

**LABORATORY REARED LARVAL FORMS OF *HIPPOLYSMATA*
(*EXHIPPOLYSMATA*) *ENSIROSTRIS* KEMP (DECAPODA :
HIPPOLYTIDAE)**

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ABSTRACT

Complete larval history of the marine caridean, *Hippolysmata* (*Exhippolysmata*) *ensirostris*, has been studied by rearing in the laboratory. Nine well defined zoeal stages are observed during development and first zoea took 43 days to become post-larva. Detailed description of nine zoeal stages and post-larva are given. Larvae have been reared in a salinity range of 34.5 to 35.0‰, and fed on freshly hatched *Artemia* nauplii.

INTRODUCTION

HIPPOLYSMATA (*EXHIPPOLYSMATA*) *ENSIROSTRIS* Kemp is a marine caridean prawn attaining a size of 80 mm (George, 1969) in total length and is distributed in the waters around India, Ceylon, Burma and Sumatra (Holthuis, 1947). The fishery importance of the species in Indian waters has been pointed out by Shaikhmahmud and Tembe (1960) and Kunju (1969). Though there is no account of the biology of the species, information is available on the post-larval stages (Kemp, 1916 ; Gurney, 1936) and the eggs and very early larvae (Bensam and Kartha, 1967). The present communication embodies the description of the complete larval stages of *H. ensirostris* reared in the laboratory.

MATERIAL AND METHODS

One berried specimen of *H. ensirostris* (measuring 73 mm in total length) was obtained at a depth of 20 m off Cochin along with some penaeid prawns and fishes on 8-4-1975 during one of the fishing trips of the research vessel 'Cadalmin I' and was brought alive to the laboratory. The animal was kept in a glass trough containing sea water collected from the area of fishing with a salinity of 35.14‰. Hatching of larvae started at 0700 hrs on the morning of the next day (9-4-1975) and initially 25 zoeae were released up to 1130 hrs. After an interval of 8½ hrs, 108 zoeae hatched out (at 2000 hrs) on the same day, thus making a total of 133 larvae. Though 80% of the eggs were still attached to the pleopods of the mother, the animal moulted on 11-4-1975 and all the remaining eggs were discarded along with the exuvia. Within a few hours after moulting the female again acquired berry. As the berry was not fertilized the eggs did not develop.

Larvae were reared in batches of 50 numbers in 1000 ml beakers. Every day 75 % of the water was siphoned out along with the excreta and exuvia at the bottom and water level was made up by adding fresh sea water of salinity range 34.5 to 35.0‰. Larvae were fed with freshly hatched nauplii of brine shrimp (*Artemia*). No mortality was observed during the first two stages. But there was heavy mortality at the third zoeal stage. To prevent the breaking of the extremely long 5th pereopods

from stage IV onwards, extreme care was taken during the change of water. Water was poured into the beaker slowly along the inner side of the stem of an inverted glass funnel.

The following abbreviations are used for describing the larvae : Tl : total length ; Cl : carapace length ; A-1 : antennule ; A-2 : antenna ; Md : mandible ; Mx-1 : maxillule ; Mx-2 : maxilla ; Mxp-1 : maxilliped I ; Mxp-2 : maxilliped II ; Mxp-3 : maxilliped III ; P-1 : pereopod I ; P-2 : pereopod II ; P-3 : pereopod III ; P-4 : pereopod IV ; P-5 : pereopod V ; and T : telson.

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DESCRIPTION OF LARVAL STAGES

In the case of the first 2 zoeal stages, the differences noticed from the description of the corresponding stages given by Bensam and Kartha (1967) are figured (Fig. 1 a-j) and tabulated below in Table 1.

Table 1. *The salient differences of the first two larval stages of H. ensirostris.*

Characters (1)	Bensam and Kartha (1967) (2)	Present work (3)
<i>First Stage</i>		
Tl	2.15 mm	1.89 to 2.23 mm
Md	Asymmetry not mentioned.	Asymmetrical (Fig. 1, a).
Mx-1		
proximal endite :	with 4 setae.	with 7 setae (Fig. 1, b)
distal endite :	with 3 spines.	with 4 setae.
endopod :	with 4 setae.	with 5 setae.
Mxp-2		
distal part of exopod	not segmented.	clearly segmented (Fig. 1, c).
Posterior margin of 5th abdominal segment	without spine.	with spine.
Time taken for moulting to next stage	3 days.	2 days.
<i>Second Stage</i>		
Tl	no increase in length.	length increased 2.49 to 2.75 mm
Cl	Not given	0.70 to 0.77 mm
Supra-orbital spine :	absent	present (Fig. 1, e).
Antennular peduncle :	feebly segmented.	Unsegmented (Fig. 1, f).
Antennal scale :	distally without segmentation.	distally with 3 segments (Fig. 1, g).
Antennal flagellum :	stumpy without apical seta.	with a long plumose seta (Fig. 1, g).
Md :	no change from previous stage.	left incisor with 5 teeth of which one movable, right incisor with 4 teeth (Fig. 1, h).
P-1 :	absent	biramous bud present.

According to Bensam and Kartha (1967) the larvae were devoid of pigmentation, whereas the present larvae in all stages are beautifully pigmented. Orange red chromatophores are distributed dorsally in between the eyes in the first stage, and on the dorsal side of the eye in the second stage. In both stages the following pigmentation pattern is also seen: orange red chromatophores on either side of the distal aspect of carapace; second abdominal segment; tip of antennular peduncle; last 3 segments of the endopod of Mxp-3 and the base of telson.

The description of the 3rd stage given by Bensam and Kartha (1967) does not seem to be complete.

Zoea III (Fig. 1, k to l; 2, a to b); Tl 2.69 to 2.82 mm; Cl 0.84 to 0.91 mm.

After 24 hours zoea II moults to the next stage.

Eye stalk has become long (Fig. 1, k); rostrum reaches beyond half the length of the first antennal segment; antennal spine developed; P-1 developed; biramous bud of P-2 and uniramous bud of P-5 developed; T demarcated from last abdominal segment by an articulating joint; uropod distinct; pigmentation same as in the previous stages.

A-1 (Fig. 1, l): peduncle 2-segmented, proximal and distal segments carrying 5 and 4 plumose setae respectively; outer flagellum with 2 aesthetes and one long plumose seta; inner stumpy carrying single long plumose seta. A-2 (Fig. 2, a): with short flagellum carrying apically a spine-like seta; scale with 2 distal segmentations and 13 setae, of which the outermost alone non-plumose and spine like, one plumose seta present on the distal outer margin. Md: in between the incisor and molar processes 1 to 2 short slender teeth present. Mx-1: distal and proximal endites with 7 short and 6 long setae of which some are serrated. Mx-2: proximal



Fig. 1. *Hippolysmata* (*Exhippolysmata*) *ensirostris*: *Zoea I*: a- Md, b- Mx-1; c- Mxp-2, d- Mxp-3. *Zoea II*: e- carapace, f- A-1, g- A-2, h- Md, i- Mx-2, j- Mxp-1. *Zoea III*: k- anterior part of the body, l- flagellum of A-1.

endites roughly semicircular with 9 to 10 arched setae, 2nd endites is separated from the proximal one only by a small arch and bears 3 setae, distal endites with 3 to 4 long setae; endopod unsegmented carrying 3 terminal and 6 inner setae; exopod with 7 plumose setae. Mxp-1: coxopod with 4 to 5 and basipod with 10 to 11 plumose setae; endopod 4-segmented, distal segmentation faint, 1st, 2nd, 3rd and 4th segments with 3, 2, 2 and 3 setae respectively; exopod longer than endopod with 4 apical and 1 sub-apical plumose setae; Mxp-2: exopod twice the length of endopod carrying 4 apical and 6 sub-apical plumose setae. P-1 (Fig. 2, b): endopod 4-segmented, distal segment with 3 setae of which one is stout and serrated, penultimate and 1st segments with 4 and 3 setae respectively; exopod as long as endopod with 4 apical and 6 sub-apical plumose setae; T: triangular, broader posteriorly, carrying 7 pairs of spines, innermost spine being non-plumose and short. Uropod: biramous; exopod with 9 plumose setae and endopod with 2 short apical non-plumose setae;

Zoea III moults to the next stage after 48 hours.

Zoea IV (Fig. 2, c to j); Tl 3.53 mm; Cl 1.01 mm.

Dorsal surface of the carapace with prominent grooves, a tubercle with a spine present at the base of the rostrum. Supra-orbital, antennal and pterygostomial spines present; behind the pterygostomial spine are seen 2 lateral spines. Eyes large, borne on elongated peduncle, a projection is developed on the distal part of the peduncle (Fig. 2, c); P-2 and P-5 developed, and behind P-2 is seen the biramous bud of P-3; the propodus of P-5 much flattened and brightly coloured due to the presence of orange red chromatophores.

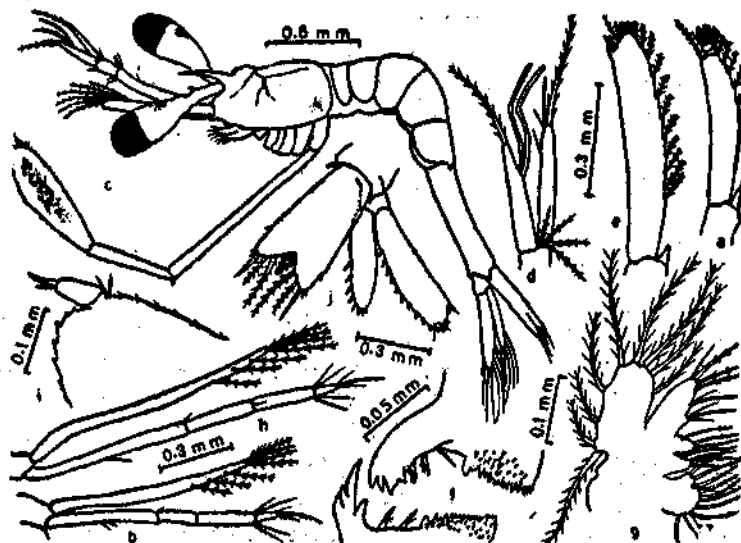


Fig. 2. *Hippolysmata* (*Exhippolysmata*) *ensirostris*: Zoea III: a- A-2, b- P-1. Zoea IV: c-lateral view (P-5 only shown), d- flagellum of A-1, e- A-2, f- Md, g- Mx-2, h- P-2, i- dactylus of P-5, j- uropod and telson.

A-1 : peduncle 2-segmented, 1st segment with 6 setae at the proximal outer region ; inner flagellum longer than the outer carrying a long plumose seta and 2 short non-plumose setae terminally (Fig. 2, d). A-2 (Fig. 2, e) : flagellum short devoid of apical seta ; scale with 17 setae and a spine, and without distal segmentation. Md (Fig. 2, f) : incisor produced carrying 4 to 5 teeth ; molar with rows of short stout teeth ; 2 to 3 slender teeth present in between the 2 processes. Mx-1 : proximal and distal endites with 7 to 8 and 6 to 7 setae, of which some are serrated distally. Mx-2 (Fig. 2, g) : exopod bears 9 plumose setae. Mxp-2 : protopod with 5 to 6 setae ; endopod 3-segmented, terminal segment with 5 setae of which 3 are stout, claw-like and serrated on the inner side ; exopod 3 times the length of endopod carrying 10 plumose setae distally. Mxp-3 : protopod with 2 setae ; endopod 4-segmented, distal segment bearing 3 setae of which 2 are pectinate, 3rd segment bears 6 setae of which 4 are pectinate ; P-1 : setae on the 2nd and 3rd endopod segments increased. P-2 (Fig. 2, h) : endopod 4-segmented, distal segment with 3 setae, 1st and 2nd joints carry one seta each ; exopod shorter than endopod with 4 apical and 3 pairs of sub-apical setae. P-5 (Fig. 2, c) : uniramous, more than 1.2 times the total length of the animal, 1st segment longest with a spine on the distal outer side, propodus highly flattened with serrated border carrying few spines ; dactylus small flat and with 2 small distal setae (Fig. 2, i). T : with a pair of lateral spines, distally it carries 7 pairs of spines, outermost 2 pairs are short, inner 4 pairs of spines plumose (Fig. 2, j). Exopod of uropod with one spine and 15 plumose setae ; endopod with 8 plumose setae.

This zoea moults to the next stage within 3 to 4 days.

Zoea V (Fig. 3, a to f) ; Tl 3.68 mm ; Cl 0.96 to 1.01 mm.

The presence of spine on the eye stalk, absence of lateral spines behind pterygostomial spines, presence of fully developed P-3, development of biramous buds of P-4 and the rectangular shape of the telson are the characteristic features of this zoeal stage.

A-1 : longer than carapace ; proximal segment of peduncle with 8 plumose setae on the inner side ; outer side distally carries 4 plumose setae and proximally carries 9 setae ; flagellae as long as the proximal segment of peduncle and show indistinct segmentation ; outer flagellum towards the middle carries 3 aesthetes ; both flagellae apically carry 3 setae of which one is long and plumose. A-2 : flagellum short and stumpy ; scale long and 7 times as long as wide and bears 21 plumose setae along its inner and distal margin and one spine at the outer distal margin. Md : incisor with 3 to 5 stout teeth ; teeth on the molar process show a serrated appearance. Mx-2 : exopod bears 14 plumose setae, distally it is produced and bears a long plumose seta at its apex. Mxp-3 : propodus of endopod with 9 to 10 pectinate setae ; exopod with 4 apical and 5 pairs of sub-apical long plumose setae. P-1 (Fig. 3, b) : basipod with one short spine-like seta on inner side ; endopod 4-segmented, carpus and propodus are almost of the same length, 1st segment with 3 short setae, 1st and 2nd joints with 1 and 3 setae respectively, propodus with 4 setae on the sides and 4 pectinate setae distally, dactylus with one stout claw-like seta and 2 slender setae of which one is pectinate ; exopod longer than endopod with 4 terminal and 7 pairs of lateral long plumose setae. P-2 (Fig. 3, c) : longer than P-1 and can be distinguished easily by the long carpus which is $1\frac{1}{2}$ times the length of propodus, dactylus same as that of P-1 (Fig. 3, d). P-3 (Fig. 3, e) : biramous ; basipod with one seta ; endopod 4-segmented, distal aspect of propodus with 4 pectinate setae ; dactylus same as in P-1 and P-2 ; exopod shorter than endopod, bearing 6 pairs of

setae. P-5 elongated; carpus with 4 short setae and one spine. T: rectangular in shape with 2 pairs of lateral and 6 pairs of terminal spines of which the 2nd and 4th pairs being the longest (Fig. 3, f). Exopod of uropod with 20 plumose setae and one spine and endopod with 16 plumose setae.

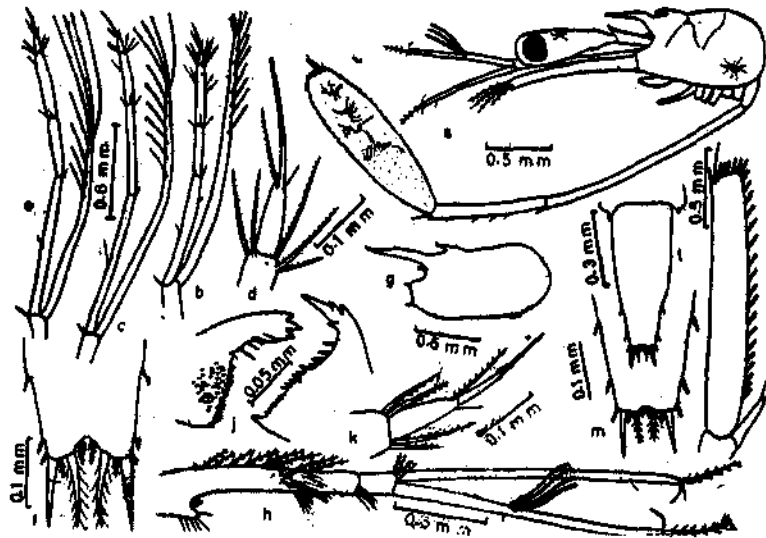


Fig. 3. *Hippolysmata (Exhippolysmata) ensirostris*: Zoea V: a- lateral view of cephalothorax (only P-5 shown), b- P-1, c- P-2, d- dactylus of P-2, e- P-3, f- tip of telson. Zoea VI: g- carapace, h- A-1, i- A-2, j- Md, k- dactylus of P-4, l- telson, m- tip of telson.

This zoea moults to the next stage after 2 to 3 days.

Zoea VI (Fig. 3, g to m; 4, a); Tl 4.0 mm; Cl 1.17 mm.

This stage is characterised by the presence of one dorsal rostral tooth (Fig. 3, g) and the development of P-4.

A-1 (Fig. 3, h): proximal segment of the peduncle bearing 8 plumose setae on the inner side, a circlet of plumose setae developed towards the anterior part of the peduncle; flagellae longer than the peduncle and show indistinct segmentation; outer flagellum carries 4 aesthetes towards its middle. A-2 (Fig. 3, i): flagellum short, 1/5 the length of scale, bearing 2 short setae at its apex; scale with 25 plumose setae and one spine; Md (Fig. 3, j): number of teeth in between the processes increased. Mxp-3: endopod 4-segmented, at the distal margin of the propodus 4 long pectinate setae present, in addition to these 5 pectinate setae also present in the distal half of the segment. P-2: first segment of endopod bears 2 setae towards the middle on the lateral aspect, a spine present on the outer distolateral aspect, distal margin of the propodus with 5 pectinate setae; exopod as long as endopod with 4 apical and 8 pairs of sub-apical plumose setae. P-3: 1st segment of endopod twice the length of 2nd carrying 2 setae at its middle region, outer distal end bearing a strong spine, propodus slightly swollen carrying a number of setae along its surface and distally bearing 4 long pectinate setae; exopod as long as the first two segments

of endopod bearing 10 pairs of setae. P-4 (Fig. 4, a) : almost resembles P-3 ; propodus of endopod bearing distally 4 pectinate setae, dactylus with 3 apical setae of which one is pectinate and another stout and claw-like (Fig. 3, k) ; exopod as long as the 1st segment of endopod bearing 5 pairs of plumose setae. P-5 : 1st segment of endopod twice the length of 2nd, carrying one long seta in middle, one stout spine present on the distolateral margin of this segment, 2nd segment carries 4 spines of which the distolateral one on the outer side is long and stout. T : tapering towards the posterior end (Fig. 3, l) bearing 2 pairs of lateral and 6 pairs of terminal spines, the innermost 2 pairs of spines being the smallest (Fig. 3, m).



Fig. 4. *Hippolysmata (Exhippolysmata) enstrostris* : Zoa VI : a- P-4, Zoa VII : b- lateral view of cephalothorax, c- abdomen with uniramous pleopod buds, d- abdomen with some biramous pleopod buds, e- A-2, f- Mx-1, g- Mxp-1, h- Mxp-2, i- telson tip.

2 to 3 days are taken by zoa VI to moult to the next stage.

Zoa VII (Fig. 4, b to i) ; TI 4.88 to 5.00 mm ; CI 1.40 to 1.41 mm.

This stage is characterised by the development of uniramous pleopod buds which are bare (Fig. 4, c). In advanced larvae of this stage 2nd to 4th pleopod buds become biramous (Fig. 4, d).

A-1 : number of setae on the proximal segment increased ; flagellum longer than peduncle, carrying at their apex 3 setae of which one is long and plumose ; flagellae show indistinct segmentation ; outer flagellum bears 5 to 7 aesthetes in 2 groups of 1 to 3 and 4. A-2 (Fig. 4, e) : flagellum 2-segmented, $\frac{1}{2}$ the length of scale, distal segment longest bearing 3 small setae at its apex ; scale with 29 plumose setae and one spine. Md : incisor process with 4 to 5 stout teeth on the right Md ; molar process bears a large number of small teeth, which have an irregular granulated appearance. Mx-1 (Fig. 4, f) : proximal endite with 10 to 12 and distal endite with 7 setae, majority of the setae are pectinate distally. Mx-2 : exopod with 25 to 26 plumose setae. Mxp-1 (Fig. 4, g) : coxopod with 4 to 5 setae of which one is stout

and long; basipod with 10 to 13 setae, many of them are plumose and endopod carries apically 2 long plumose and 2 small biristle-like setae; on the inner side 7 setae in 3 groups of 2, 2, and 3 present; exopod slightly expanded in the proximal region bearing 2 plumose setae, distally it bears 4 apical and one sub-apical plumose setae. Mxp-2 (Fig. 4, h): protopod with 4 setae of which 2 are long and distally plumose; endopod 3-segmented distal segment ends in a stout claw-like spine and around this 4 to 5 setae present. Mxp-3: propodus on the distal half bears 11 pectinate setae. P-3: propodus bears 12 setae. T: tapering posteriorly bearing 2 pairs of lateral and 5 pairs of distal spines (Fig. 4, i).

Zoea remains in this stage for 5 to 8 days. It moults twice before passing on to the next stage.

Zoea VIII (Fig. 5, a to j; 6, a); TL 6.11 to 9.11 mm; Cl 1.8 to 2.7 mm.

Presence of 3 to 4 dorsal rostral teeth (Fig. 5, a) and the biramous pleopods with short setae on the exopods (Fig. 5, g to h) are the important characters of this stage. Eyes are prominent, as long as the peduncle of A-1 (Fig. 5, a).

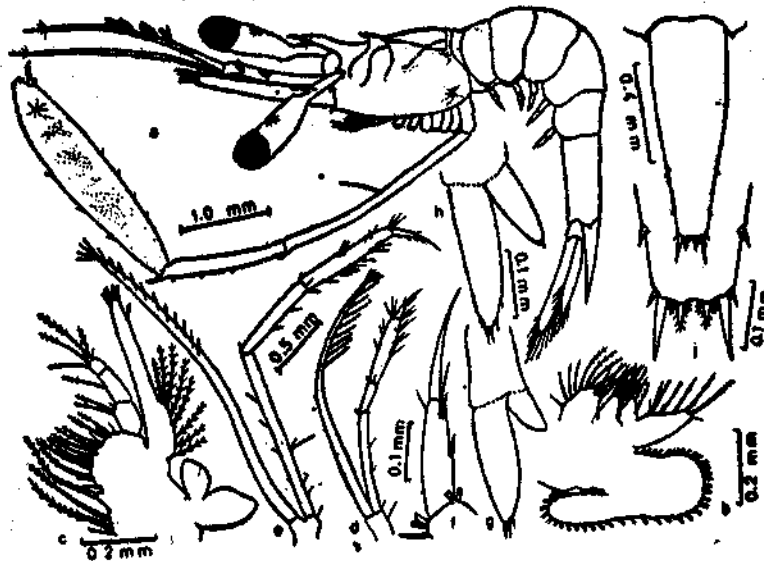


Fig. 5. *Hippolysmata (Exhippolysmata) estrostris*: *Zoea VIII*: a- lateral view (P-1 to P-4, not shown), b- Mx-2, c- Mxp-1, d- Mxp-3, e- P-3, f- dactylus of P-4, g- pleopod I, h- pleopod II, i- telson, j- tip of telson.

A-1: number of setae on the proximal segment increased, flagellum nearly twice the length of peduncle carrying apically 4 to 5 setae of which one is stout, longer than the rest and plumose; outer flagellum with 10 aesthetes in 3 groups of 3, 3 and

4. A-2 : flagellum 2-segmented and longer than the scale. Mx-2 (Fig. 5, b) : exopod with 40 to 45 plumose setae. Mxp-1 (Fig. 5, c) : base of exopod flattened bearing 8 plumose setae along the margin : bilobed epipodite present. Mxp-3 (Fig. 5, d) : setae on the propodus increased. P-3 (Fig. 5, e) : number of setae on the propodus increased and dactylus with 2 additional spines on the inner margin. P-4 : same as in the previous stage except for the presence of 2 additional spines on the inner side of dactylus (Fig. 5, f). P-5 : longer than the total length of the body (Fig. 5, a) ; propodus longer than the carapace, highly flattened, bearing marginal spines and setae and brightly coloured. P-5 : on one side, which was totally broken in the previous stage has been seen regenerated in one zoea of this stage. Though it is smaller than that of the P-5 on the other side, the general appearance is the same and the last segment is broader and longer (Fig. 6, a). T : narrower posteriorly (Fig. 5, i) bearing 2 pairs of lateral and 5 pairs of terminal spines, of which the inner 3 pairs of spines plumose (Fig. 5, j).

This zoea takes 6 to 12 days to moult to the next stage.

Except for the presence of lateral spines on the telson, this zoea closely resembles the *Eretmocaris* species A.I described by Gurney (1936).

Zoea IX (Fig. 6, b to k ; 7, a to g) ; TI 11.39 mm ; CI 3.5 mm.

Rostrum with 9 dorsal teeth (Fig. 7, a). Supra-orbital spine has become small. 1st and 2nd pereopods chelate, and exopod and endopod of pleopods with marginal setae (Fig. 6, j). 2nd to 5th pleopods (Fig. 6, j) with appendix interna.



Fig. 6. *Hippolysmata (Exhippolysmata) ensirostris* : *Zoea VIII* : a- regenerated P-5. *Zoea IX* : b- A-1, c- M-1, d- Mx-1, e- Mxp-2, f- chela of P-1, g- chela of P-2, h- dactylus of P-4, i- pleopod I, j- pleopod II, k- tip of telson.

A-1 (Fig. 6, b) : stylocerite prominent ; flagella 4 times the length of peduncle ; proximal part of the outer flagellum with a number of indistinct segments. Md (Fig. 6, c) : incisor process with 4 to 5 stout teeth ; molar process with numerous rows of short teeth which are serrated ; in between the processes 7 to 11 slender teeth present of which some are serrated. Mx-1 (Fig. 6, d) : proximal endite terminally bears 4 to 5 slender spine-like setae which are pectinate distally, in addition to these a number of slender bristle-like setae present all along the distal aspect of this endite ; distal endite with 7 stout serrated setae and a number of bristle-like slender setae. Mx-2 (Fig. 7, b) : setae on the exopod increased, distal lobe has become more

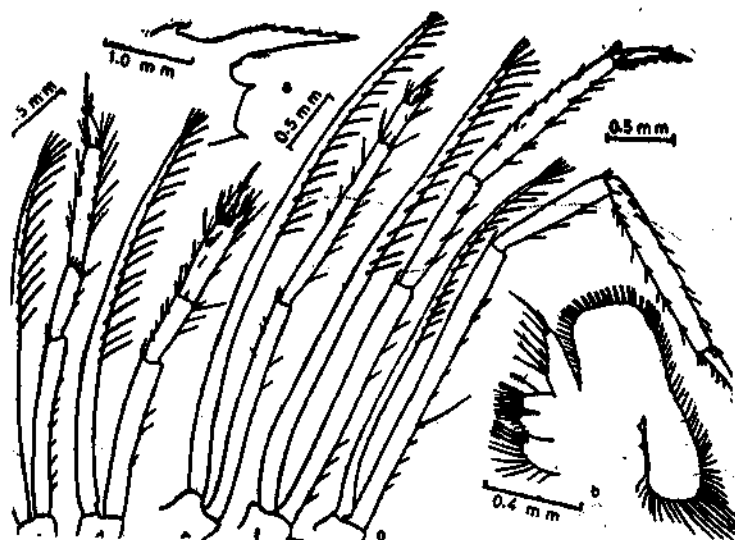


Fig. 7. *Hippolysmata (Exhippolysmata) enstrostris* : Zoea IX : a- rostrum, b- Mx-2, c- Mxp-3 d- P-1, e- P-2, f- P-3, g- P-4.

flattened. Mxp-1 : basal portion of the exopod flattened bearing 22 to 23 plumose setae along its broader, distally it carries 4 apical and 6 pairs of sub-apical plumose setae. Mxp-2 (Fig. 6, e) : endopod slightly expanded, dactylus has terminal claw-like pectinate setae, in addition to this 2 large pectinate and 4 bristle-like setae also present ; some of the setae on the basipod and 1st segment of endopod long and plumose distally. Mxp-3 (Fig. 7, c) : propodus with numerous setae and spines, inner margin of the 1st segment with 8 setae, one spine also present at the outer distal part. P-1 (Fig. 7, d) : distal part of the propodus elongated forming chela with dactylus ; fingers of the chela with a number of bristle-like pectinate setae (Fig. 6, f) ; bristle-like setae and spines are present on the carpus and propodus ; carpus shorter than propodus. P-2 (Fig. 7, e) : longer than P-1 : carpus four times the length of propodus ; fingers of the chela with a number of pectinate setae (Fig. 6, g). P-3 (Fig. 7, f) : endopod longer than exopod ; dactylus with 4 spines on the inner side ; bristle-like setae present on all the segments, and their number is more in propodus.

P-4 (Fig. 7, g) : longer than P-3, dactylus with 4 serrated spines on the inner side (Fig. 6, h), propodus with a number of bristle-like setae, 1st segment with numerous setae on the inner side of which one is very long. T : tapering posteriorly and carries 3 pairs of spines and 2 pairs of bristle-like setae, inner pair of spines plumose, outermost spine very short (Fig. 6, k).

The zoea takes 6 to 8 days to metamorphose into the post-larva I.

Post-larva I (Fig. 8, a to h ; 9, a to h ; 10, a to b) : TL 11.14 mm ; CI 3.55mm.

Body moderately stout ; rostrum with 12 dorsal and 6 ventral teeth, the dorsal tooth on the carapace is separated by a wide space from the 1st rostral tooth ; carapace with pterygostomial and antennal spines ; eyes large but not exceeding rostral tip, peduncle short and devoid of any spine (Fig. 10, a). At this stage larva leaves the planktonic life, pleopods become functional and are used for swimming.

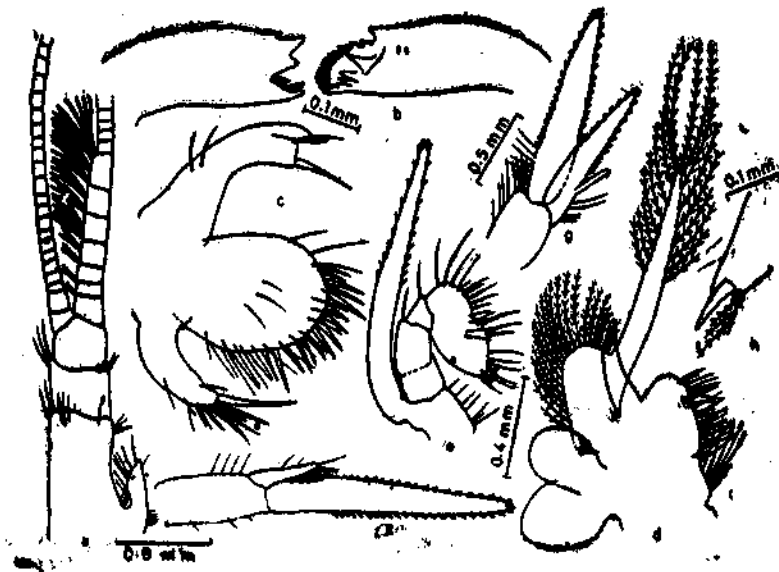


Fig. 8. *Hippolysmata (Exhippolysmata) ensirostris* : Post-larva I : a- A-1, b- Md, c- Mx-1, d- Mxp-1, e- Mxp-2, f- pleopod I, g- pleopod V, h- lateral spines on exopod of uropod.

A-1 (Fig. 8, a) : peduncle 3-segmented, proximal segment longer than the outer 2 combined ; stylocerite reaches beyond the middle of the proximal segment ; middle segment carries 3 small spines on the distal outer margin ; outer flagellum uniramous, basally stout bearing a number of aesthetes ; both the flagellum segmented ; A-2 : scale 4 times as long as broad ; basal 2 segments of flagellum stouter. Md (Fig. 8, b) : only molar process present, it bears 5 to 7 stout ridges and a number

of bristle-like teeth. Mx-1 (Fig. 8, c) : proximal endite bears 5 to 7 stout spines and a number of bristle-like setae, this endite is arranged horizontally to the distal endite ; distal endite is circular in shape bearing a number of stout teeth and bristle-like long setae along its outer margin ; endopod terminally bilobed, distal lobe with a short seta apically, proximal lobe with 2 setae, about the middle 2 slender setae are also present. Mx-2 (Fig. 9, a) : 3 endites are seen ; proximal endite is smallest bearing a number of bristle-like setae along its inner margin ; endopod unsegmented bearing 2 apical and 2 lateral setae ; exopod expanded distally bearing a number of plumose setae along its margin. Mxp-1 (Fig. 8, d) : basipod broad with numerous bristle-like setae ; endopod unsegmented ; base of the exopod expanded bearing a number of plumose setae on the margin, distally it carries 4 long apical and 7 pairs of sub-apical plumose setae ; epipod bilobed and large. Mxp-2 (Fig. 8, e) : basipod with 7 slender setae ; endopod 4-segmented, 1st segmentation very faint, propodus and dactylus coalesced and flattened bearing numerous setae ; exopod long with 4 apical

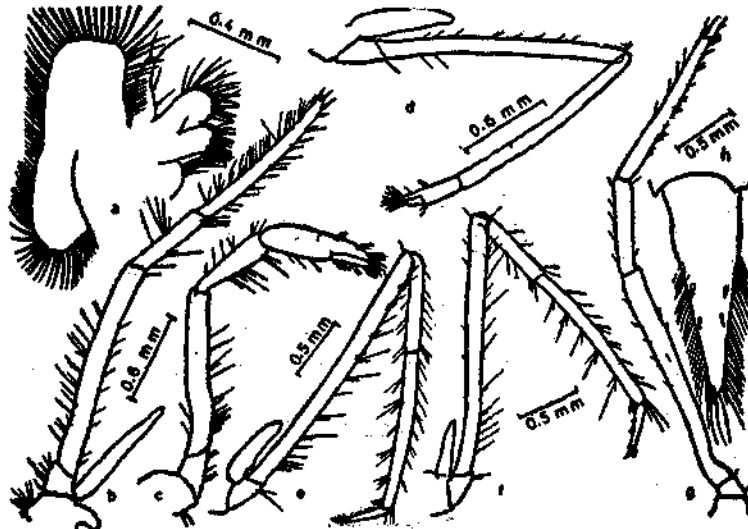


Fig. 9. *Hippolysmata (Exhippolysmata) ensirostris* : Post-larva I : a- Mx-2, b- Mxp-3, c- P-1, d- P-2, e- P-3, f- P-4, g- P-5, h- telson.

and 10 pairs of sub-apical plumose setae. Mxp-3 (Fig. 9, b) : endopod 3-segmented carrying a number of pectinate setae ; terminal segment carries stout spines ; exopod has become rudimentary ; epipod small. P-1 (Fig. 9, c) : merus twice the length of carpus ; all segments carry bristle-like setae ; exopod completely absent. P-2 (Fig. 9, d) : longer than P-1 ; endopod 5-segmented ; merus and carpus almost of the same length, carpus shows indistinct segmentation ; exopod rudimentary without setae. P-3 and P-4 (Fig. 9, e and f) : almost identical in shape ; exopod rudimentary and bud-like without setae ; endopod 5-segmented, merus with 2 to 5 spines on the distal inner margin, propodus with spines and bristle-like setae, dactylus bearing 3 lateral and 1 distal spine. P-5 (Fig. 9, g) : endopod 5-segmented propodus with 13 spines and a number of setae, dactylus with 3 inner and 1 distal spine. Pleopod I (Fig. 8, f) : exopod 4 times the length of endopod carrying a number of plumose setae

along its margin. Pleopod II (Fig. 8, g) : to pleopod V : almost identical in shape ; endopod smaller than exopod and carries appendix interna. T (Fig. 9, h) : shorter than uropod, carrying 2 pairs of dorso-lateral spines in the posterior half. T : tapers posteriorly and ends in a median point, on either side of which 2 spines are present

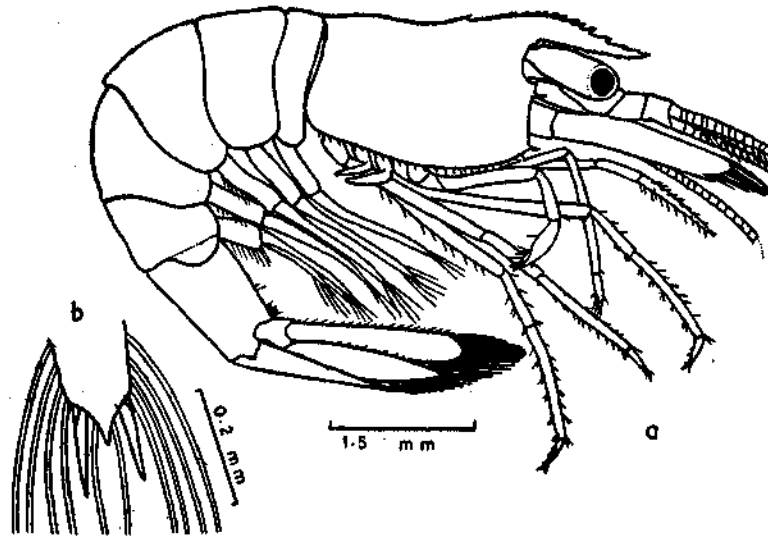


Fig. 10. *Hippolysmata (Exhippolysmata) ensirostris* : Post-larva I a- lateral view, b-tip of telson.

(Fig. 10, b) the outermost being small and placed slightly above the inner spine. All along the margin, telson carries a number of long plumose setae. Exopod of uropod has 2 spines placed inner to the outer distal angle, of which the longer and stouter one is movable (Fig. 8, h).

DISCUSSION

One of the striking features in the larval development of this species is the possession of a highly elongated fifth pereopod with an expanded oar-shaped propodus in the 4th zoea. This character is retained in the succeeding zoeal stages till the last moult into post-larva. Even when it is broken it is regenerated in the same form within two moults. Another important character noticed in the advanced larval stages of this species is the presence of a spine on the elongated eye stalk. The development of spine is indicated as a small tubercle on the eye stalk of 4th zoea. This becomes a conspicuous spine in the next stage and is retained until the zoea metamorphoses to post-larva. The presence of this spine in all the advanced stages clearly distinguishes these larvae from those described as *Eretmocarid* by Gurney (1936) (except *Eretmocarid* species A.I) ; by Dakin and Colefax (1940) and by Pillai (1955) as well as stage VI and VIII of *Lysmata* sp. by Menon (1940). *Eretmocarid* species A.I (Gurney, 1936) closely resembles the zoea VIII of the present species especially in the presence of spine on the eye stalk, but differs from it in the absence of lateral spines on the telson.

As mentioned earlier heavy mortality was noticed during the 3rd zoeal stage. This may be due to the fact that yolk granules present in the first 2 larval stages are completely absorbed in this stage and the larvae depend solely on external food from zoea III onwards. Further, owing to the development of long 5th pereopods which is one of the important changes when the zoea passes on to the fourth stage, there may be greater physiological strain during moulting of 3rd zoea to 4th. The failure of rearing larvae of *H. vittata* by Pillai (1966) and *H. ensirostris* by Bensam and Kartha (1967) beyond the 3rd stage and the heavy mortality observed in this stage during the present observation clearly show that the 3rd moult is the critical one in the larval development of these shrimps.

Several differences are noticed in the early larvae of *H. ensirostris* described by Bensam and Kartha (1967) and the early larvae in the present series. Both being reared from known parents in the laboratory it is highly intriguing that such differences occur in the same species. The first 3 stages of *H. vittata* described by Pillai (1966) closely resemble the corresponding stages of *H. ensirostris*. The 1st zoea described by him is however longer than that of *H. ensirostris*. But the 1st zoea of *H. vittata* described by Kuriyan (1951) more or less agrees in length with the same stage of the present species. The distal expansion of one of the aesthetes on the outer antennular flagellum of the 1st stage of *Hippolysmata* sp. described by Menon (1940), is not present in the 1st stage of this species. The absence of this is also observed by Pillai (1966) in the description of 1st stage of *H. vittata*.

The description and figure of the late larvae of *H. ensirostris* given by Kemp (1916) closely resembles that of the 9th zoea of the present work. His post-larval description probably refers to the 2nd or 3rd post-larval stage. The presence of ventral rostral teeth, complete absence of mandibular incisor process and the telson ending in a sharp point carrying a pair of spines on either side clearly distinguish the post-larva I of the present species from *H. vittata* described by Pillai (1955).

REFERENCES

- BENSAM, P AND K. N. RASACHANDRA KARTHA 1967. Notes on the eggs and early larval stages of *Hippolysmata ensirostris* (Kemp). *Proc. Symp. on Crustacea, Mar. biol. Ass. India*, Part II : 736-743.
- DAKIN, J AND N. COLEFAX 1940. The plankton of the Australian coastal waters off New South Wales. Part I. *Publications of the University of Sydney*. Monograph No. I. 1-215.
- GEORGE, M. J. 1969. Systematics—Taxonomic consideration and general distribution. *Prawn Fisheries of India. Bull. cent. mar. Fish. Res. Inst.*, 14 : 5-48.
- GURNEY, R. 1937. Larvae of Decapod Crustacea Part IV. *Hippolytidae. Discovery reports*, 14 : 353-403.
- HOLTHUIS, L. B. 1947. The Hippolytidae and Rhynchocinetidae collected by the Siboga and Snellius expeditions with remarks on other species. *Siboga-Exped.*, 39 a 8 : 99 p.
- KEMP, S. 1914. Notes on Crustacea Decapoda in the Indian Museum. *Hippolytidae. Rec. Indian. Mus.*, 10 : 81-120.
- 1916. Notes on Crustacea Decapoda in the Indian Museum, *Ibid.*, 12 : 403-404.
- 1916. Notes on Crustacea Decapoda in the Indian Museum, VII. Further notes on *Hippolytidae. Ibid.*, 12 : 385-406.

- KONJU, M. M. 1969. The genus *Solenocera*, Lucas 1850, *Atypopenaeus* Alcock 1905, *Hippolysmata* Stimpson 1860, *Palaemon* Weber 1795 and *Acetes* Milne Edwards. 1830. *Bull. cent. mar. Fish. Res. Institute*, 14 : 159-177.
- KURIYAN, G. K. 1951. A note on the eggs and first stage larva of *Hippolysmata vittata* (Stimpson). *Jour. Bombay. Nat. Hist. Soc.*, 50 : 416-417.
- MENON, M. K. 1940. Decapod larva from Madras plankton. *Bull. Madras. Govt. Mus. N. S. (Nat. Hist.)*, 3 (6) : 1-47.
- PILLAI, N. K. 1955. Pelagic crustacea of Travancore. I. Decapod larvae. *Bull. Res. Inst. Univ. Kerala Ser. C.*, 4 (1) : 47-101.
- PILLAI, S. VENUGOPALA 1966. Some observations on the early larval stages of *Hippolysmata vittata* (Stimpson). *J. mar. biol. Ass. India*, 8 (1) : 152-158.
- SHAIKHAHMUD, F. S. AND V. B. TEMBE 1960. Study of Bombay prawns. *Indian. J. Fish.*, 7 (1) : 69-81.