirri were present. Dorsal and ventral cirri partially fused to form segments. In the anterior region, the superior lobe of the notopodium was divided to form a simple series of branchial foot (Fig. 8C). Interior lobe of neuropodium absent, feet reduced and simplified posteriorly. Neuropodium present with a single broad setigerous lobe. Notopodial lobes being reduced to two. Notosetae were all homogomph spinigers. Most of the neurosetae were heterogomph falcigers (Fig. 8D). Some were homogomph falcigers (Figs. 8E&F).

Homogomph and heterogomph spinigers are also seen in this worm (Figs. 8G&H). The tentacular segment and the prostomium are partially fused. The prostomium is bilobed. Lateral antenna eyes and occipital papillae were median. Single aciculums and few capillary setae were present. Short tentacular cirri were present. Elytrophores were elongated. Biramous parapodia were present. Neuropodia was stout. Post setal lobes were shorter and conical together enclosing very thick bundles of numerous neurosetae. Proboscis was clearly developed (Fig. 8B).

Laeonereis ankyloseta (Day, 1957) (Plate 9; Figs. 9A-G)

Laeonereis ankyloseta Day, 1957: 83, Fig. 5a-j.

Body elongated up to 50 mm long with numerous segments. Head was clearly seen. Distinct peristomium and prostomium (Fig. 9A) were seen in anterior region and sharply on head. Brownish spots were present on the anterior segment of the worm. Prostomium was as broad as long and has a clear median groove. Well developed proboscis was seen (Fig. 9C).Two pairs of eyes were present on prostomium. No modifications were seen in anterior foot (Fig. 9D).Two frontal antennae and two biarticulate palps are also present. Parapodia were biramous. One to three lobes are present on the notopodium. Two lobes and ventral cirri were present on neuropodium. Compound setae were present and simple setae were also seen. Tentacular cirri were very short in size. Smooth maxillary ring was present. Two notopodial lobes and longer dorsal cirri were present on anterior feet. First segment behind the head was apodous. The first two feet uniramous and the rest were biramous. Parapodium consists of dorsal and ventral cirrus. Neuropodium consists of two lobes, 1. An setigerous lobe on which pre and post setal lips were prominent, 2. An inferior lobe was observed. Specialised gills were also present. The origin of the dorsal cirrus and its length were relative to the superior lobe of the notopodium and modifications of the later in posterior feet (Fig. 9B). The first setigerous segments have sub-biramous parapodia, the notopodia lacking notosetae; the remaining segments have biramous parapodia. The ventral cirri were short, tapered and single. The pygidium was provided with a pair of anal cirri. Three falcigers were present. They were: 1. simple falcigers (Fig. 9E), anterior falcigers (Fig. 9F) and posterior falcigers (Fig. 9G).

Platynereis dumerilii (Audouin and Milne-Edwards, 1833) (Plate 10; Figs. 10A-G)

Nereis dumerilii Audouin and Milne-Edwards, 1834:19b.

Platynereis dumerilii : Fauvel, 1923:359, Fig. 141a-f.

Body of the species elongated with 45 mm length which was multisegmented. In the anterior region of the body (Fig. 10A) prostomium was longer than broad with enlarged, flattened, swollen palps. Palps were two in number. Proboscis well developed (Fig. 10B). Prostomium was distinct. Long tentacular cirri were present. Long anterior feet with two rounded large notopodial lobes were present, a minute intermediate lobe and long dorsal cirrus are seen. Numerous spinigers (Fig. 10G) were present on notosetae on middle feet onwards, two or three homogomph falcigers. The blade was elongate and deeply bent backward at the top which has a terminal knob. Neurosetae was spinigers and falcigers

(Fig. 10E&F). Tendons attached on blades. In the heteronereid stage the first modified foot (Fig. 10C) of the male is the 15th and of the female the 18th. Setae were composite or simple, spinigerous or falcigerous (Fig. 10D). Anterodorsal and posterodorsal cirri were of about the same length, anteroventral ones slightly shorter, bent downwards and posterodorsal cirri extending to chaetiger 2. Parapodia have conical acicular neuropodial ligule. Dorsal cirri were cirriform, only about half as long as dorsal cirri. Notochaetae are absent. Antennae are short and are not reached the tip of prostomium. Anterior segments six times broader than long, posterior one about as broad as long.

Perinereis cultrifera (Grube, 1840) (Plate 11; Figs. 11A-F)

Nereis cultrifera Grube, 1840:74.

Perinereis cultrifera : Fauvel, 1923: 352, Fig. 137.

Body of the species was wide, tapering posteriorly, integument smooth, 250 mm in length and have 125 segments (Fig. 11A). Proboscis was observed eversible in this worm. In the anterior region prostomium was triangular in shape with a pair of short antennae without cirrophores (Fig. 11B). A pair of biarticulate large palps with short styles, 2 pairs of eyes in a trapezoid arrangement was observed. Peristomial segments were apodous. Parapodia were biramous (Fig. 11C) except for the first two which uniramous. The setae were compound and include both spinigers (Figs. 11E& F) and falcigers. Dorsal tentacular cirri longer than ventral ones, second dorsal tentacular cirrus reaching back to chaetiger 6, pharynx with a pair of denticulate jaw. Two notopodial lobes are present on the anterior feet. Dorsal cirrus was short. Straight blades were seen in neuropodial falcigers. Paragnaths were present on some areas. The first segment behind the head was apodous. The neuropodium consists of two lobes. The setae are compound. The blade may be falcigerous (Fig. 11D) typically short and stout. Superior lobe of posterior notopodia not expanded.

Glycera alba (Muller, 1788) (Plate 12; Figs. 12A-G)

Nereis alba Muller, 1788: 217. pl. 2. Figures 6–7.

Glycera alba : Fauvel, 1923: 385. Figure 150

Body was 100 mm long with 150 segments. Prostomium composed of rings with palps and antenna forming a cross at the tip (Fig. 12A&D). Papillae on the proboscis have a distal flange and midbody segments were biannulate. Parapodia have pre and postchaetal lamellae. Long presetal lobes were present on parapodium. Superior postsetal lobe was pointed and the inferior one was rounded. Postchaetal lamellae were long, pointed uniform in size and clearly separated. Branchiae arise from the dorsal edge of the parapodium (Figs. 12C, E&G) at the level of the presetal lobe. Dorsal cirri were ovoid and ventral cirri triangular. Gills occur on the dorsal side of the parapodium starting at chaetiger 20. Pharynx has papillae of three kinds, fingernail finger shaped and conical. Aileron with an inner branch united to the outer branch by an interramal plate. Ramus was not divergent and ventral cirri short in length. Toothed jaws were visible (Fig. 12K). There was oral ring forming the mouth opening and lips.

Head and half of the anterior segments were dark brown in colour. Tentacular cirri were fairly short except for the posterior dorsal one. All paragnaths were small and conical in shape. Falcigers was slightly hooked. Aciculum diverged (Fig. 12B) and consists of acicular seta (Fig. 12F).

Goniada emerita (Audouin and Milne -Edwards, 1833) (Plate 13; Figs. 13A-J)

Goniada emerita Audouin and Milne-Edwards, 1833:268; Fauvel, 1923:391, Fig. 154h-q.

Body was relatively broad, elongate with three regions. Prostomium composed of eight rings, with palps and antennae forming a cross at the tip anteriorly (Figs. 13A&B). Anterior parapodia uniramous with a prechaetal lamella was observed. Postchaetal lamella was bigger and middle parapodium biamous (Fig. 13E). Posterior parapodium was biramous with a small notopodium with a prechaetal lamella and a short postchaetal lamella. Posterior neuropodia with short prechaetal and longer postchaetal lamellae was observed. Paragnath has two teeths (Fig. 13D) and dorsal and ventral cirri were finger like. Notopodial chaeta was short. Neuropodial chaetae are compound. Two kinds of papillae was present on pharynx; some were semiglobular and some bifid. Macrognath has 3 teeth and ventral cirrus was triangular. Mouth was circular in shape (Fig. 13F). Stalks was present and have compound bristles (Figs. 13G&H). Posterior tooth was large. The anterior teeth have biramous feet. Proboscis covered with essentially similar papillae and fermenting in a mouth with a pair of large toothed jaws and a circle of small micrognaths were observed. A longitudinal row of V shaped chevrons (Fig. 13C) on either side of the 147th proboscis was observed. No branchia; notoseta were simple and observed two types; 1. Acicular notosetae (Fig. 13I) and 2. spinigerous notosetae (Fig. 13J); neurosetae compound spinigerous.

Nephtys capensis (Day, 1953) (Plate 14; Figs. 14AH)

Nephtys capensis Day, 1953: 431, Fig. 5g-m.

Body was elongated, depressed, slender and 75 mm long. Numerous segments were present in this worm. Two well developed antennae were present; one was longer than the other. Anterior region prostomium was arched and pentagonal in shape (Fig. 14A&B). Two palps were present and are equal in shape. Dorsal tentacular cirri are present on the first segment and were leaf shaped. Ventral tentacular cirri was little longer than the palps. Geniculate seta (Fig. 14G) and forked seta were developed (Fig. 14H). Post setal lamellae of notopodia were simple, rounded, and was little longer than the acicular lobe. Neuropodia were oval in shape and is broadly rounded and much longer than the acicular setae. Eyes were visible through the skin. Dorsal cirrus of first foot was well developed. Cirriform gills start on setiger 4 and project straight out. Tapered notopodial cirrus was at the base. In the anterior feet all lamellae exceed the setigerous lobes were observed. Parapodium was well developed (Fig. 14C). Entire body was covered with marginal spinules (Fig. 14E). The notopodium has a round presetal lamella and a larger, orbicular post setal one. The neuropodium has round presetal lamellae and larger orbicular post setal lamellae. The notopodium has an oval presetal lamella, a blade like superior lamella and large orbicular post setal lamellae. In the posterior feet, all lamellae decrease in size. In the neuropodium, the main lobe is inferior and a posterior lobe was very long and has flattened and laddered capillaries (Fig. 14F).

Eunice indica (Kinberg, 1865) (Plate 15; Figs. 15A-G)

Eunice indica Vitatta Fauvel, 1923:404, Fig. 158h-n.

Eunice indica : Kinberg, 1865: 562; Crossland, 1904: 318, pl. 21 Figs. 9–12; Fauvel, 1953: 241,Fig. 119g.

Body of the species was long with, 58 mm length and have small head. Palps were present clearly and fused, so that the anterior margin was slightly notched. Antennae long and smooth reaching to setiger 7. Long and slender tentacular cirri were present. Numerous teeth were seen on jaws. Anterior dorsal cirri were not elongated. Branchiae from setiger 3 increase rapidly to 10–15 filaments and were restricted to the anterior part of the body. Compound seta and foot (Fig. 15C) were present (Figs. 15B&G). Acicula of this species was almost straight, blunt and yellow in colour. Long pointed guards are present and were bidentate. One margin acicular seta (Figs. 15D&F) was seen and is striated. An antenna was seen and subequal in length and shorter than prostomium (Figs. 15A&E). Two eyes were present and are large in size. Eyes were black and oval in shape. Parapodia of this species were blunty and conical in shape. Dorsal cirrus was rounded and the capillaries seen on setae. Parapodia reach full size about segment 10 and each parapodium has laminar dorsal cirrus. A longer bristled lobe was present with a long cirriform appendage. A posterior uncini was present with 5 teeth and arranged in a row. Antennae are subequal and shorter than prostomium. Two black eyes were present and large and oval in shape. Parapodia were blunty and have conical dorsal cirrus, rounded ventral cirrus and broad setigerous lobe. Capillaries were seen on setae. Mandibles were white in colour and calcified distally. Gills were simple and begin on chaetiger 9 and continuing to near the end of the body. First two parapodia consist of winged capillary chaetae and simple stout hooks.

Owenia fusiformis (Delle Chiaje, 1844) (Plate 16; Figs. 16A-H)

Owenia fusiformis Delle Chiaje, 1844:31; Fauvel, 1927: 203, Fig. 71a-f.

Body relatively short, cylindrical anteriorly (Figs. 16A, B, C& H) was observed. Entire worm enclosed in a strong cartilaginous tube hardened by imbricating shell fragments and sand grains. A deep ventral groove was present and a pair of lateral grooves seen along the whole length. Long internal ventral cirrus was present. Worm was greenish brown in colour and the size was 100 mm length with 30 segments. The membrane mounted on a trilobed base and incised to form six main divisions. These divisions were enclosed and the terminal mouth which has three lobed dorsal and ventral lips (Fig. 16E). Dorsally bristles were formed. Three chaetigerous thoracic segments were present and short with notopodia. Two ocular marks was seen at the base of the membrane. Thoracic region has three short setigers bearing capillary setae. The first 5 abdominal segments were much longer, with noto and neuropodia. The posterior end of the body has short segments. Notopodial chaetae of thorax were spinose capillaries. The chaetae of the third bundle were shorter than the others. Parapodial lappets was absent on notopodia. Capillary spinulose was present (Fig. 16F). Abdominal neuropodia was wide, flattened tori with many small bidentate hooks clearly seen (Fig. 16D). Parapodia reach full size up to segment 10 and each parapodium has laminar dorsal cirrus, 2–3 times as long as broad were observed. A long bristled lobe

was present with a long cirriform appendage and smaller ventral cirrus essentially similar to the dorsal one. Sandy tube was present (Fig. 16G).

Discussion

Out of 27 species recorded, 11 were from the mangrove, 9 from the estuary and 7 from the seaweed bed. More number of species was found in the mangrove region. Most of the polychaetes were collected belong to Nereidae, Capitellidae, and Glyceridae families. The remaining species were from the families Eunicidae, Spionidae, Oweniidae, Orbiniidae, Pilargidae, Maldanidae, Cossuridae and Nephtyidae. Among these, *Perinereis cultrifera, Platynereis dumerilli, Eunice indica, Capitella capitata, Glycera alba, Cossura coasta, Goniada emeriti, Nephtys capensis* and *Euclymene annandalei* were present in all stations. So far, 12 species such as 1. *Capitella capitata*, 2. *Cossura coasta*, 3. *Eunice indica*, 4. *Euclymene annandalei*, 5. *Glycera alba*, 6. *Goniada emeriti*, 7. *Notomastus aberans*, 8. *Nephtys capensis*, 9. *Owenia fusiformis*, 10. *Perinereis cultrifera*, 11. *Platynereis dumerilli* and 12. *Scololepis squamata*, have been reported from Cochin mangrove by earlier [5–7] and the same species reported by Thilagavathi, *et al.* [8] and Murugesan, *et al.* [9] from Muthupettai and Pichavaram mangrove. Out of these, seven froms *Capitella sp, Ancistrosyllis sp, Euclymene sp, Eunice sp, Goniada sp, Perinereis sp* and *Scololepis sp* were reported only up to genus level by Sunil Kumar and Antony [10] from Cochin mangrove, same genus reported by Murugesan, *et al.* [9] and Pravinkumar, *et al.* [11], from Muthupettai and Pichavaram mangrove. Out of these, 10 forms *Capitella sp, Cossura sp, Eunice sp, Euclymene sp, Glycera sp, Goniada sp, Notomastus sp, Nephtys sp Owenia sp* and *Platynereis sp* were reported only up to genus level have been reported by Indian estuaries from earlier authors Khan & Murugesan [12]; Same genus reported in Zuari estuary [13], Vellar estuary [14, 15], Cochin backwaters (Pradnya, *et al*., 2017) and estuaries of TamilNadu [16]. So far, 9 species such as, 1. *Ancistrosyllis robusta*, 2. *Capitella capitata*, 3. *Cossura coasta*, 4. *Eunice indica*, 5. *Euclymene annandalei*, 6. *Glycera alba*, 7. *Goniada emeriti*, 8. *Perinereis cultrifera* and 9. *Scololepis squamata* have been reported earlier in Vasishta and Godavari estuary [17, 18]. The same species was reported in Indian estuaries including Cochin estuary [19, 12, 20]; Zuari estuary [13, 14]; Cochin backwater [15]; Karwar estuary [16]; Pudhucherry estuary [21] and various estuaries in Tamilnadu [22]. Recent trend in marine ornamental fish trade, attract a wide variety of polychaete worms for the reef aquarium. In view of their use in aquaculture as shrimp brood stock diet and in removing organic wastes from shrimp discharges, as toxicological test organisms and as a pollution indicator organism, present study justify the need of polychaete study. Polychaete taxonomy is essential for the fundamental understanding of biodiversity and its conservation. Many species will become extinct before they are described and we remain continually unaware of the total numbers of species that comprise polychaete biodiversity. Manakkudy is a suitable environment for the growth of polychaetes.

Conclusions

Out of 27 species collected, 16 species are new records to the study area. They are, *Glycera alba, Capitella capitata, Notomastus aberans, Scololepis squamata, Eunice indica, Owenia fusiformis, Schroederella*

pauliani, Ancistrosyllis robusta, Dendronereides zululandica, Goniada emeriti, Platynereis dumerilli, Laeonereis ankyloseta, Cossura coasta, Euclymene annandalei, Nephtys capensis and *Perinereis cultrifera* are reported for the first time. The detailed taxonomic investigation of the present data can form a baseline for future monitoring programmes in this area.

Declarations

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Authors' contributions

Study design: SL, MMB and TC; Specimen collection: SB and TC; Sample preparation: SB, Data acquisition: SL, SB and TC; Data analysis: SB, TC and SB; Lab space and resources: TC and MMB; Manuscript writing: SL, TC, MMB and SB. All authors contributed to manuscript revision, read and approved the submitted version.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

1. Jimi N, Fujimoto S, Takehara M, Imura S. Black spicules from a new interstitial opheliid polychaete *Thoracophelia minuta* sp. nov.(Annelida: Opheliidae). Scientific reports. 2021;11(1):1–8.
2. Nunes FLD, Rigal F, Dubois SF, Stanislas F, Viard F. Looking for diversity in all the right places? Genetic diversity is highest in peripheral populations of the reef-building polychaete *Sabellaria alveolata*. Mar Biol. 2021;168(5):63.
3. Madeira D, Fernandes JF, Jerónimo D, Ricardo F, Santos A, Domingues MR, Calado R. Calcium homeostasis and stable fatty acid composition underpin heat wave tolerance of the keystone polychaete *Hediste diversicolor*. Environ Res. 2021;195:110885.
4. Espinel-Velasco N, Tobias-Hünefeldt SP, Karelitz S, Hoffmann LJ, Morales SE, Lamare MD. Reduced seawater pH alters marine biofilms with impacts for marine polychaete larval settlement. Marine Environmental Research. 2021;167:105291.
5. Sunil Kumar R. Habitat selection, distribution and population density of *Sphaeroma terebrans* (Crustacea: Isopoda) in the littoral subsoil of a tropical estuarine mangrove ecosystem. Zoos Print Journal. 2001;16(6):509–13.
6. Sunil Kumar R. Biomass, horizontal zonation and vertical stratification of polychaete fauna in the littoral sediment of Cochin estuarine mangrove habitat, south west coast of India. Indian Journal of Geo-Marine Sciences. 2002;31(2):100–7.
7. Sunil Kumar R. A checklist of polychaete species some mangroves of Asia. Zoos Print Journal. 2003;18(2):1017–20.
8. Thilagavathi B, Varadharajan D, Babu A, Manoharan J, Vijayalakshmi S, Balasubramanian T. Distribution and diversity of macrobenthos in different mangrove ecosystems of Tamil Nadu coast, India. Journal of Aquaculture Research Development. 2013;4(6):1000199.
9. Murugesan P, Sarathy PP, Muthuvelu S, Mahadevan G. Diversity and Distribution of Polychaetes in Mangroves of East Coast of India. In: book: Mangrove Ecosystem Ecology and Function. Intech Open publishers; 2018. pp. 108–26.
10. Sunilkumar R, Antony A. Preliminary studies on the polychaete fauna of the mangrove areas of Cochin. In: Proceedings of The 6th Kerala Science Congress, Thiruvanthapuram, Kerala. Ravikumar R, Editor. State Committee on Science Technology and Environment; 1994. p 74–77.
11. Pravinkumar M, Murugesan P, Krishna Prakash R, Elumalai V, Viswanathan C,. Raffi SM. Benthic biodiversity in the Pichavaram mangroves, Southeast Coast of India. Journal of Oceanography Marine Science. 2013;4(1):1–11.
12. Khan SA, Murugesan P. Polychaete diversity in Indian estuaries. Indian Journal of Geo-Marine Sciences. 2005;34(1):114–9.
13. Sivadas S, Ingole B, Nanajkar M. Benthic polychaetes as good indicators of anthropogenic impact. Indian Journal of Marine Sciences. 2010;39(2):201–11.

14. Ramesh G, Murugesan P, Muthuvelu S. Diversity of Benthic Fauna in the Marine Zone of Vellar Estuary (Southeast Coast of India). International Journal of Recent Scientific Research. 2013;4(12):2158–66.
15. Feebarani J, Damodaran R. Environmental impact assessment base on polychaete species in Cochin backwaters (South west coast of India. J Aqu Biol Fisheries. 2014;2:148–54.
16. Bandekar PD, Naik UG, Haragi SB. Diversity status of benthic macro polychaetes species in estuarine region of Karwar. West Coast of India. International Journal of Fisheries Aquatic Studies. 2017;5(1):216–9.
17. Rao DS, Sarma DVR. Homogeneity and diversity of intertidal polychaete fauna in the Vasishta Godavari estuary, Proceedings – Animal Sciences. 1981; 90 (3): 321–331.
18. Rao DS, Sarma DVR. New polychaete records from Indian waters. J Bombay Nat Hist Soc. 1982;79:445–50.
19. Sarala DK, Venugopal P. Benthos of Cochin backwaters receiving industrial effluents. Indian Journal of Geo-Marine Sciences. 1989;18(3):165–9.
20. Pillai NGK. On some benthic polychaetes from Cochin Estuary. Journal of the Marine Biological Association of India. 2001;43(1 & 2):120–35.
21. Balachandar K, Sundaramanickam A, Kumarasen S. Spatial and seasonal variation of Macrobenthos from Puducherry Coast, Southeast Coast of India. Int J Curr Microbiol Appl Sci. 2016;5:33–49.
22. Selvaraj P, Murugesan P, Punniyamoorthy R, Parthasarathy P, Marigoudar SR. Assessment of the ecological health of Vellar and Ennore estuarine ecosystems using health indices. Indian Journal of Geo-Marine Sciences. 2019;48(10):1580–92.
23. Day JH. The polychaete of South Africa. Part 6: Sedentary species dredged off Cape coasts with a few new records from the shore. J Lim Soc Zool. 1961;44:463–560.
24. Fauchald K. The Polychaete Worms: definitions and keys to the orders, families and genera. Nat His Mus Los Angeles Cty Sci Ser. 1977;28:1–188.
25. Fauvel P, Annelida P. The Fauna of India including Pakistan, Ceylon, Burma and Malaya; 1953.p 507.
26. Fabricius O. Fauna Groenlandica..etc, 452 pp. Hafniae et Lipaise, 1785. Von dem spio-Geschlechte, *Nereis seticornis* und *Nereis filicornis*, Schr. *Ges*.nat. Fr. Berl. 1780; 6:256–270.
27. Southern R. Polychaeta of the Chilka Lake and also of freshwater and brackish water in other parts of India. Mem Ind Mus. 1921;5:563–659.
28. Ehlers E. Die bodenssigera Anneliden aus der Sammlungen der deutschen Tiefse-Expedition. Hiss. Ergebn dt, Tiefsee-Exped. Valdivia. 1908;16:1–167.

Figures

Figure 1

Microscopic view of S. pauliani collected from Manakkudy mangrove

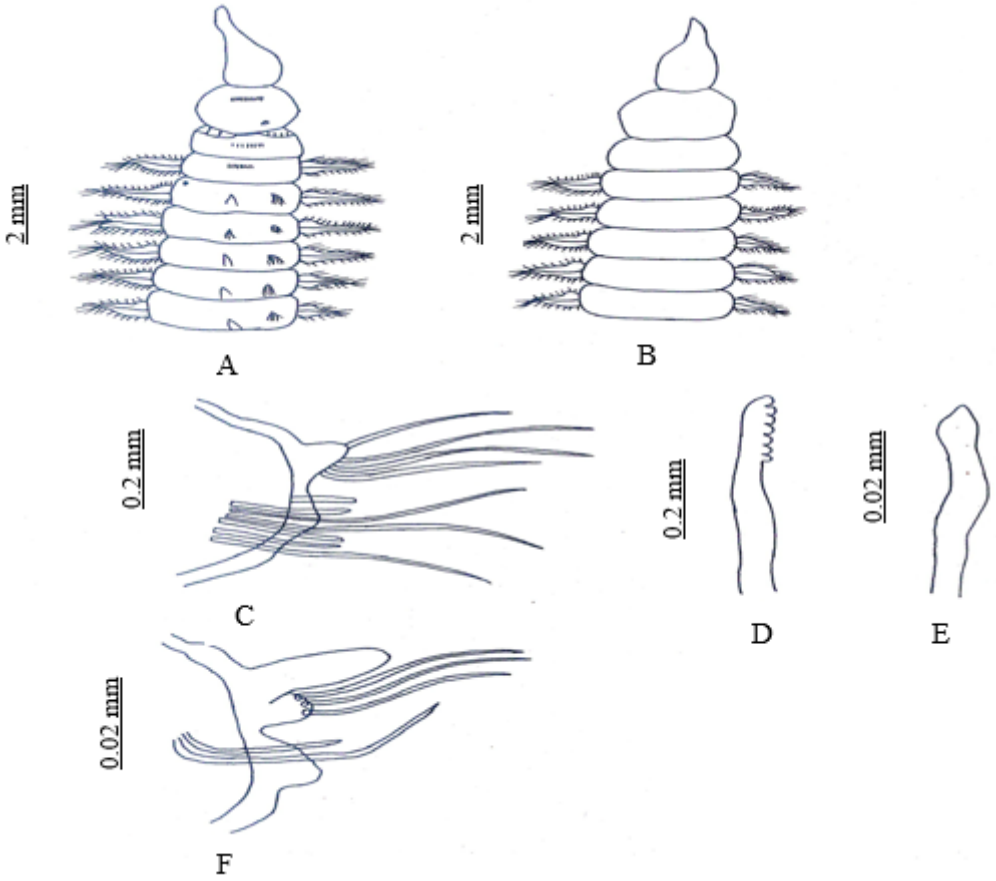

Figure 2

Schroederella pauliani Laubier, 1962. (A) Anterior region, head -dorsal view (B) Anterior region, head - ventral view (C) Thoracic foot (D) Thoracic uncinus (E) Abdominal neuroaciculum (F) Abdominal foot.

Figure 3

Microscopic view of C. coasta collected from Manakkudy mangrove

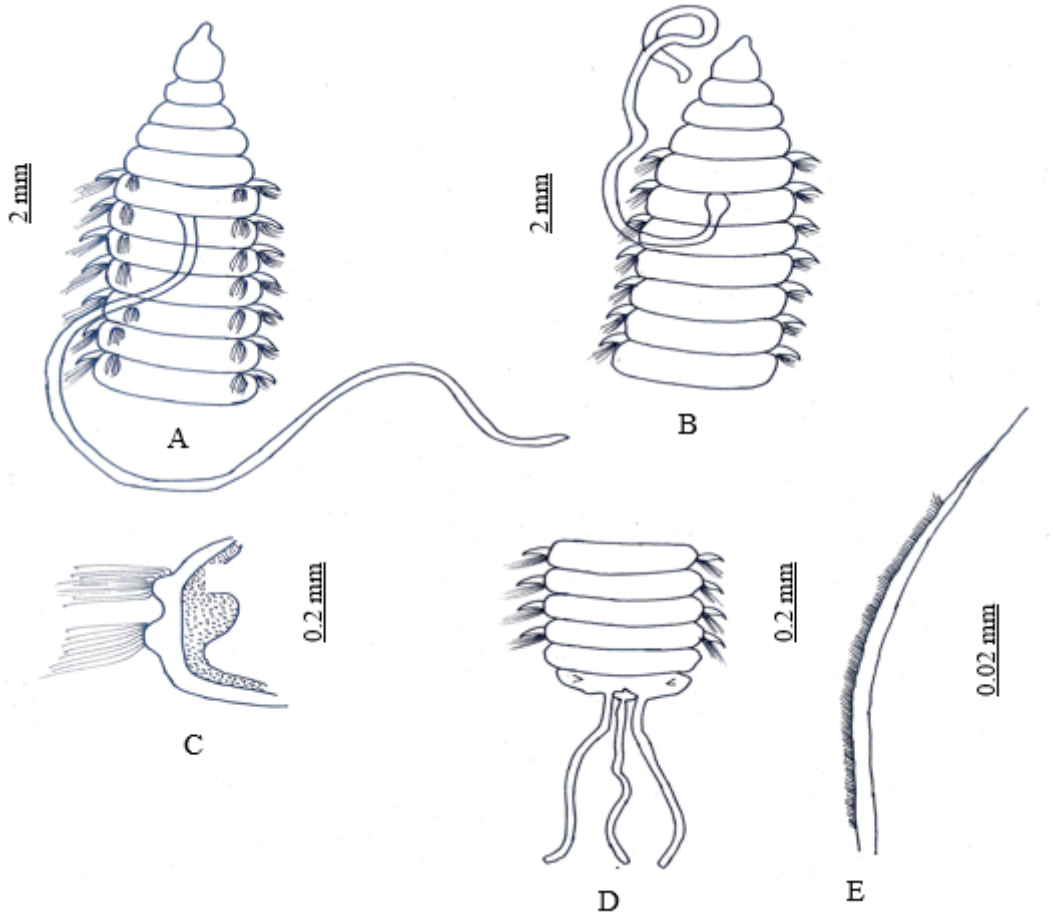

Figure 4

Cossura coasta Kitamori, 1960. (A) Anterior region, head -dorsal view. (B) Anterior region, head - ventral view. (C) Foot from mid - region. (D) Posterior end- dorsal view. (E) Blade

Figure 5

Microscopic view of S. squamata collected from Manakkudy mangrove

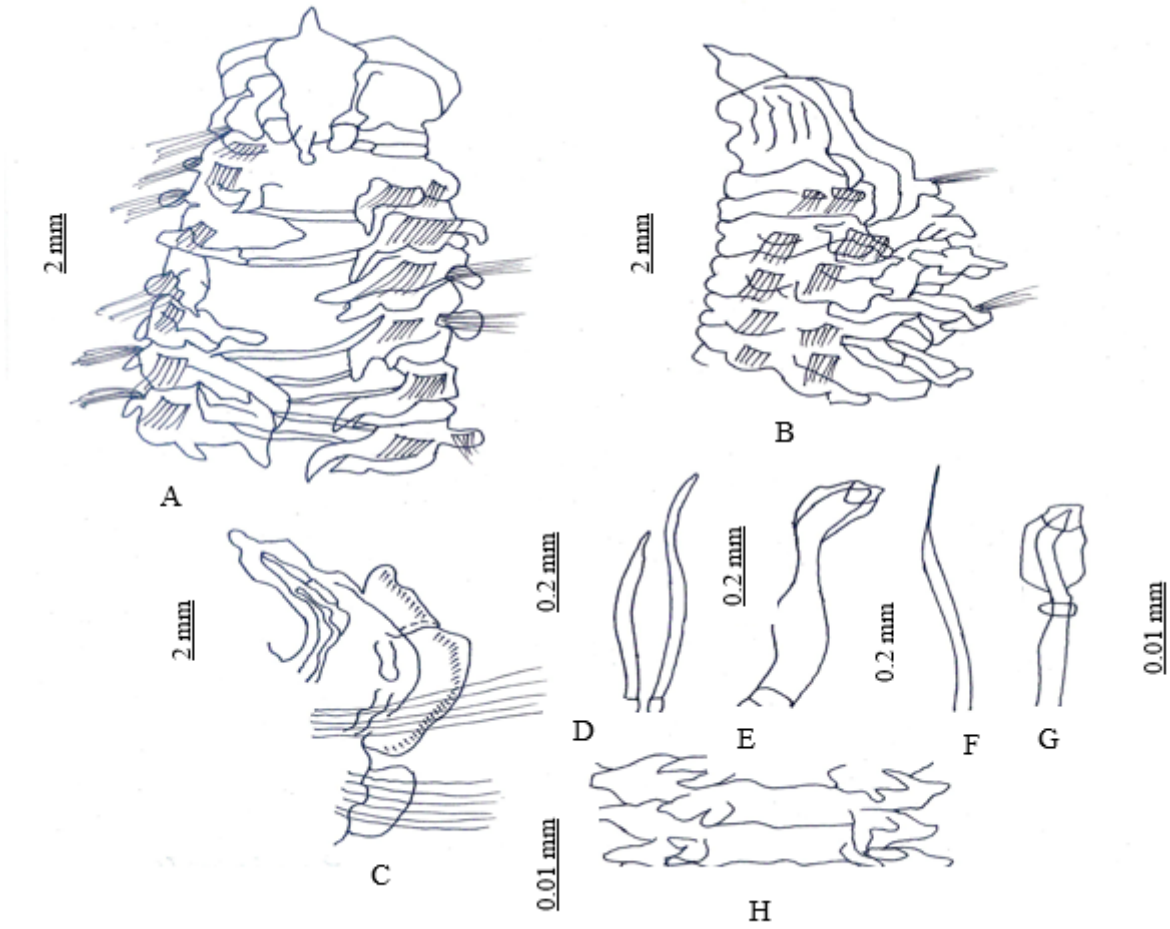

Figure 6

Scololepis squamata Muller, 1806. (A) Anterior region, head - dorsal view. (B) Anterior region, head - lateral view. (C) Parapodium of chaetiger. (D) Capillary neurochaetae. (E) Neuropodial hooded hooks. (F) Capillary notochaetae. (G) Notopodial hooded hooks. (H) Pygidium.

Figure 7

Microscopic view of C. capitata collected from Manakkudy mangrove

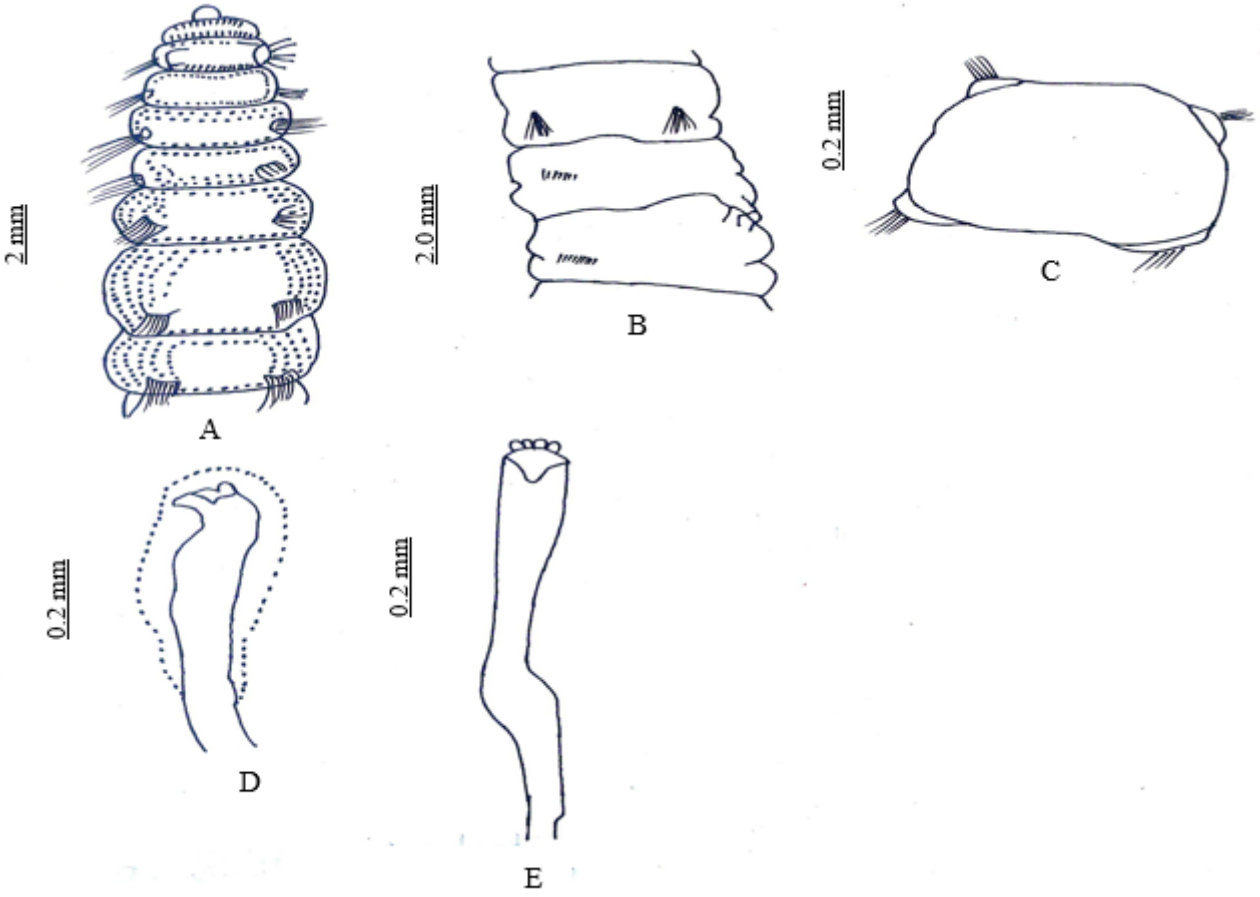

Figure 8

Capitella capitata Fabricius, 1780 (A) Anterior region, head - dorsal view (B) Setiger 7, 8 and 9 (C) Abdominal segment (D) Profile view of hooded hook (E) Face view of hooded hook.

Figure 9

Microscopic view of N. aberans collected from Manakkudy mangrove

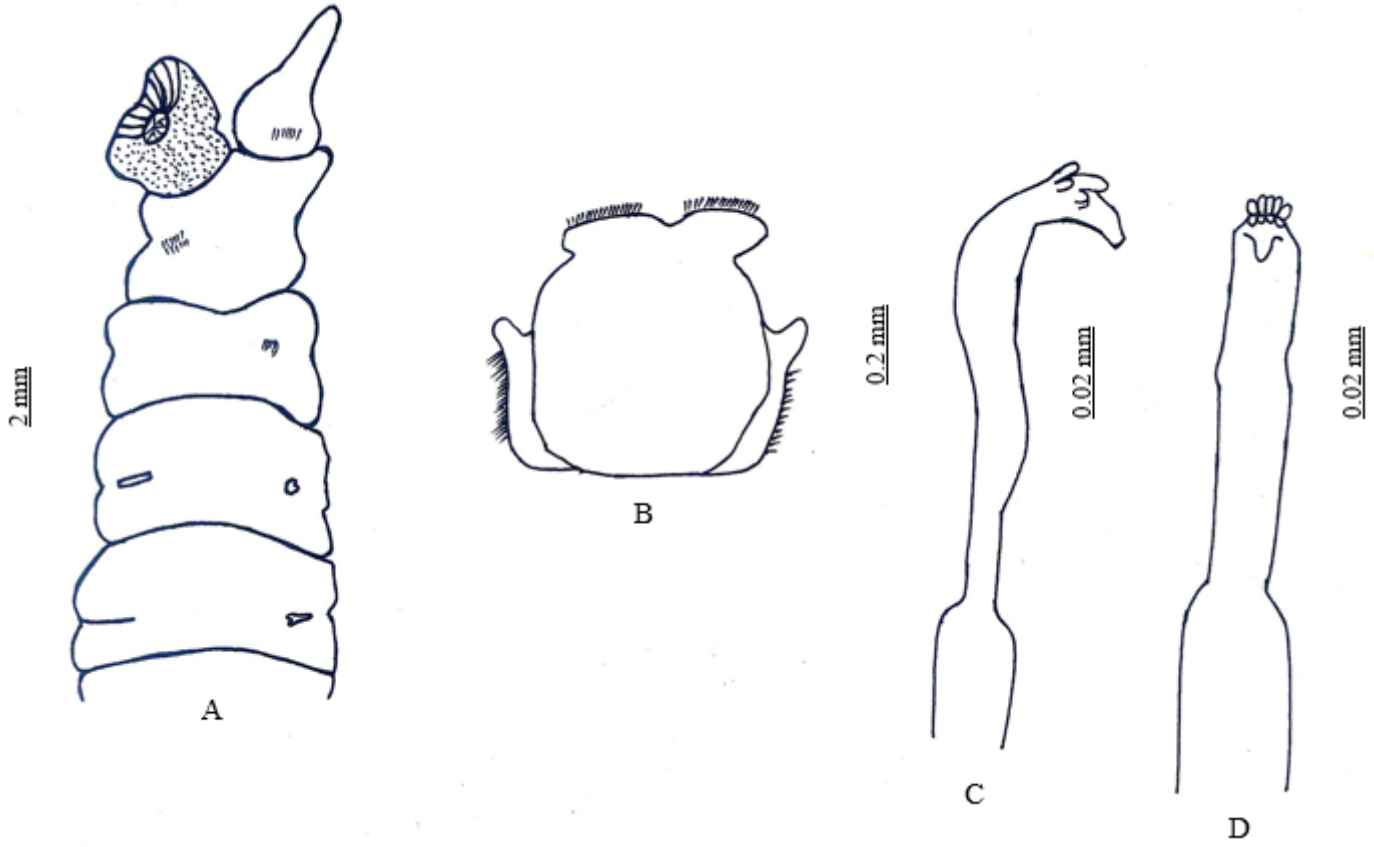

Figure 10

Notomastus aberans Day, 1957 (A) Anterior region, head - dorsal view (B) T/S anterior abdominal segment and (C, D) Profile and face view of hooded hooks.

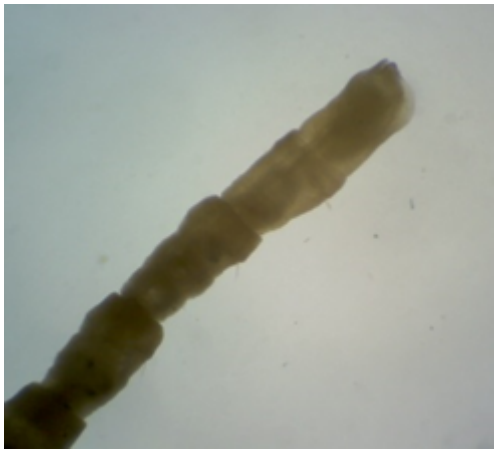

Figure 11

Microscopic view of E. annandaeli collected from Manakkudy mangrove

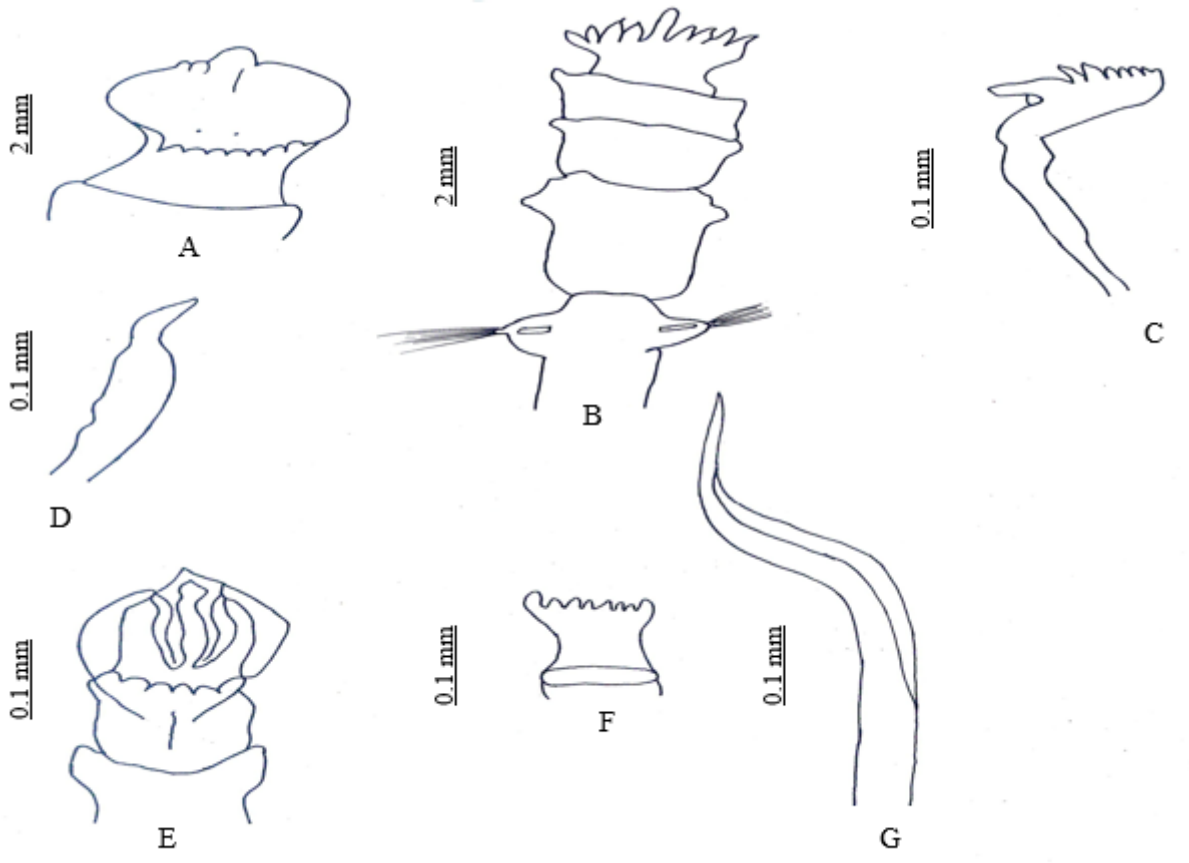

Figure 12

Euclymene annandalei Southern, 1921 (A) Anterior region, head- dorsal view (B) Ventral view of posterior end (C) Normal hook (D) Acicular spine of setiger (E) Posterior region, head - ventral view (F) Anal funnel and (G) Straight winged seta.

Figure 13

Microscopic view of A. robusta collected from Manakkudy mangrove

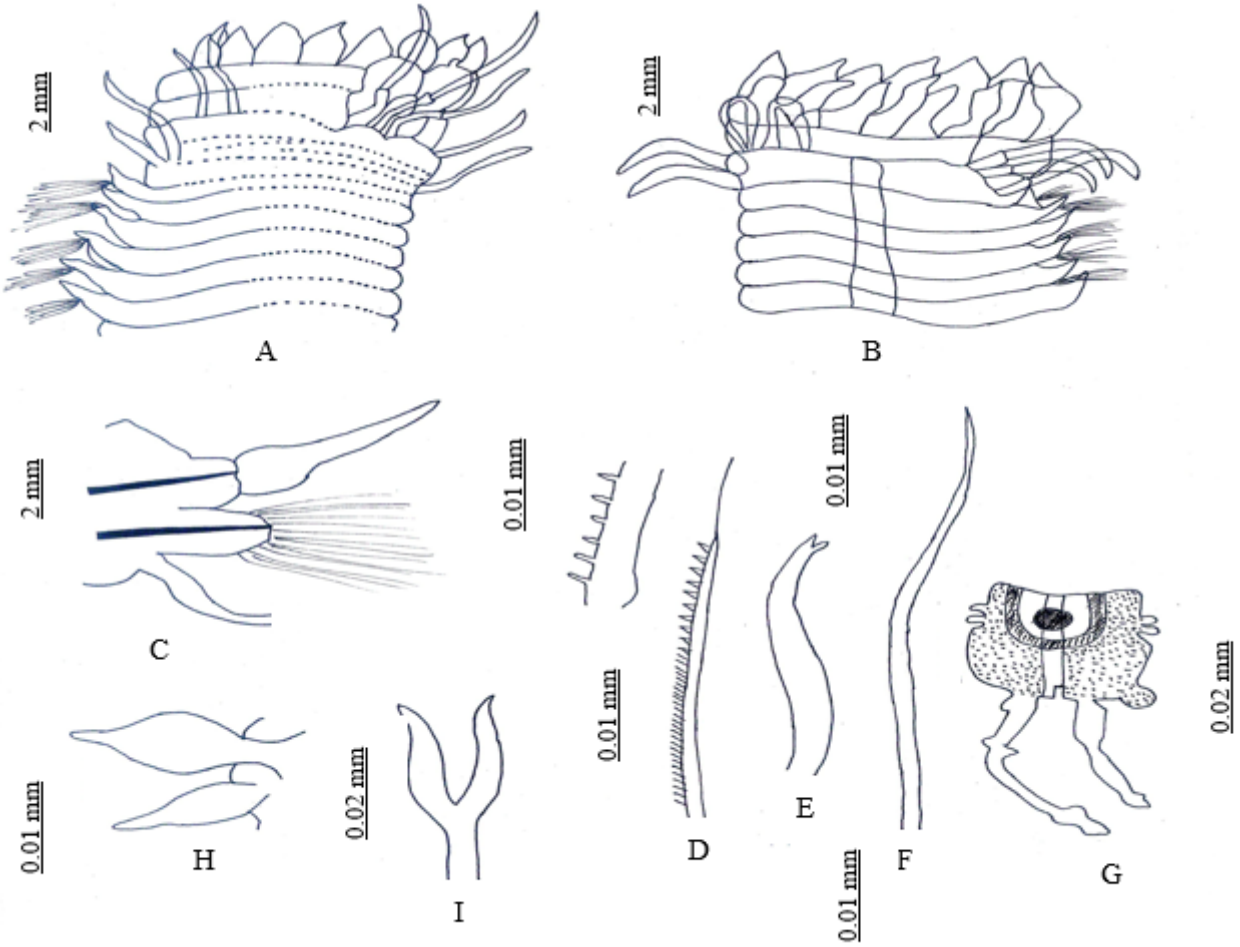

Figure 14

Ancistrosyllis robusta Ehlers, 1908 (A) Anterior region, head - dorsal view (B) Anterior region, head - ventral view (C) Forty fourth foot (D) Saw- edged capillary seta (E) Blade of longer neuroseta (F) Long central neuroseta (G) Pygidium. (H) Tentacular cirri and (I) Forked seta.

Figure 15

Microscopic view of D. zululandica collected from Manakkudy mangrove

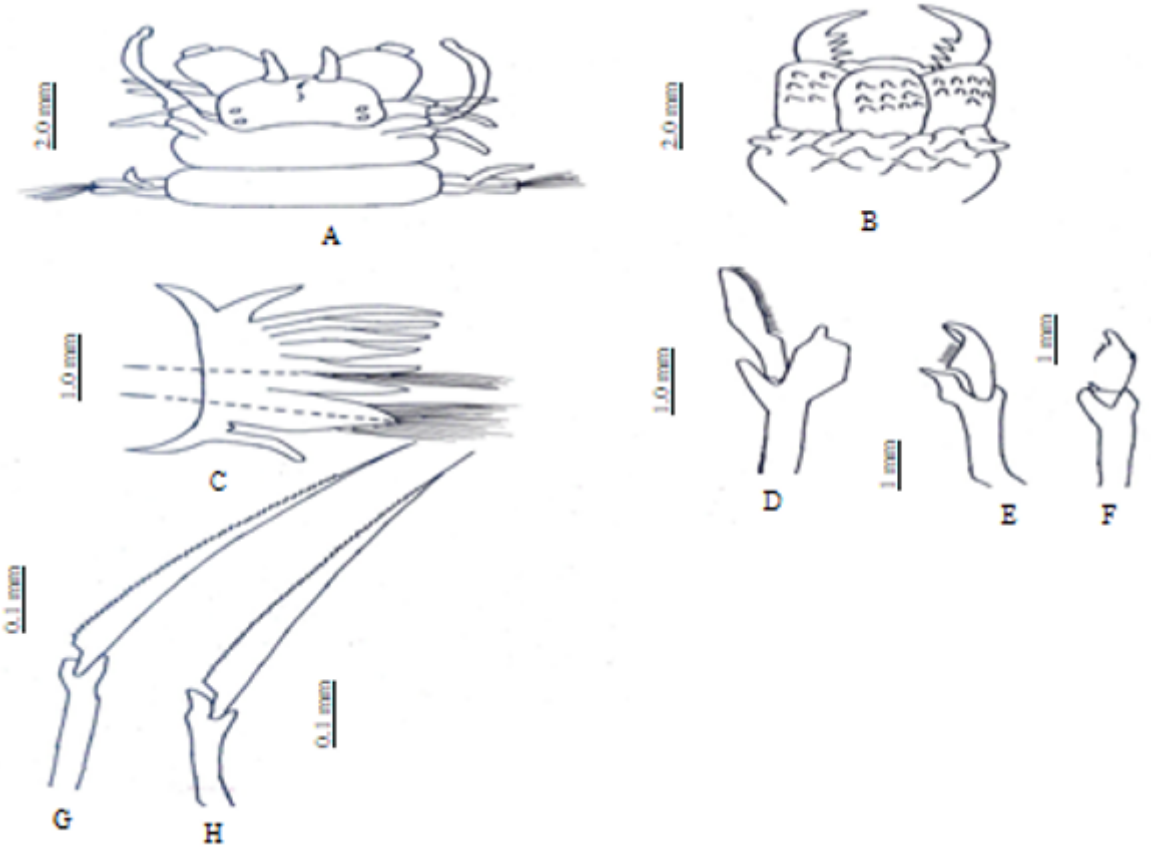

Figure 16

Dendronereides zululandica Day, 1951 (A) Anterior region, head -dorsal view (B) Dorsal and ventral views of proboscis (C) Branchiferous foot (D) Falciger (E) Heterogomph falciger (F) Homogomph falciger (G) Homogomph spiniger and (H) Heterogomph spiniger.

Figure 17

Microscopic view of L. ankyloseta collected from Manakkudy mangrove

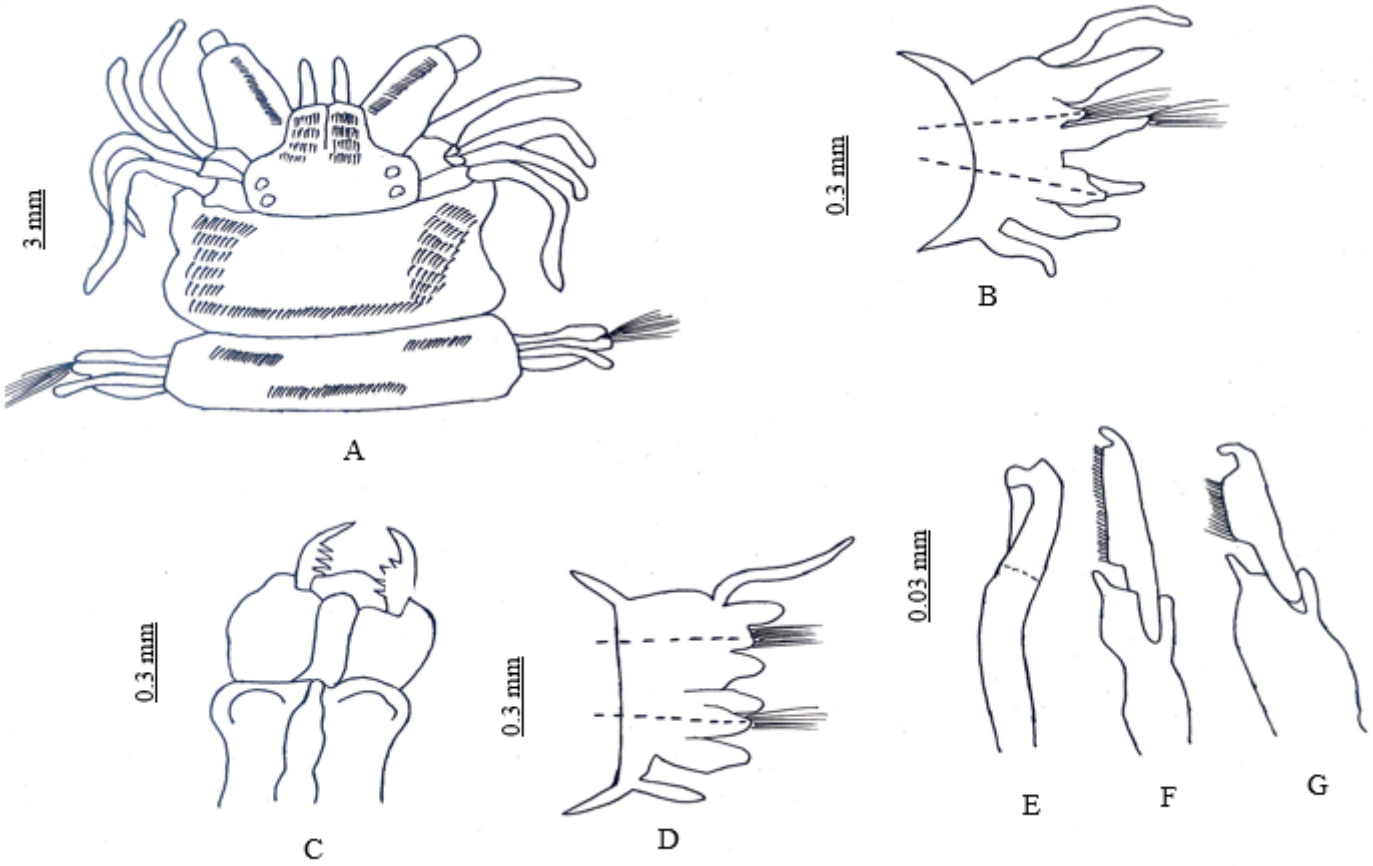

Figure 18

Laeonereis ankyloseta Day , 1957 (A) Anterior region, head -dorsal view (B) Posterior foot (C) Ventral view of proboscis (D) Anterior foot (E) Enlarged simple falciger (F) Anterior falciger and (G) Posterior falciger.

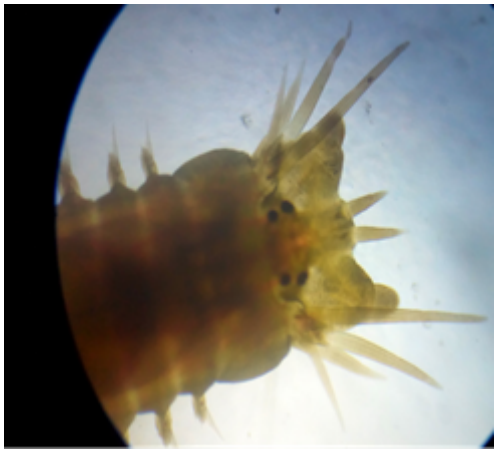

Figure 19

Microscopic view of P. dumerilli collected from Manakkudy mangrove

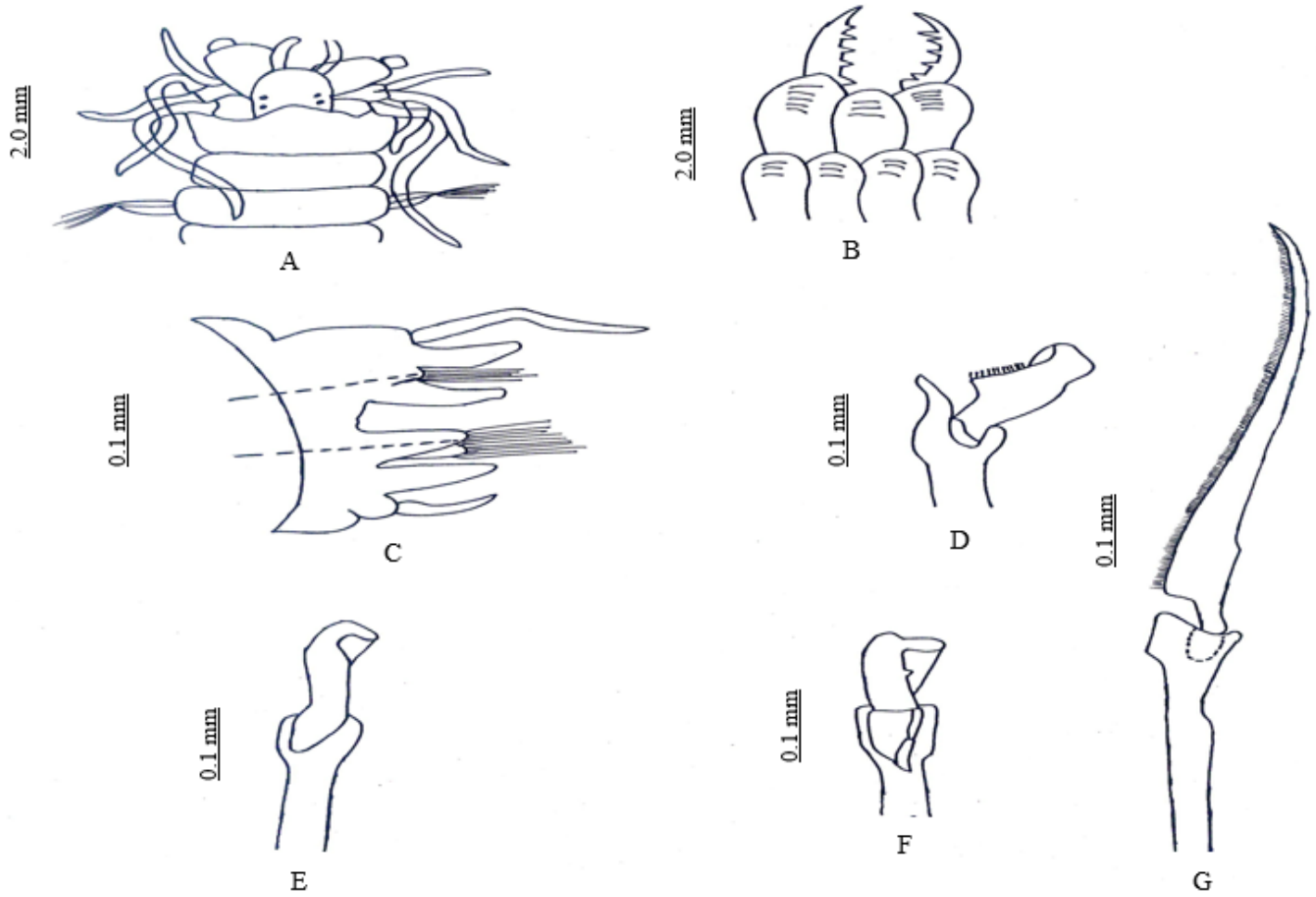

Figure 20

Platynereis dumerilli, Audouin & Milne-Edwards, 1833 (A) Anterior region, head - dorsal view (B) Ventral views of proboscis (C) Posterior foot (D) Neuropodial falciger (E) Notopodial falciger - dorsal view (F) Notopodial falciger - ventral view and (G) Heterogomph spiniger

Figure 21

Microscopic view of P. cultrifera collected from Manakkudy mangrove

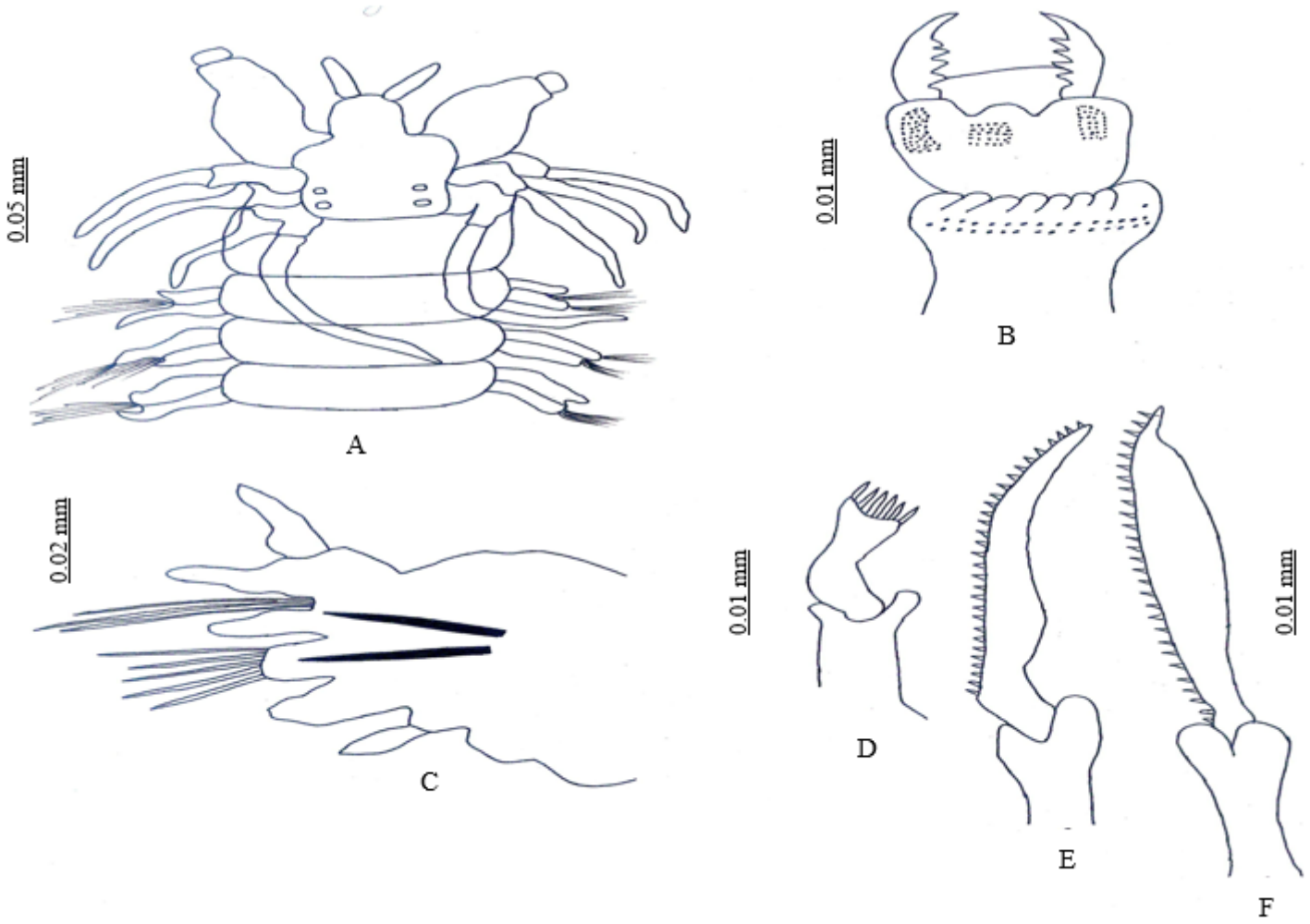

Figure 22

Perinereis cultrifera Grube, 1840 (A) Anterior region, head - dorsal view (B) Proboscis - ventral view (C) Middle parapodium (D) Heterogomph falciger (E) Heterogomph spiniger and (F) Homogomph spiniger.

Figure 23

Microscopic view of G.alba collected from Manakkudy mangrove

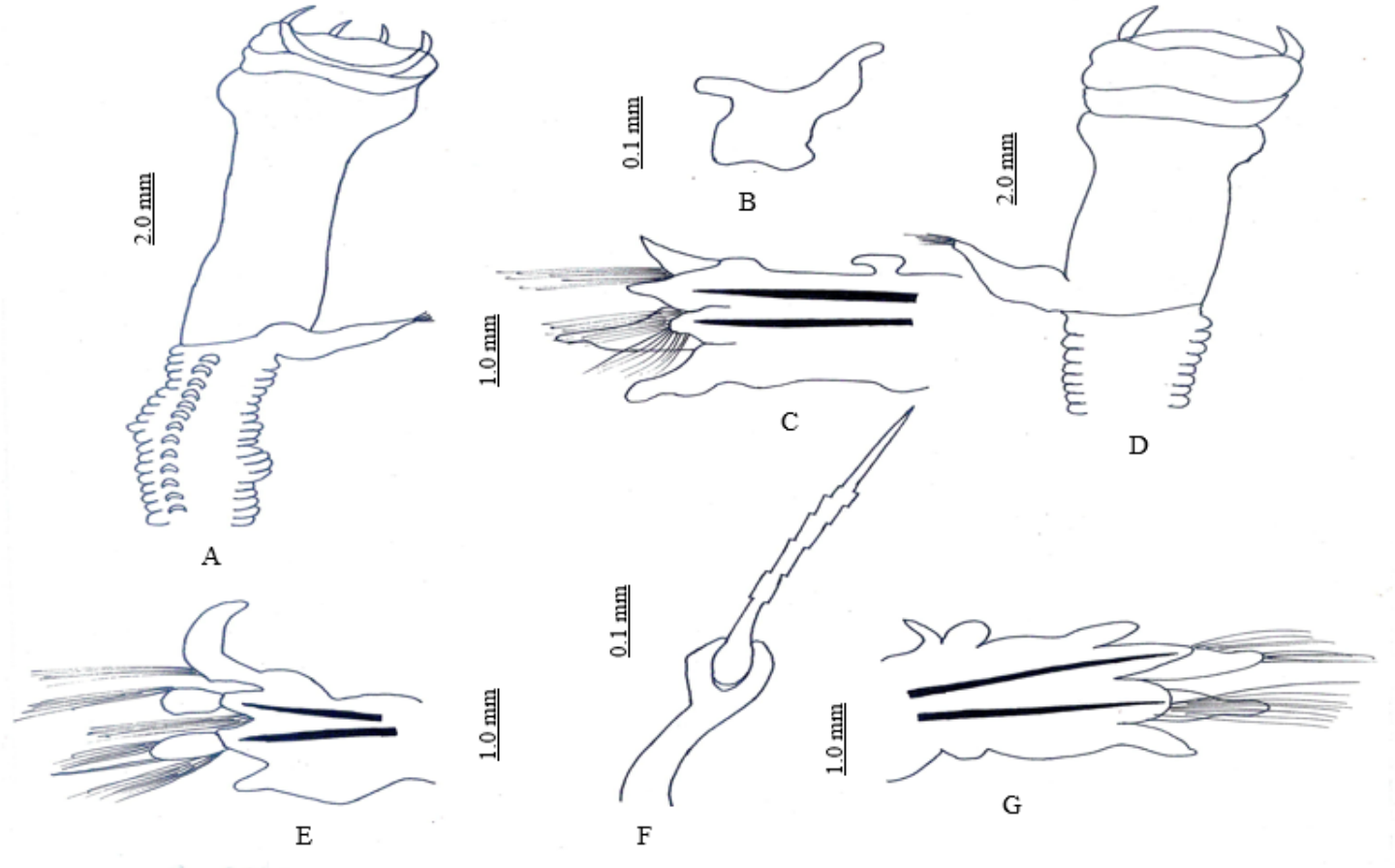

Figure 24

Glycera alba Muller, 1788 (A) Anterior region, head -dorsal view (B) Jaw support (C) Parapodium dorsal view (D) Anterior region head- ventral view (E) Parapodium lateral view (F) Aciculum and (G) Parapodium ventral view.

Figure 25

Microscopic view of G. emeriti collected from Manakkudy mangrove

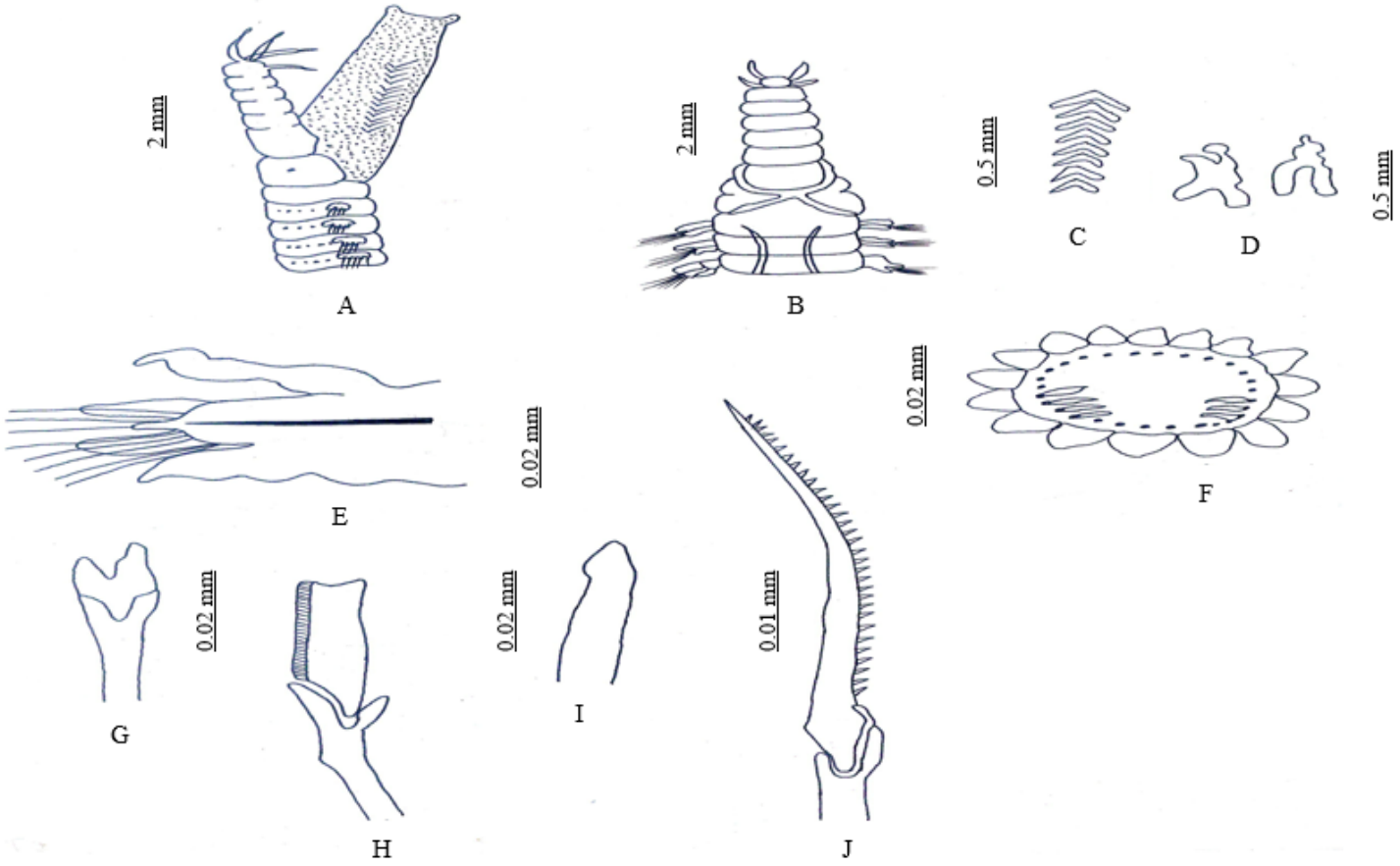

Figure 26

Goniada emerita, Audouin & Milne Edwards, 1833 (A) Anterior region, head -dorsal view (B) Anterior region, head -ventral view (C) Chevrons (D) Paragnaths (E) Middle parapodium (F) Mouth (G&H) Stalks of compound bristles (I) Acicular notoseta and (J) Spinigerous notoseta.

Figure 27

Microscopic view of N. dibranchis collected from Manakkudy mangrove

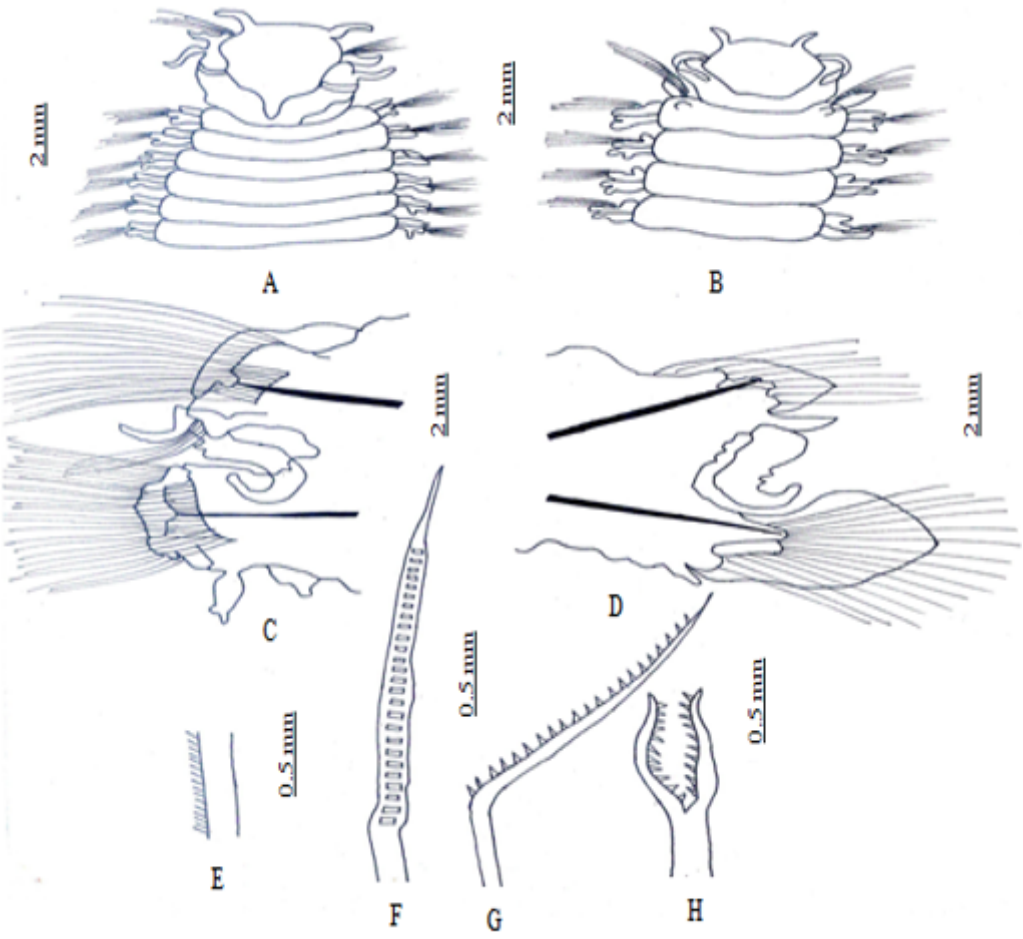

Figure 28

Nephtys capensis Day, 1953 (A) Anterior region, head - dorsal view (B) Anterior region, head - ventral view (C) Median parapodium (D) Anterior foot (E) Marginal spinules (F) Laddered capillary (G) Geniculate seta and (H) Forked seta

Figure 29

Microscopic view of E. indica collected from Manakkudy mangrove

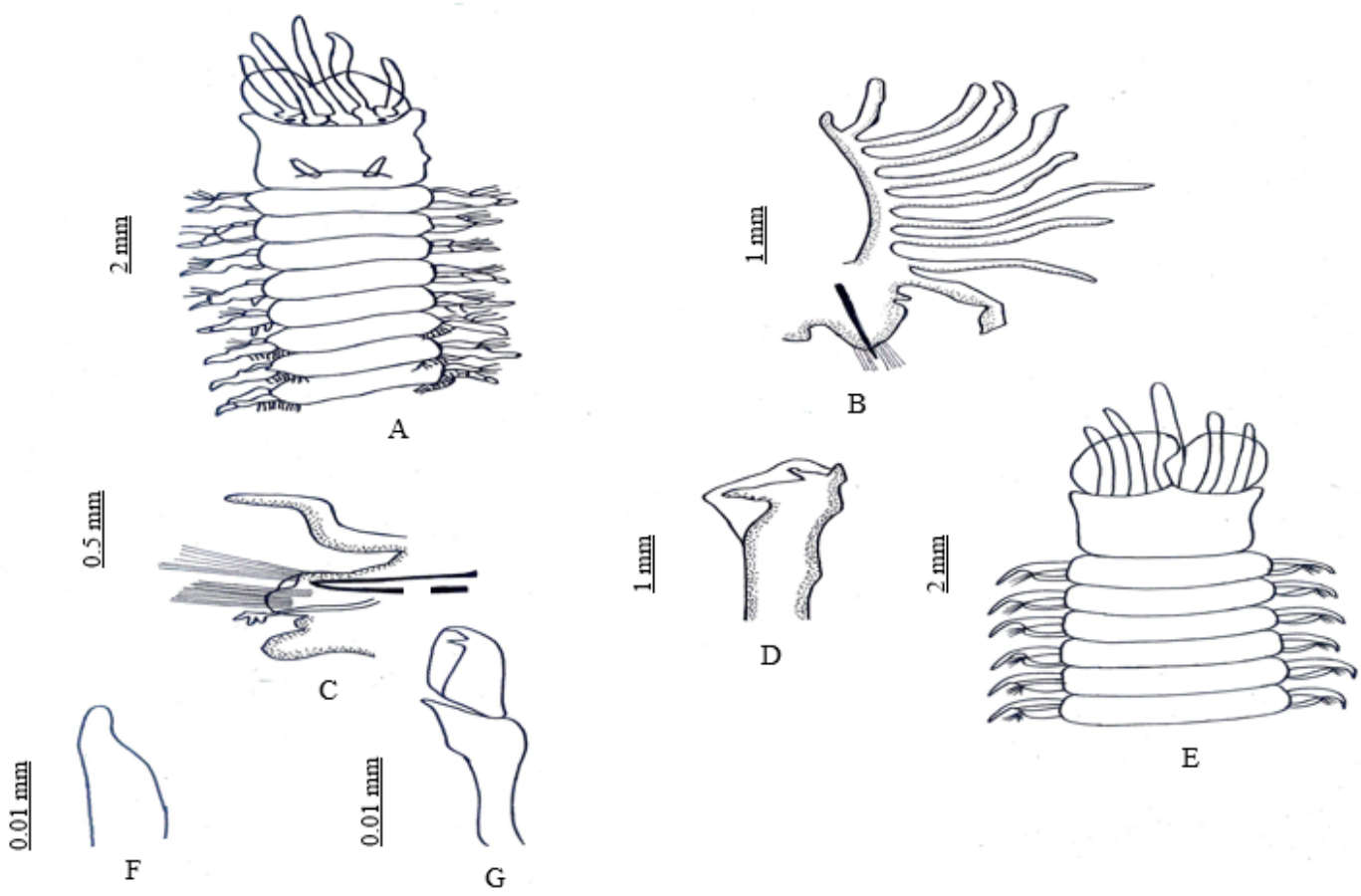

Figure 30

Eunice indica, Kinberg, 1865 (A) Anterior region, head - dorsal view (B) Anterior foot (C) Posterior foot (D) Acicular seta. (E) Anterior region, head -ventral view (F) Tip of aciculums and (G) Compound seta.

Figure 31

Microscopic view of O. fusiformis collected from Manakkudy mangrove

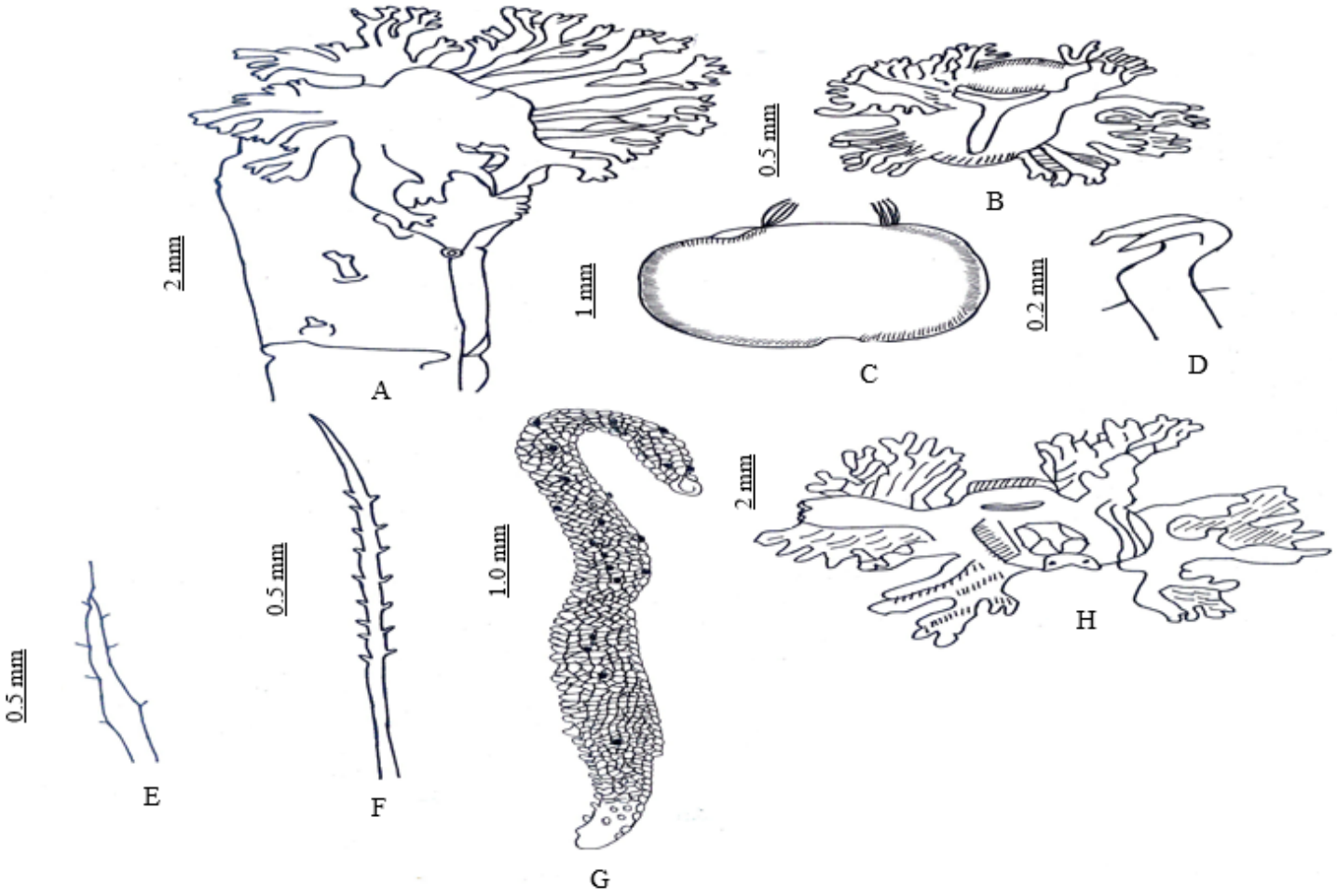

Figure 32

Owenia fusiformis Delle Chiaje, 1844 (A) Ventro- lateral view of anterior end (B&H) Head with mouth (C) T/S Middle segment (D) Hook (E) Dorsal bristle (F) Spinulose capillary and(G) Sandy tube.

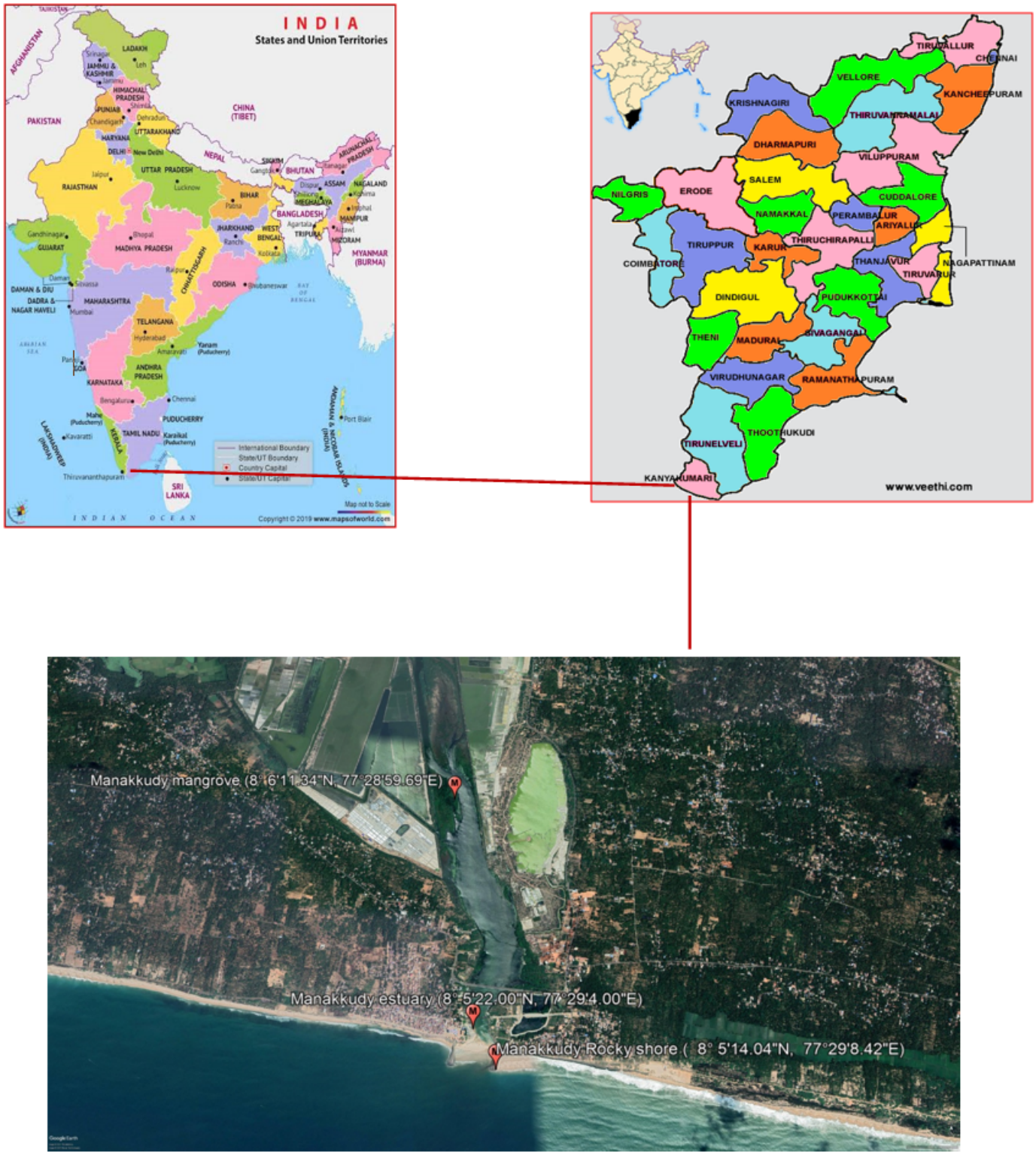

Figure 33

Map showing the study area of Manakkudy mangrove forest Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.