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EARLY DEVELOPMENT AND LARVAL STAGES OF *PALAEMON TENUIPES* (HENDERSON)

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Introduction

Palaemon tenuipes Henderson, locally known as 'Mutta chemmeen' though of little commercial value is often caught during the monsoon period at Cannanore.

Studies on the embryonic and larval development of palaemonid prawns from Indian waters are very few and studies of Menon (1939) on the first two larval stages of *Palaemon carcinus* and *Palaemon ruids*, Das (1935) and Rajyalakshmi (1961) on *Palaemon lamarrei* H. M. Edw., Nataraj (1947) and Iyer (1949) on the *Palaemon idae* Heller, and John (1947) on the life history of *Palaemon carcinus* Fabr., are there. In 1960 Rajyalakshmi has made a comparative observation on the early development and larval stages of *Palaemon malcomsonii*—H. M. Edw., *P. rudis* Heller., *P. mirabilis* Kemp and *P. scabriculus* Heller. So far no studies have been carried out on the developmental and larval stages of *Palaemon tenuipes* from Indian waters. The present account on the development of *P. tenuipes* is based on the observations on the early developmental stages of the species followed upto the third stage.

Material and Methods

Berried females of the species were collected from the 'Kambavala' (shore-seine) catches and were reared in the laboratory. Eggs were detached by a pipette and were observed for their developmental stages and specimens were sorted into various batches accordingly. The specimens were kept separately in glass vessels with sea water.

Regular observations were made in all the batches to follow the developmental stages, and the sea water was renewed every day.

The larvae and the adults were fed on diatoms and crushed eggs of prawn and crab. Measurements and sketches were taken from the fresh specimens.

Observations

Embryonic development

Egg : The egg is more or less oval, greenish yellow in colour with an average size of 0.52×0.4 mm. The yolk in the unfertilised egg is granular (Fig. 1) with very small globules. In the fertilised eggs, the central mass is dense and appears

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darker than the peripheral area. The eggs are attached to the pleopods with very thin filaments.

The fertilised egg undergoes cleavage within two hours. Before the onset of cleavage the whole yolk shrinks slightly. Four to eight blastomeres are formed within two to three hours from the onset of cleavage (Fig. 2A and B). It takes nearly 6 hours for the fertilised egg to develop into 16-cell blastomere stage (Fig. 2C). The division during this period is more or less regular and definite. After 16-cell stage, divisions tend to be irregular. It takes about 8 hours for the 16-cell stage to develop into the morula stage. At this stage, a clear cytoplasmic area in the antero-lateral portion is formed by the sinking of the superficial cells, from where the germinal buds are formed.

On the third day of development, the ventral plate gets differentiated into an anterior cephalothoracic and posterior abdominal lobe. During this stage, rudiments of the cephalic appendages appear as buds on the cephalothoracic lobe (Fig. 3A & B). From the fifth day the embryonic lobe develops further and the cytoplasmic layer is extended to the ventral side. A few additional buds develop in this area posterior to the former ones. These prominences are traced to be maxilla I and II, maxillipeds, I, II and III. By the end of the sixth day the antennular and antennal buds flex downwards and backwards, while the abdominal lobe flexes and extends anteriorly. At this stage, small vacuoles are seen accumulating at the dorsolateral region of the embryo where the future heart vesicle develops (Fig. 4). Further development of the embryonic appendages is seen during the succeeding days. The optic vesicles are well developed and are pigmented. The pigmentation first appears as a thin streak and later spreads into definite pattern. Carapace develops by the eighth day and the embryo occupies the whole cavity of the egg capsule. The yolk mass is reduced in size and the colour becomes paler. A big vacuole is seen on the posterior region of the dorsal side, and smaller ones are seen merging into it. Cephalothoracic appendages, except for the antennal scale are tubular in shape with blunt tips (Fig. 5). The telson reaches upto the anterior portion of the developing embryo. To study the disposition and characters of the larval appendages at this stage, the embryo had to be liberated from the egg capsule and pressed under a thin cover glass (Fig. 6). The antennule is long and tubular, constricted anteriorly into an apical cone. Antenna is with a long setaceous scale and an inner flagellum. Mandibles, maxilla I and II are all with a definite shape. Maxillipeds I to III are long, tubular and biramous with blunt tips. At this stage, abdomen shows clear signs of segmentation. The telson is flat, bilobed and bears 7+7 short simple setae on its free border. The heart at this stage is clear and shows peristalic movements.

By the end of the twelfth day, the embryo makes slight jerky movements. During the next two days, all the following larval characters of protozoea are formed. Optic vesicles are prominent antero-ventrally. Rostrum is prominent and it does not extend beyond the optic lobes. Simple setae are developed at the tip of the antenna, maxilla I, II and maxillipeds I to III. Bud-like prominences of peraeopods are seen behind the maxillipeds. Telson extends beyond cephalic region and optic vesicles. Pink pigment spots appear at the base of telson. Thoracic appendages are free from the carapace. The embryo becomes transparent and the yolk is reduced to a small lobed mass which lies dorsally in the cephalothoracic region (Figs. 7 and 8).

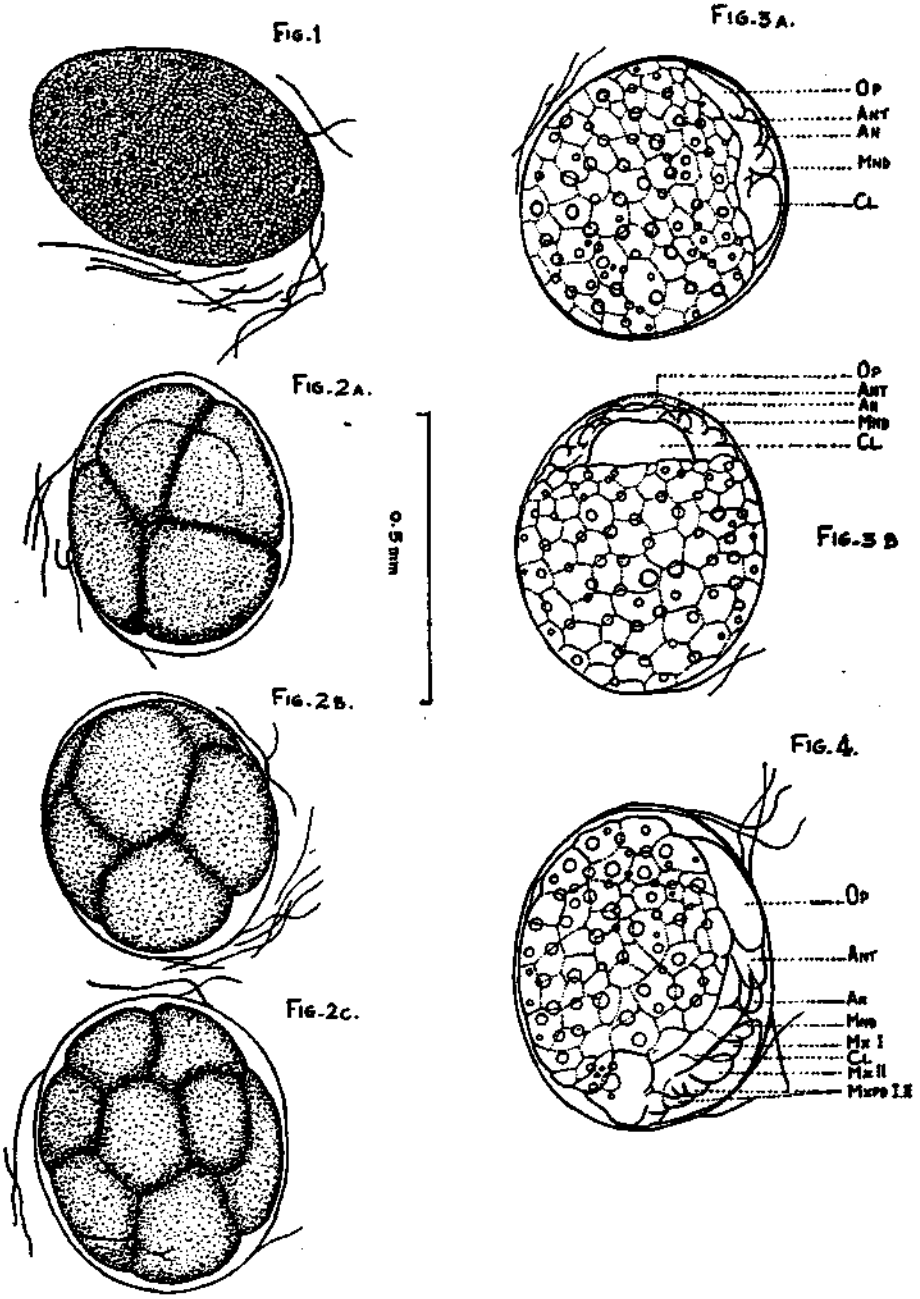

Fig. 1. Unfertilised egg of *Palaemon tenuipes*. Fig. 2-A. 4-cell stage (lateral view). Fig. 2-B. 8-cell stage (ventral view). Fig. 2-C. 16-cell stage (lateral view). Fig. 3-A. Egg on the 3rd day of development (lateral view). 3B. Egg on the 3rd day of development (ventral view). Fig. 4. Egg of the 6th day of development (lateral view).

ANT-Antennule; AN-Antenna; CL-Thoracico-abdominal lobe; MND-Mandible; OP. Optic lobe. MX-I and II-Maxilla I and II; MXPD-I and II. Maxillipeds I and II.

The larvae hatched out during the night of 14th day. The average temperature of the sea water medium in which the embryonic development took place was found to be 25.5°C.

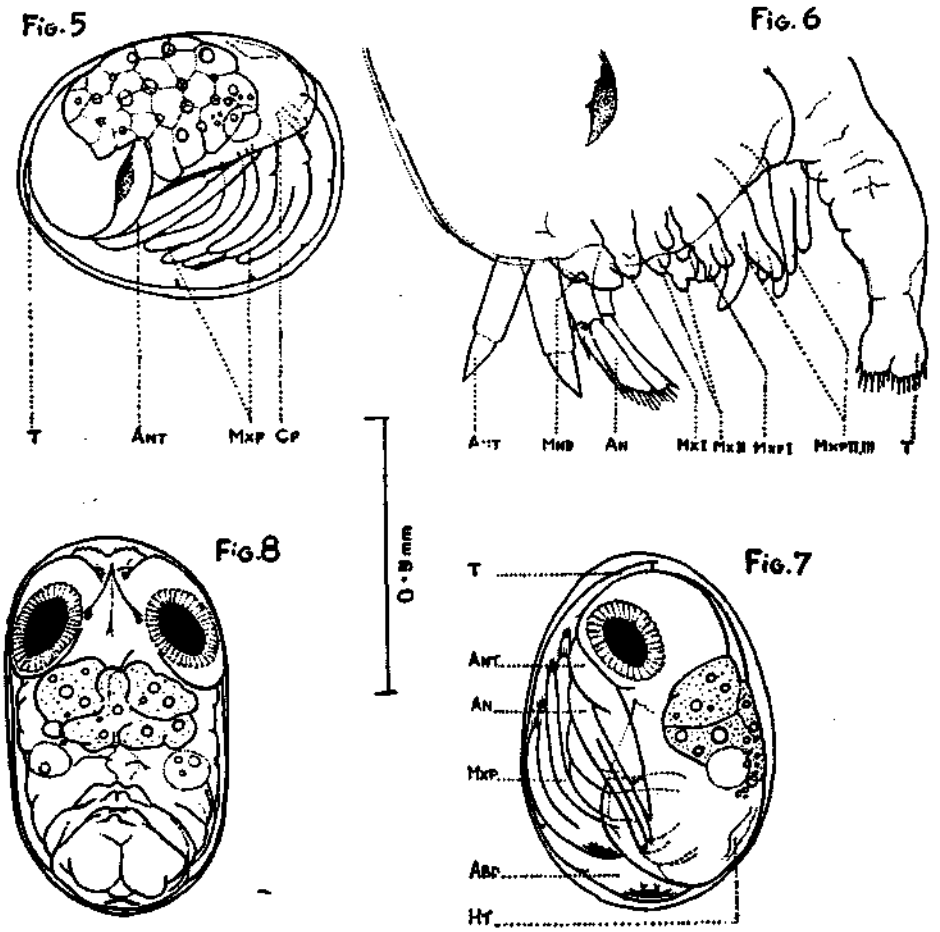

FIG. 5. Egg on the 8th day of development. FIG. 6. Embryo on the 8th day of development (squeezed out from the egg capsule). FIG. 7. Egg on the 13th day of development (lateral view). FIG. 8. Egg on the 13th day of development (dorsal view).
CP-Carapace ; T-Telson.
MX. I and II—Maxilla I and II ; MXP-I, II and III. Maxillipeds I, II and III. T. Telson.
ANT-Antennule ; AN-Antenna ; ABD-Abdomen. HT-Heart ; MXP-Maxillipeds.

Larval stages :

Stage I (Fig. 9A)

The freshly hatched larvae look more or less like the protozoea stage of other decapod crustaceans. The average size of the first day larva is 2.04 mm. Carapace is with small pterygostomial spine, and the rostrum is small and hidden in between the optic vesicles. The larvae are transparent with a few pigment spots, on the base of the telson, the third abdominal segment, and scattered pigments on the thoracic region. Oral region is slightly pink in colour. Eyes are bluish-

black, sessile and prominent. Traces of yolk granules and vacuoles are noticed in the thoracic region.

Antennule (Fig. 9A1)

Peduncle unsegmented, with an apical cone-like outer flagellum bearing four aesthets and a small plumose seta. The inner flagellum is in the form of a plumose seta.

Antenna (Fig. 9A2)

Scale with markings of segmentation at the apex. Nine plumose setae and one spine-like seta on either side of the scale are noticed. Inner flagellum is unsegmented and bifid at the apex.

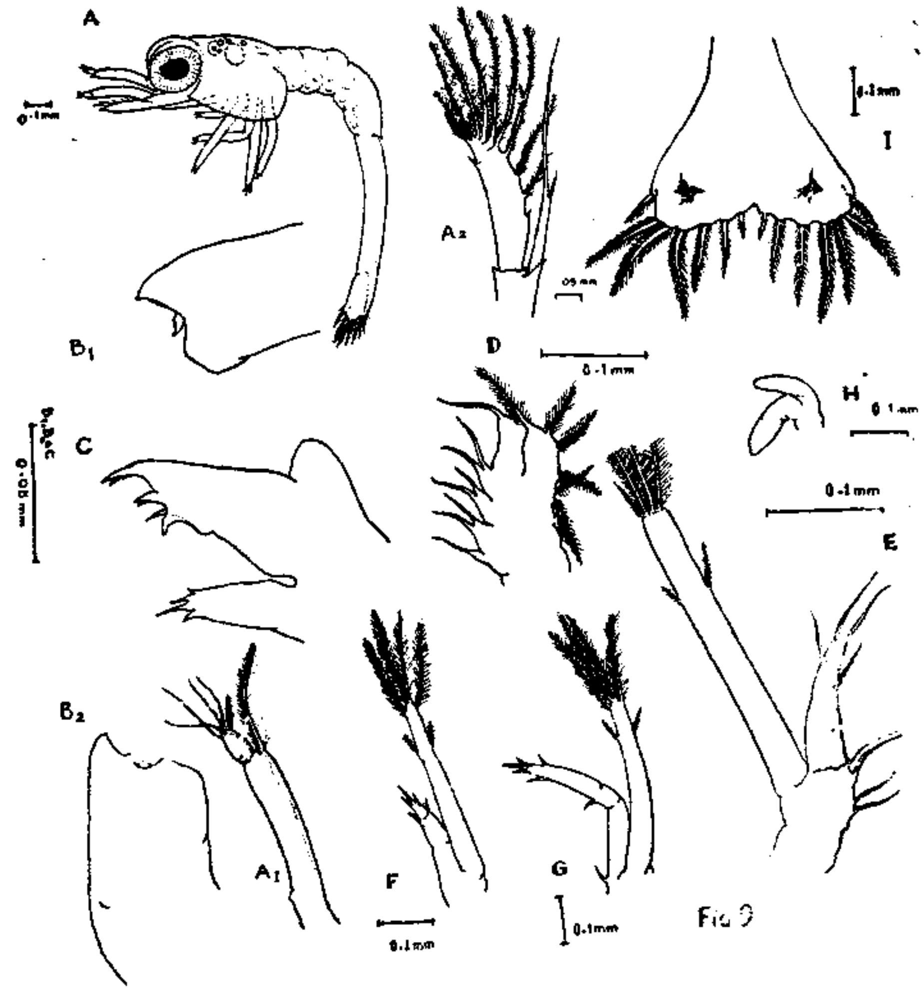

FIG. 9A. First stage larva.
A1-Antennule; A2-Antenna; B1 & B2-Mandibles (right side and left side). C-Maxilla I; D-Maxilla II; E-Maxilliped I; F-Maxilliped II; G-Maxilliped III; H-Peraeopod; I-Telson.

Mandible

The incisor part with only one prominence in the right mandible (Fig. 9B1) and with two prominences in the left one (Fig. 9B2). In the right mandible a small movable structure is noticed in between the incisor and molar regions.

Maxilla I (Fig. 9C)

The palp is short, conical and blunt at the tip. The distal lacinia bears six teeth and the proximal one four teeth. The proximal lacinia is fragile.

Maxilla II

Endopodite bears a single non-plumose seta at the tip and two similar ones at its base. The protopodite has three masticatory processes each with two simple setae. In one instance, the exopodite showed six plumose setae (Fig. 9D).

Maxilliped I (Fig. 9E)

The basipodite is flat and bears four simple setae. The two endopodites are short and bearing four setae. The exopodite is long and bears four plumose apical setae, of which one is shorter and spine-like. Two short setae are also noticed on either side of the exopodite.

Maxilliped II (Fig. 9F)

Endopodite is short and feebly segmented, bearing 3+2 simple setae. Exopodite is long and unsegmented bearing four long plumose setae, and two shorter ones.

Maxilliped III (Fig. 9G).

Endopodite is 3-segmented. The first and the 2nd segment bear one simple seta each and the apical segment with 3+2 setae. The exopodite is as in maxilliped II.

Peraeopods

Rudiments of the first two pairs of peraeopods are present in this stage (Fig. 9H). They are short, biramous and bent under the 3rd maxilliped.

Telson (Fig. 9 I) is flat, more or less triangular and bilobed. It bears 7+7 plumose setae. The outer and inner setae on each lobe are very short and spine-like. Two prominent pigmented spots are present at the base of the telson, one on each side.

Stage II (Fig. 10A)

First moulting, after hatching, occurred on the next day and the second stage larvae measure about 2.21 mm. Coloration is as in stage I, except for the addition of brownish pigments in the eye stalk. Rostrum is pointed and more conspicuous than in the 1st stage. Eyes stalked and prominent. In the carapace supraorbital and pterygostomial spines are present.

In the antennule, except for the traces of segmentation in the peduncle, no other change is noticed. Inner flagellum of the antenna is segmented and bears a short spine at its basal segment (Fig. 10B).

The mandibles of the larva are asymmetrical. The incisor part of the right mandible bears four long teeth and the molar region with shorter ones (Fig. 10C1). In the left mandible a tooth-like process is noticed in between the incisor and molar

region (Fig. 10C2). This asymmetry in the mandibles is a characteristic feature of the carideans as pointed out earlier (Menon, 1940).

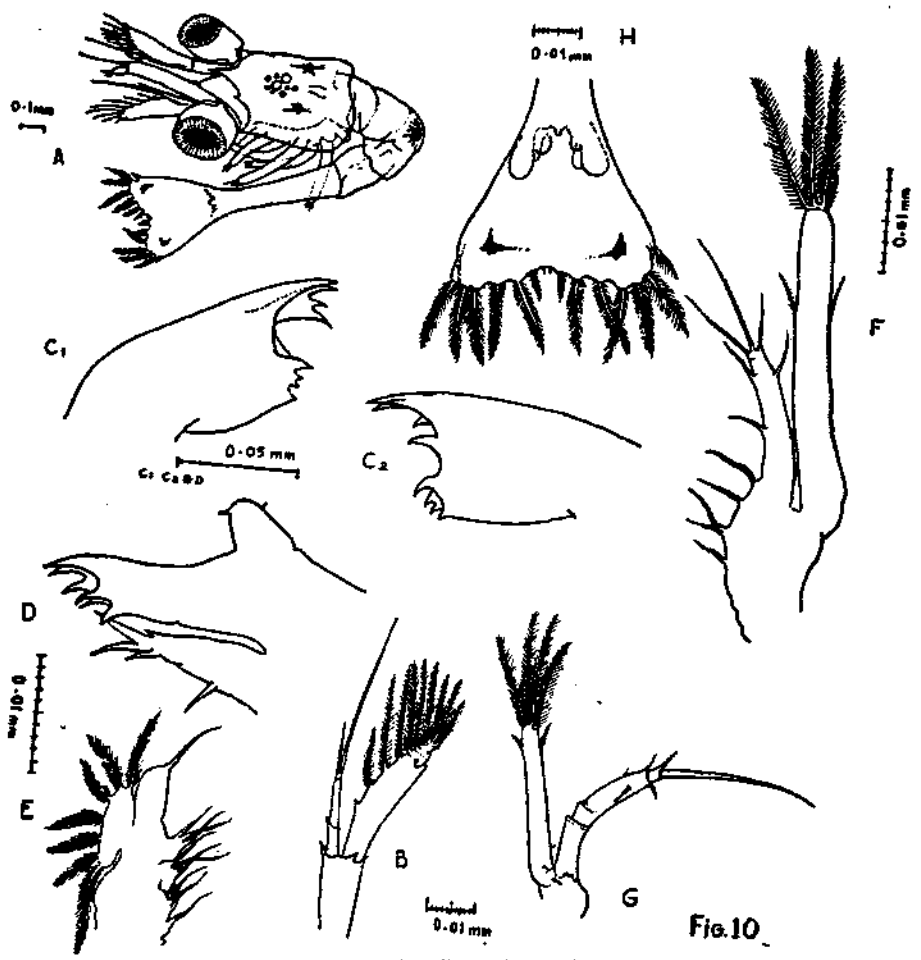

FIG. 10A. Second stage larva.
B-Antenna ; C1-Mandible (right side) ; C2-Mandible (left side) ; D-Maxilla I ; E-Maxilla II ; F-Maxilliped I ; G-Peraeopod (First pair) ; H-Telson.

In maxilla I (Fig. 10D) the palp bears a short spine-like process and the distal lacinia with an additional tooth-like process. Maxilla II (Fig. 10E) with one additional seta in the basal part of the endopodite and two plumose setae in the exopodite.

The basipodite of the maxilliped I (Fig. 10F) bears 5 simple setae, and the endopodite with 6 of which 2 are apical and much elongated. Maxillipeds II and III are similar in shape and structure as in the previous stage.

The first two pairs of peraeopods are well developed and functional (Fig. 10G). The endopodite is four-segmented and bears a long seta at the tip. Seta-like processes one on the fourth and four on the 3rd segment are noticed in this stage.

Exopodite is unsegmented and with 4+2 plumose setae. Last two peraeopods are rudimentary.

Telson is not yet differentiated from the last abdominal segment. The number of the plumose seta is increased to 8+8 (Fig. 10H). Rudiments of uropods are also noticed at the basal region of the telson.

Stage III (Fig. 11A)

The second stage larva moulted on the 4th day after hatching. The size of the 3rd stage larva is 2.45 - 2.53 mm. Pink chromatophores are noticed on the

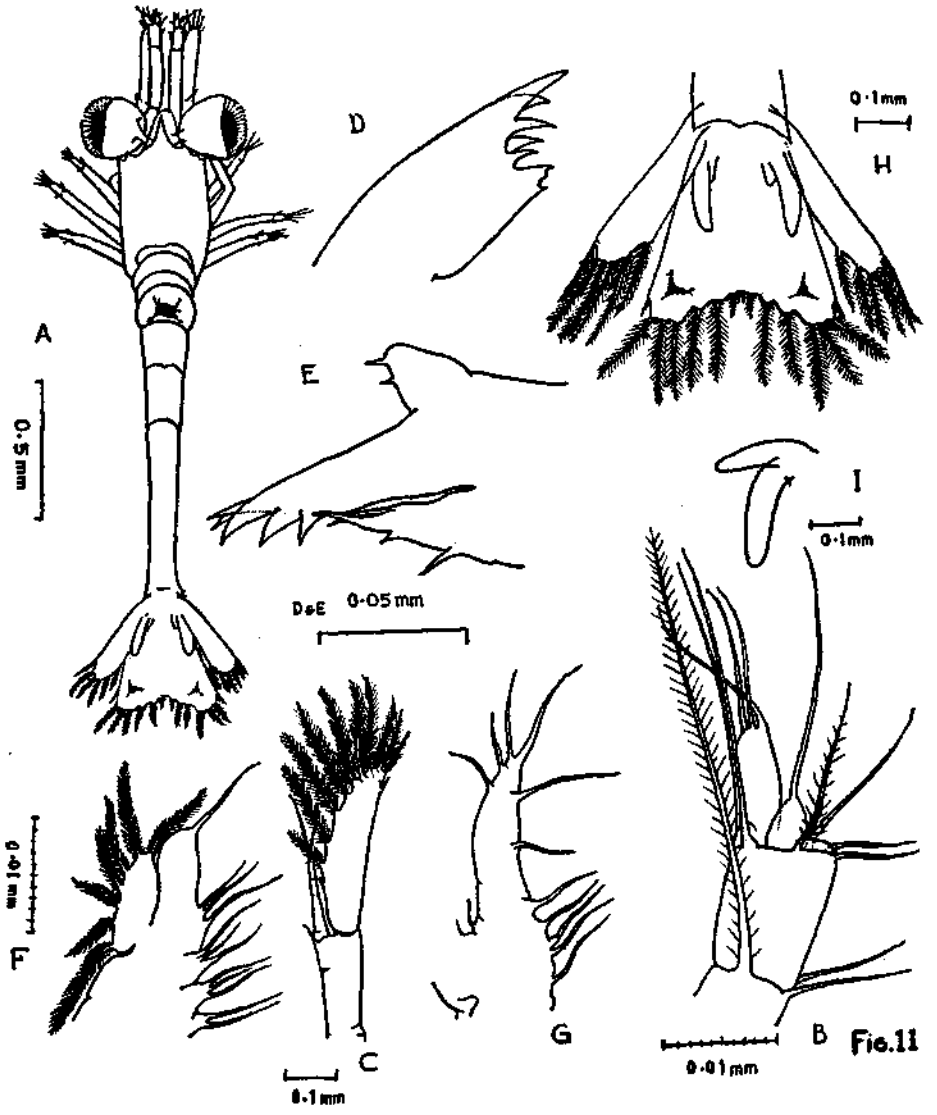

FIG. 11A. Third stage larva.
B-Tip of antennule; C-Antenna; D-Mandible; E-Maxilla I; F-Maxilla II; G-Maxilliped I (basal portion); H Telson; I-last pair of peraeopod.

posterior region of the carapace. Rostrum is prominent and with a single tooth at its dorsal margin (Fig. 11A2).

Antennule (Fig. 11B)

Peduncle is bi-segmented and the basal portion is much elongated. There are about four setae in a sort of whorl at the base of the shorter segment. One of these setae is sparsely plumose and very much elongated, reaching beyond the tip of the setae of the inner flagellum. Five to six setae are also noticed on the distal border of the second segment. The outer flagellum is longer and thicker, bearing three long simple setae.

Outer flagellum of the antenna is five segmented (Fig. 11C) and the distal segment bears two simple setae. One additional plumose seta is added to the scale. In the right mandible, two teeth-like processes are noticed in between the incisor and molar regions (Fig. 11D). An additional short spinous process is noticed on the endopodite of the 1st maxilla (Fig. 11E) and in the maxilla II a few additional setae on the masticatory processes are noticed (Fig. 11F).

The basipodite of the maxilliped I bears five setae and the endopodite shows signs of segmentation (Fig. 11G). Six setae are present on the endopodite. The exopodite is as in the previous stage. Maxilliped II and III and also the first two pairs of peraeopods are the same as in the second stage. The last two pairs of peraeopods are rudimentary and slightly bigger in size. (Fig. 11 I).

Telson (Fig. 11 H) is differentiated from the last abdominal segment. Uropods are well developed. The exopod is long and broad. The endopod is short and finger-shaped and is devoid of any setae. The telson is narrower than in the previous stage and triangular in shape. The free border bears 8+8 plumose setae, the inner and outer ones being short and spine-like. The free border of telson is denticulate.

The larvae did not undergo any further development or moulting during their survival for about 11-12 days after hatching.

Although tow-net collections were made from 2-6 fathoms area during the breeding season, May to August, no advanced stage larva of the species could be obtained. All the larval forms obtained from the tow-nettings were in the first and second stages. Though the larvae obtained from local waters were also reared in the laboratory, they did not develop beyond the 3rd stage.

General Remarks

Studies on the larval forms of *P. tenuipes* and those of the *P. rudis* and *P. carcinus* (Menon, 1939), *P. mirabilis*, *P. malcomsonii* and *P. scabriculus* (Rajyalakshmi 1960), show similarity in general characters, except for a few differences in the number of setae in the appendages, and in the absence of spines in the 5th abdominal segment. *P. lamarrei* (Rajyalakshmi, 1961) shows marked variations in the characters, viz. larval length measuring 4.77 - 5.00 mm., well developed rostrum and 2nd maxilla, functional peraeopods and rudimentary pleopods from the first larval stage.

Summary

An account of the early embryonic and larval development of *Palaemon tenuipes* (Henderson) has been made and differences from the allied forms from Indian waters are noticed.

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