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南手長蝦幼生及其有關問題研究

許 世 人

On the Larvae of Freshwater Prawn, *Macrobrachium longipes* de Haan, from Taiwan

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南手長蝦在本省溪河及湖池周年均有發現。在宜蘭及中南部地區亦被視爲佳餚之一。本種在淡水中繁殖、成長及成熟。剛孵化之幼生爲水蚤期，投予豐年蝦之無節幼虫爲餌料，經過15—19天，八次脫壳即變態成稚蝦。

INTRODUCTION

According to Chang,[1] five species of freshwater prawn of the genus *Macrobrachium* occur throughout the Taiwan waters. *M. longipes* is an important species which is caught commercially in several districts and much relished by local consumers. In Taiwan, studies on larval and juvenile ecology of fresh water prawn of local species had been limited because it was difficult to identify their zoeae taken in plankton of the waters and the propagation scarcely done in the laboratory. The objective of this paper is to provide description of zoeal stages of *M. Longipes* and some results of observation on experiments for future investigation of ecology of all the local species of freshwater prawn.

MATERIALS AND METHODS

On April 21, 1979, twenty freshwater prawns were caught by scoop-net in the corbicular ponds and drainage of Mai-Liao Hsiang, Yun-Lin Hsien, Taiwan. The external morphology were measured as Table 1.

These prawns were placed into a 15-liter plastic holding tank and then transported by bus within eight hours to the Tainan Fish Culture Station of Taiwan Fisheries Research Institute. Due to over crowding, only two eggbearing female was surviavl and placed in a 40-liter glass-cistern filled with tap water dischlorined by active carbon and well aerated. Hatching occurred in the night of April 29. There were some 1,300 zoeae. Seawater used, stocked in the cement ponds of green house of the station for more than one week, was pumped from the tidal cannal at the rear of the laboratory. The salinity was 37.5‰. The temperature of the rearing water was maintained at 25±3°C throughout the experiments.

Table 1 Some characters of external morphology of *M. longipes*.

No.	Sex	Body length	Body weight	Carapace length	Rostral formula	No. of eggs
1	m	7.0cm	8.16 gm	3.75 cm	13-14/3	——
2	m	7.3	9.81	4.1	14/2	——
3	m	6.5	7.45	3.6	12/3	——
4	m	6.9	8.28	3.75	16/2	——
5	m	6.0	5.26	3.4	13/3	——
6	m	6.3	5.45	3.1	12/3	——
7	m	5.4	3.18	2.7	12/3	——
8	m	5.0	3.05	2.6	11/3	——
9	m	6.0	4.45	3.2	11/3	——
10	f	5.0	2.91	2.5	12/2	——
11	f	4.6	2.52	2.5	12/4	1,300
12	f	5.2	3.09	2.75	13/3	——
13	f	5.0	2.92	2.5	12/3	——
14	f	4.2	3.31	2.3	11/3	——
15	f	5.0	2.8	2.4	11/3	——
16	f	4.5	2.15	2.3	12/3	1,300
17	f	4.8	2.65	2.5	11/3	——
18	f	4.2	2.17	2.1	12/3	1,100

I. Salinity test.

Before the experiment, 2 sets of 2-liter buckets were filled with 990 ml, 800 ml, 330 ml, 200 ml and 10 ml dischlorined tap water respectively, then by using a pipe, 30 zoeae were transfered to individual bucket. Immediately afterwords siphoned seawater into bucket slowly with a tiny hose until the water volume was 1 liter. The experimental zoeae were fed on *Artemia* nauplii, rearing water was treated without aeration. Uneaten food particles or fecal deposits were siphoned off daily, and took a partial change of water. By depending on the situation, the amount of *Artemia* nauplii in the rearing bucket was adjusted every day. The death rate and metamorphosis of the larvae reared in different salinity was observed and recorded. The experiments started with lst zoea stage, and lasted 24 days.

II. Feeding Experiments

30 zoeae were transfered into a 2-liter bucket contained 1.5 liters of water. For convenience, one set of experiment executed only. The experiments started with the larvae aged 2 days and ended respectively at survival being very few. The

food on experimet was treated as in the following.

(1) *Chlorella sp.* siphoned the green water of hatching cistern into the bucket directly, the cell number per ml. of chlorella was unknown.

(2) *Oscillatoria limnetia.* The mass cultivation of this species, a blue-green algae, was took place in a 500-liter semitransparent white plastic tank outside the hatching room of the station. Experimental water was drew from the tank directly.

(3) *Spirulina platensis.* This species of blue-green algae was cultivated largely in the cement ponds outside of the laboratory. It was collected with filter and than dropped some into the bucket.

(4) Rotifer. It was collected from the mass cultivating pond outside the laboratory. The rotifer was fed on yeast produced by Taiwan Sugar Corporation.

(5) *Artemia* nauplii. San Francisco Bay brine shrimp eggs were used.

(6) Steamed eggs. zoeae for experiments took from the cistern in which the larvae had been fed on *Artemia* naupill for six days. Egg was broken, stirred evenly, steamed throughly and pressed through the net several times in order to form suitable particles for the larvae. It was prepared in advance and was pressed in a refrigerator for using after.

III. Observation of larvae

Some zoeae were reserved in hatching cistern for daily observation. They were treated on 10% seawater and fed on *Artemia* nauplii. More than four larvae were observed for each stage under microscope.

RESULT AND DISCUSSION

I. Salinity Tests.

There was a close relationship between the zoeae duration and the salinity of rearing water. It took 15-19 days for zoeae to metamorphose into postlarvae in 0-33% sea water (Fig. 1.) It was quite obvious that larvae could not adapt to high level of salinity than *M. rosenbergii*[2]. (Fig. 2.) From the results, it also indicated that brackish water was not necessary on the propagation of *M. longipes*.

II. Feeding Tests (Fig. 3) :

Artemia nauplii were a good organism for living food. The survival rate of larvae fed on *Artemia* nauplii was 100% in low salinity. The reason of high death rate of larvae reared in the freshwater was the lack of food because the *Artemia* nauplii died easily in the freshwater. The starvation also caused the procrastination of zoeal moulting and metamorphosing into postlarvae. The high death rate of 5 days aged zoeae fed on rotifer is because of deteriorating of water quality. For the zoeae fed on *Spirulina* sp., *Chlorella* sp., and *Oscillatoria limnetia*, we found some zoeae took the algae but it was clear that the cannibalism occured seriously. The edibility of these algae is quite suspicious and debatable. There was a bubble disease

Table 2 Some external characters of the zoea of *M. longipes*

Characters \ Stage	I	II	III	IV	V	VI	VII	VIII	post larvae
Days aged	1	3	5	7	9	11	13	13—15	15—19
Body length in mm	1.87—2.01	2.63	2.95—3.13	3.34—3.5	4.4—4.5	5.2	5.8—6.0	6.5—6.8	6.7—7.0
Carapace length in mm	0.62—0.78	0.78	1.05—1.1	1.2	1.37	1.56	*	*	*
Distance between the outer margin of the eyes in mm	0.46—0.57	0.78	0.90	1.35—1.50	*	*	*	*	*
Telson width	0.37	0.40	0.40	0.26—0.29	0.20	*	*	*	*
Telson length	0.25—0.27	0.31—3.6	0.47	0.53	0.62	0.75	*	*	*
Rostral formula	0/0	0/0	1/0	2/0	2/0	2/0	2/0	6—7/0	over 9/1
No. of plumose hair on antenna	9	9—10	11—12	14	17—18	20—21	22—23	28	33
No. of plumose setae on uropodal exopod	—	—	6	10	14	17—19	25—27	26～27+5～6	33+2～3
No. of plumose setae on uropodal endopod	—	—	—	6	10	14—16	21—23	29—31	34
Lateral spine of telson	—	—	—	2 pairs	3 pairs	3 pairs	3 pairs	3 pairs	3 pairs
Telson formula	7+7	8+8	8+8	5+5	5+5	4+4	4+4	4+4	3+3

found in the zoeae fed on steamed eggs. It happened widely. The larvae suffering from bubble disease generally swam restlessly near the surface of the rearing water and they were very easily frightened. The body became transparent and gas bubble could be found in the stomach and intestine. From the symptoms we concluded that the disease was arose from eating steamed eggs which had fermented already. This disease caused a high death rate.

III. Description of larvae.

Major characters of external morphology and behavior of larvae and juveniles were very similar to *M. rosenbergii*. The larvae were also pelagic in a posture with head down and tail up, showed photopositive under low light intensity. But they were sensitive to the sound of beating or knocking on the glass bucket. They seemed more nervous than *M. rosenbergii*. There are eight zoeal stages in the larval development. The duration of zoeal stages is shorter than *M. rosenbergii* and *M. lar*[3], but longer than *Caridina denticulata* de Haan[4] and *M. asperulum*[5]. Metamorphosis of zoeal larvae into post larvae was not synchronous, but at the 19-20 days, the metamorphosis occurred largely (Fig.1) The zoeal larvae jumping out of the water and attaching on the wall of bucket was found at the age of 11-12 days old. The cannibalism was very strong, so did the juveniles and male. Grouping of chromatophores is a obvious character for identifying different species of zoeae. There are less chromatophores presenting on the carapace and abdominal segments than *M. rosenbergii*, *M. lar* and *Caridina denticulata*[34]. It's a pity that no further observation about chromatophores was executed.

Major characters of external morphology of the larvae and juveniles are enumerated below (Table 2) .

SUMMARY

1. *M. longipes* is a land-locked species, its larvae could not adapt to rearing water of high salinity. It can propagated in freshwater.
2. It takes 15—19 days for zoeal larvae to metamorphose into post larvae. Eight zoeal stages are recognized. Tests showed that the larvae feed on *Artemia* nauplii grew very well.

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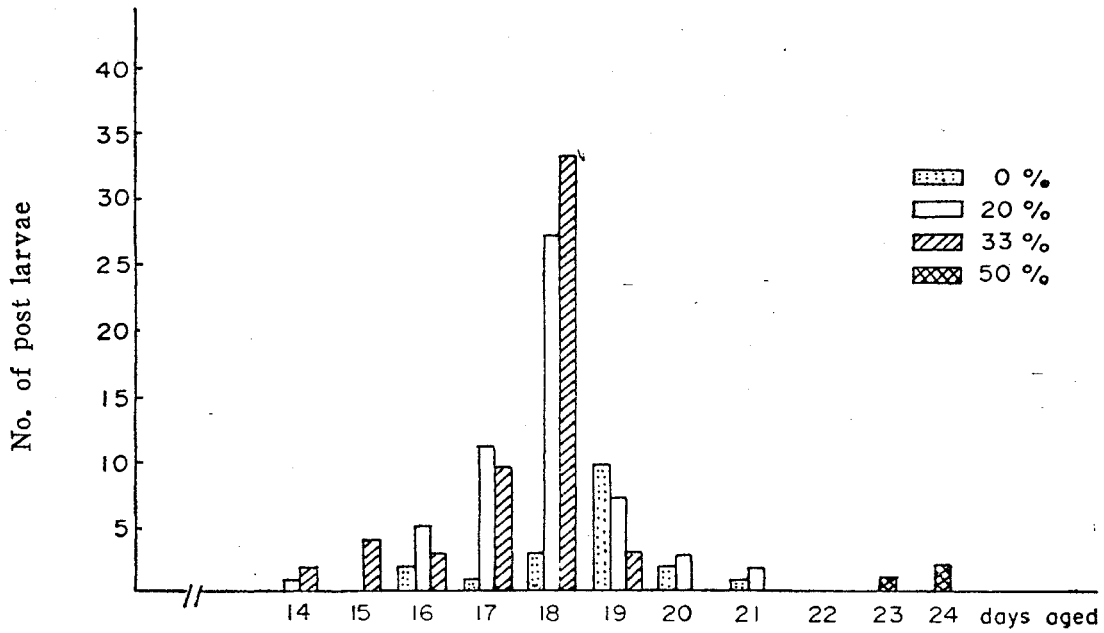


Fig. 1 Frequency of metamorphosing into postlarvae under different ratio of seawater

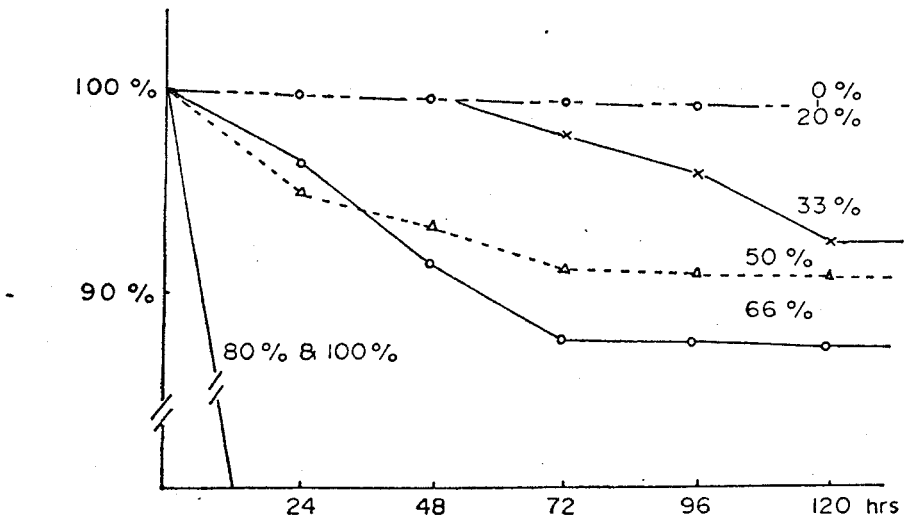


Fig. 2 Survival rate in different ratio of seawater

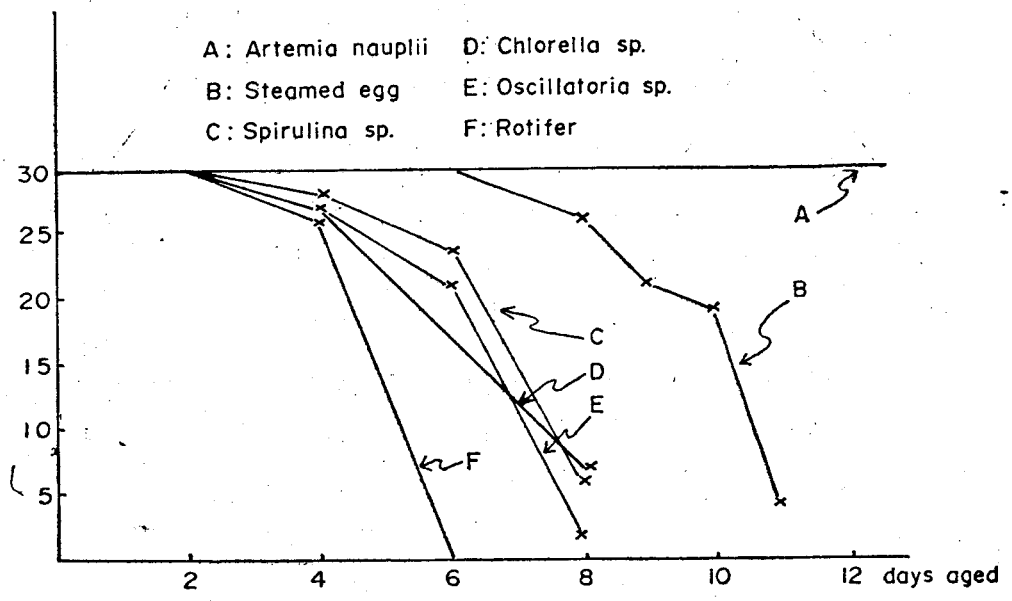


Fig.3 No. of Survival under different food

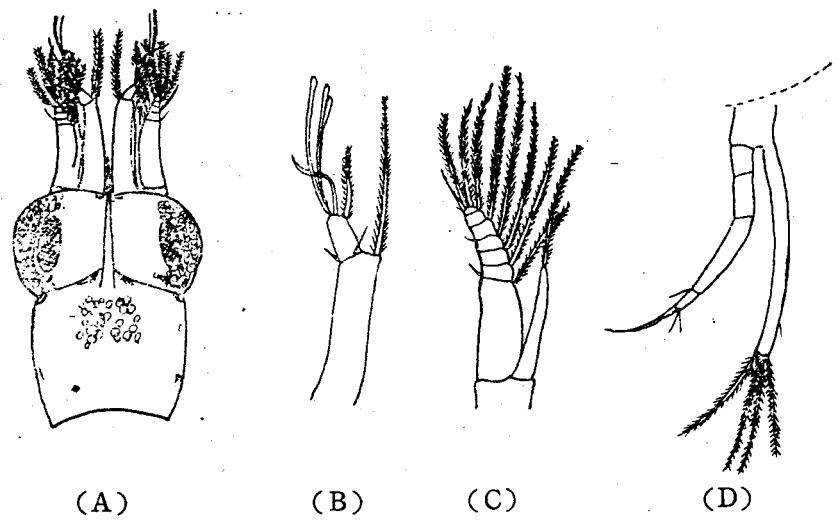
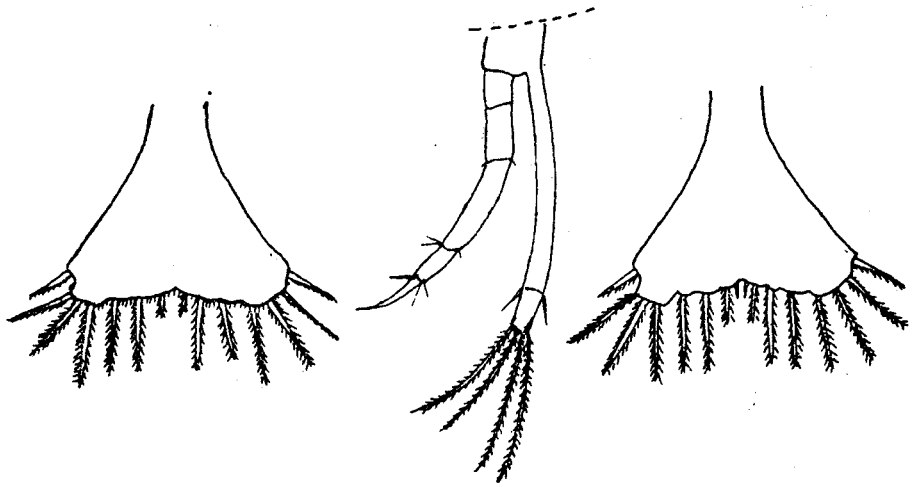


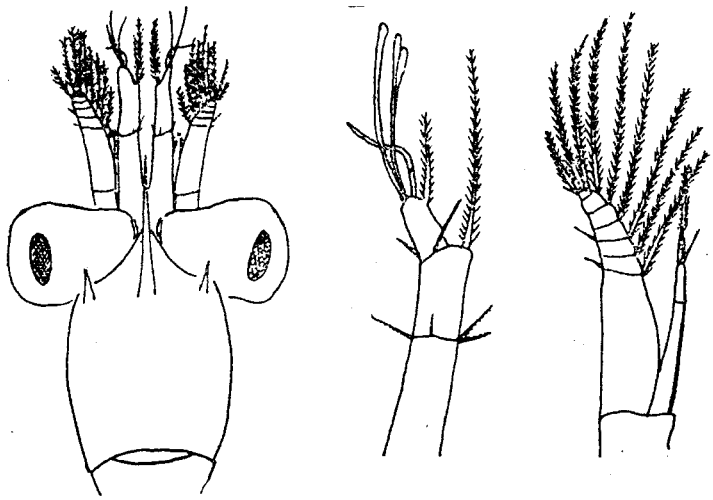
Fig.4 Major characters of the external morphology of the larvae and juveniles of *M. longipes*

(A) — (E) Stage I

(A) Dorsal view of head
(B) Antennule
(C) Antenna
(D) Thoracic leg 5



(E) (F) (G)



(H) (I) (J)

Fig. 4 (cont.)

(E) Telson of Stage I

(F) — (J) Stage II

(F) Thoracic leg 5

(G) Telson

(H) Dorsal view of head

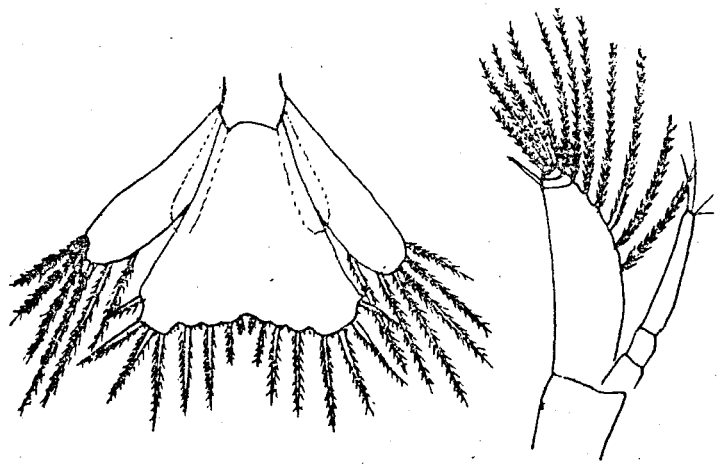
(I) Antennule

(J) Antenna

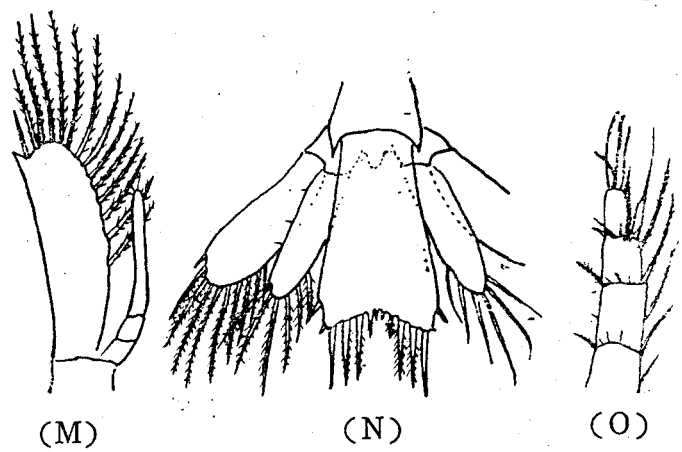
(K) — (L) Stage III

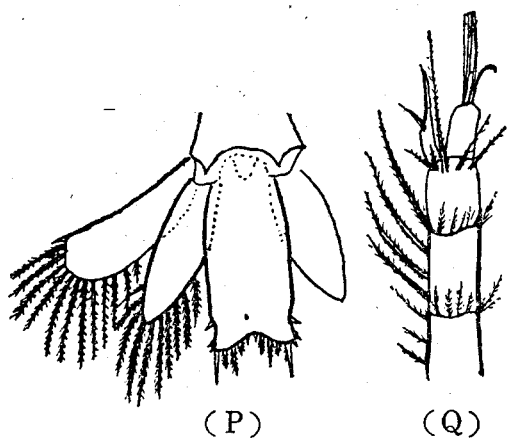
(K) Telson and uropods

(L) Antenna



(K) (L)





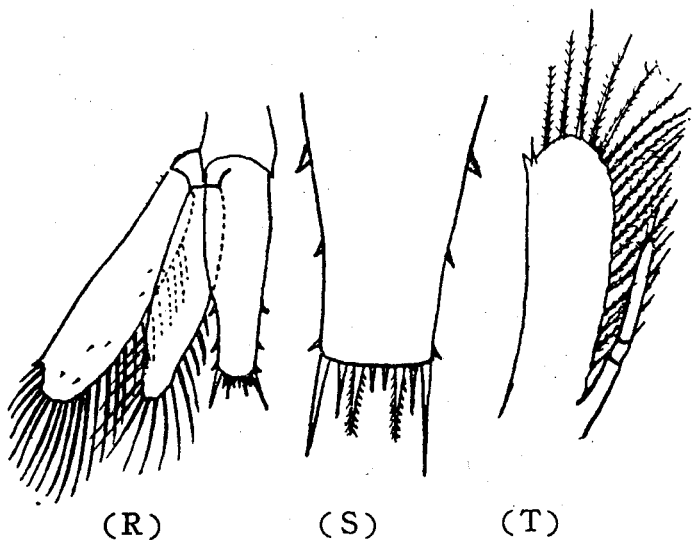


Fig. 4 (cont.)

(M) — (O) Stage Ⅳ

(M) Antenna

(N) Telson, uropods

(O) Antennule

(P) — (Q) Stage Ⅴ

(P) Telson and uropods

(Q) Antennule

(R) — (T) Stage Ⅵ

(R) Telson and uropods

(S) Telson and Its

(T) Spine, Setae. Antenna

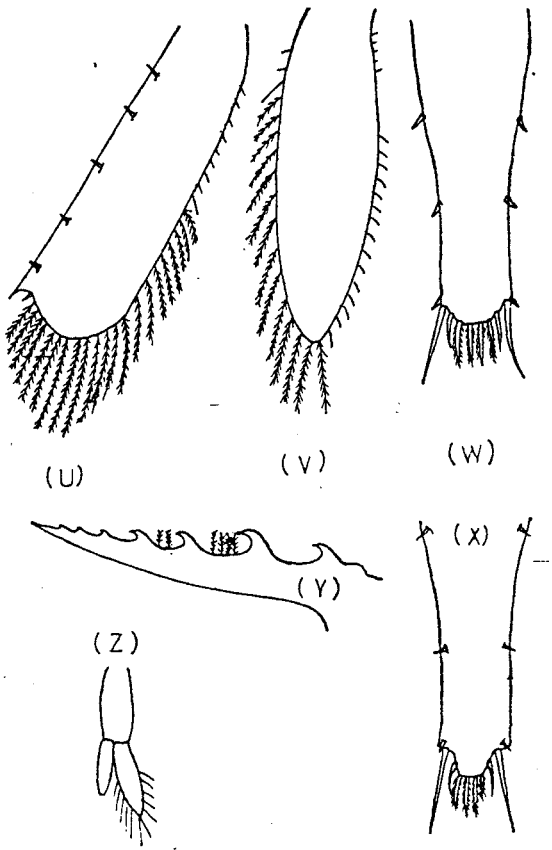


Fig. 4 (cont.)
(U) — (W) Stage VII
(U) Uropodal exopod
(V) Uropodal enopod
(W) Telson
(X) — (Z) Stage VIII
(X) Telson
(Y) Rostrum
(Z) Pleopods

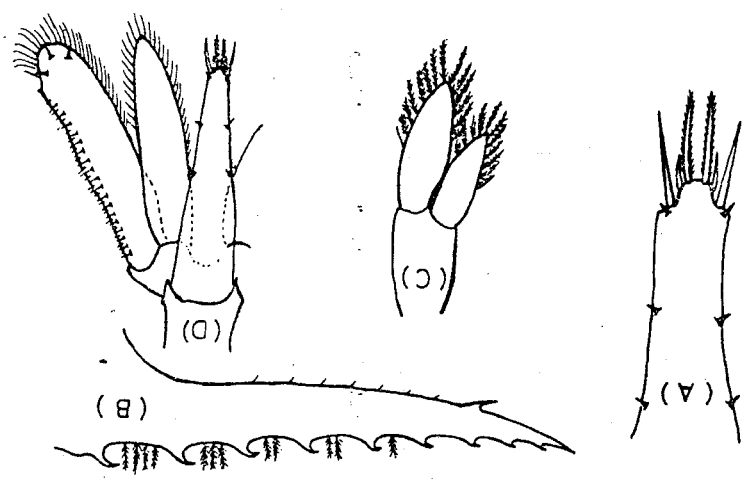


Fig. 5 Postlarva morphology
(A) Telson
(B) Rostrum
(C) Pleopods and notatory hair
(D) Telson and uropods