

LABORATORY SPAWNING AND EARLY DEVELOPMENT OF
PARAPENAEOPSIS ACCLIVIROSTRIS (ALCOCK)
(DECAPODA : PENAEIDAE)

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ABSTRACT

Information on egg, naupliar and protozoal stages of *Parapenaeopsis acclivirostris* (Alcock) are given for the first time as the result of the spawning of the species in the laboratory. The spawning took place in the midnight and the nauplius I emerged at 0800 hrs next day morning. Within 30 hrs after spawning fifth naupliar stage was attained and the larvae reached Protozoa III in 173 hrs. Eggs, five naupliar and three protozoal stages are described and illustrated in detail. A comparative study of these stages with those of *P. stylifera* is also presented.

INTRODUCTION

PARAPENAEOPSIS ACCLIVIROSTRIS (Alcock) is a marine penaeid prawn occurring in small numbers along with other commercially important prawns on the west and east coasts of India. No biological information is available on the species except its distribution (George, 1969). The present communication deals with the results of the spawning and early development of *P. acclivirostris* in the laboratory.

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MATERIAL AND METHODS

The source of material and the method of rearing of larvae are similar to those described for *M. affinis* (Thomas *et al.*, 1974).

SPAWNING AND LARVAL REARING

A single gravid female measuring 38 mm in total length was kept in a glass trough on 14-3-1975 and it spawned around midnight on the same day. At 0600 hrs next morning (15-3-1975), the eggs were in different developmental stages, most of them having fully developed nauplius. Nauplius I hatched out at 0800 hrs on

the same day and reached Protozoa I in 46 hrs after spawning (Table 1). Though the larvae in the protozoal stages were fed with cultures of unicellular algae, namely

TABLE 1. *Results of laboratory spawning and rearing of P. acclivirostris*

Larval stages	Date	Time (hrs)	Duration after spawning (hrs)
Spawning	15-3-1975	0000	0
Nauplius I	15-3-1975	0800	8
Nauplius II	15-3-1975	1400	14
Nauplius III	15-3-1975	1800	18
Nauplius IV	15-3-1975	2200	22
Nauplius V	16-3-1975	0600	30
Protozoa I	16-3-1975	2200	46
Protozoa II	19-3-1975	0200	120
Protozoa III	21-3-1975	0700	173

Synechocystes marina and *Tetraselmis gracilis* in sufficient quantities, the mortality was very high and further development could be traced only upto Protozoa III stage.

DESCRIPTIONS OF LARVAL FORMS

Egg (Fig. 1 a-c) :

Spherical in shape measuring 0.32-0.34 mm in diameter and the embryonic mass measures 0.19 mm.

Nauplius I (Fig. 1 d) : Total length (TL)—0.23-0.25 mm ; greatest body width (GBW)—0.10 mm.

Body pear-shaped, unsegmented without any trace of internal organs, broader anteriorly, with 3 pairs of appendages ; posterior end of the body rounded, bearing a pair of furcal spines ; labrum present as a protrusion on the ventral surface ; ocellus situated near the anterior end and retained in the subsequent naupliar stages. Antennule uniramous, unsegmented, bearing 3 long setae at its distal end and 3 small setae on the inner margin. Antenna biramous, unsegmented ; exopod with 2 long setae apically and 2 short setae on the inner margin. Mandible biramous, unsegmented and exopod and endopod bear 3 long setae distally. Setae on all appendages non-plumose.

Nauplius II (Fig. 1 e) : TL—0.25-0.26 mm ; GBW—0.12 mm.

Body shape similar to that of the previous stage, although the tapering of body towards the posterior end is more pronounced. Setae on all appendages become plumose ; exopod of antenna with 6 long setae ; posterior end of body with 2 pairs of furcal spines.

Nauplius III (Fig. 1 f): TL—0.26-0.28 mm ; GBW—0.14 mm.

Body more elongated posteriorly and the two furcal processes well defined ; each process with 3 spines, the middle one being the longest and more than half the length of the body.

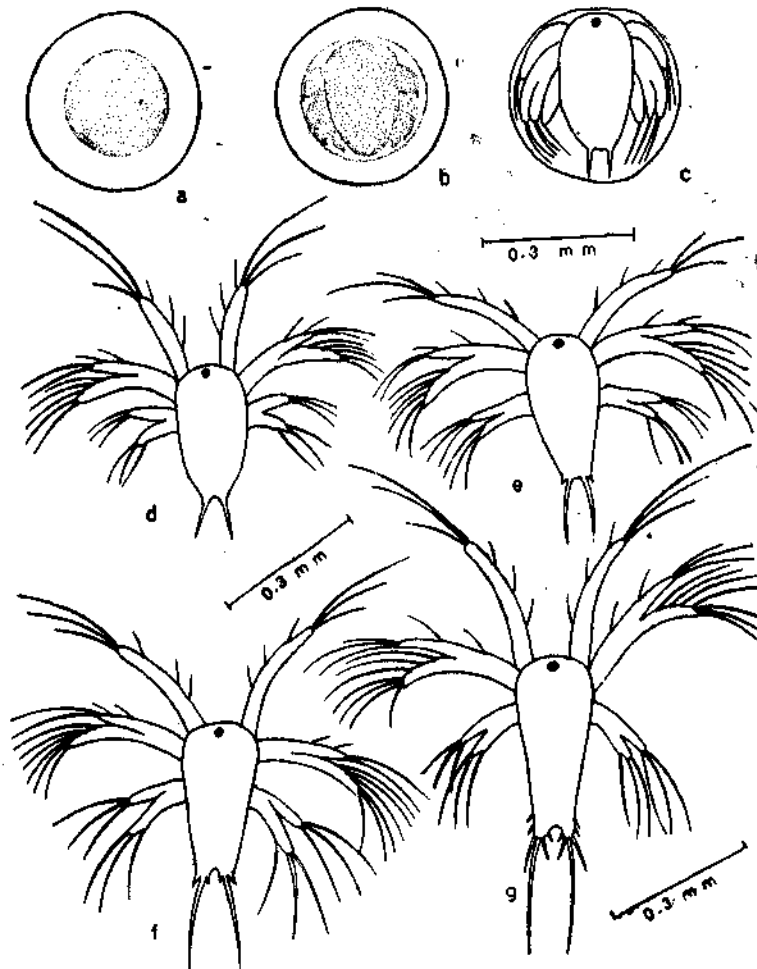


Fig. 1. *Parapenaopsis acclivirostris*: a. Egg-segmentation completed, b. Egg with developing nauplius, c. Egg with fully developed nauplius, d. Nauplius I (dorsal view), e. Nauplius II (dorsal view), f. Nauplius III (dorsal view), and g. Nauplius IV (dorsal view).

Nauplius IV (Fig. 1 g): TL—0.28-0.30 mm ; GBW—0.15 mm.

Body has become slender posteriorly. Furcal spines increased to 6, the longest spine more than half of the length of the body. Exopod of antenna with 7 long plumose setae along its inner and distal margins ; endopod with 3 long plumose setae on the inner side ; length of the setae on the antennule and mandible increases in size ; but the number remains the same as in the previous substage.

Nauplius V (Fig. 2 a): TL—0.35-0.37 mm; GBW—0.15 mm.

Furcal process pronounced, bearing 7 pairs of spines, the innermost one being the smallest; though appendages showed annular indentations, they were not clearly segmented; basal swellings of the mandible develop masticatory surfaces; biramous buds of maxilla and first two maxillipeds appear in this stage.

Protozoa I (Fig. 2 b): TL—0.71-0.74 mm; Carapace length (CL)—0.27-0.28 mm; Carapace width (CW)—0.24-0.25.

The larvae undergoes profound changes in its shape and structure. The anterior portion of the body gets covered by a carapace; narrow posterior margin becomes differentiated into a 6-segmented thorax and an unsegmented abdomen. Carapace semicircular with a pair of frontal organs and a median notch at the anterior end. Naupliar eye still persists between a pair of sessile compound eyes, visible underneath the carapace; digestive tract of the larva clearly seen. *Antennule* (Fig. 2 b)—uniramous, basal segment divided into 5 subsegments, penultimate segment longest, bearing 2 short lateral setae, distal segment with 3 unequal setae at tip and 1 short seta on inner margin. *Antenna* (Fig. 2 c)—biramous, protopod and endopod 2-segmented; distal segment of endopod with 3 long and 1 short terminal setae; 2 pairs of lateral setae at the joints; exopod 9 or 10-segmented of which 3rd to 8th segments bear lateral setae and distal one with 4 long, plumose setae; segments 3 and 5 each with 1 short seta on its distolateral margin. *Mandible* (Fig. 2 d)—flattened, asymmetrical and devoid of exopod and endopods; incissor process with 2 to 3 stout teeth while the molar process with rough grinding surfaces and with numerous small projections; in between the two processes one stout tooth with serrated outer margin present. *Maxilla I* (Fig. 2 e)—bilobed protopod, one lobe with 4 and other with 6 setae; endopod 3-segmented, first two with 2 setae each, 3rd with 5 setae; knob-like exopod with 4 long plumose setae. *Maxilla II* (Fig. 2 f)—protopod with 5 lobes, basal lobe with 6 setae and others each with 2 setae; endopod 4-segmented, first segment with 3, 2nd and 3rd with 2 and the distal one with 3 setae. *Maxilliped I* (Fig. 2 g)—protopod 2-segmented, first segment with 3 and others with 5 setae; endopod 5-segmented, first one bear 3, second to fourth segments with 2 setae and distal one with 5 long plumose setae; unsegmented exopod with 4 terminal and 4 lateral setae. *Maxilliped II* (Fig. 2 h)—smaller than maxilliped I in size; protopod 2-segmented, each with 1 seta; endopod 5-segmented 1st to 4th segments each with 1 seta and 5th with 5 terminal setae; exopod unsegmented with 3 long terminal and 3 lateral setae. *Maxilliped III* (Fig. 2 i)—biramous, unsegmented; exopod with 2 long terminal setae. Behind maxilliped III, thoracic segments become visible, but appendages remain rudimentary; abdomen unsegmented. Telson bilobed, each lobe with 7 spines. *Colouration*—branched reddish chromatophores present each on tip and joints of antennule and antenna; one at the base each of Maxilla I & II and 1st and 2nd maxillipeds.

Protozoa II (Fig. 3 a): TL—1.04-1.06 mm; CL—0.39-0.43 mm; CW—0.34-0.38 mm.

The carapace develops a rostrum and compound eyes become free from carapace and movable on stalks. *Antennule* (Fig. 3 b)—segmentation more distinct; distal segment with 2 long and 2 short setae. *Antenna* (Fig. 3 c)—same as in previous substage. *Mandible*—asymmetrical nature more pronounced. No appreciable changes in the structure of *Maxilla I* (Fig. 3 d), *Maxilla II* (Fig. 3 e), *Maxilliped I* (Fig. 3 f), and *Maxilliped II* (Fig. 3 g). *Maxilliped III* (Fig. 3 h)—biramous and unsegmented; exopod with 3 long plumose setae. Other thoracic appendages rudi-

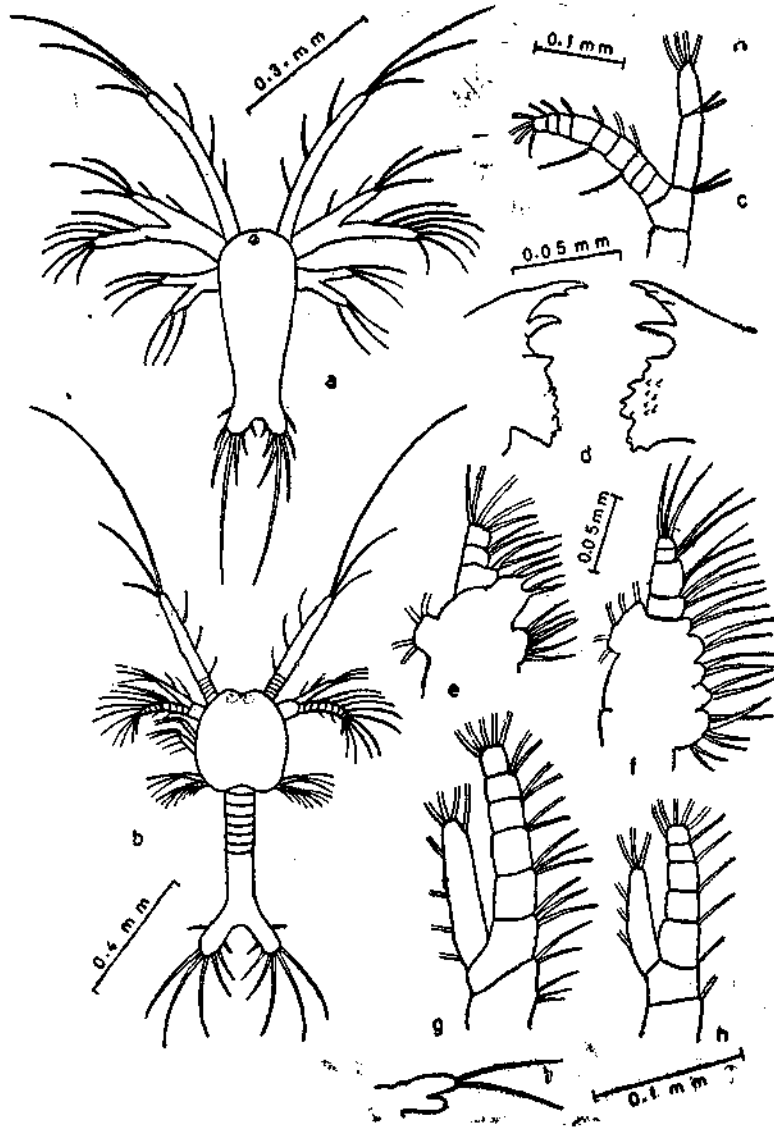


Fig. 2. *Parapenaeopsis acclivirostris*: a. Nauplius V (dorsal view), b. Protozoa I (dorsal view). c. Antenna of Protozoa I, d. Mandible of same, e. Maxilla I of same, f. Maxilla II of same, g. Maxilliped I of same, h. Maxilliped II of same, and i. Maxilliped III of same.

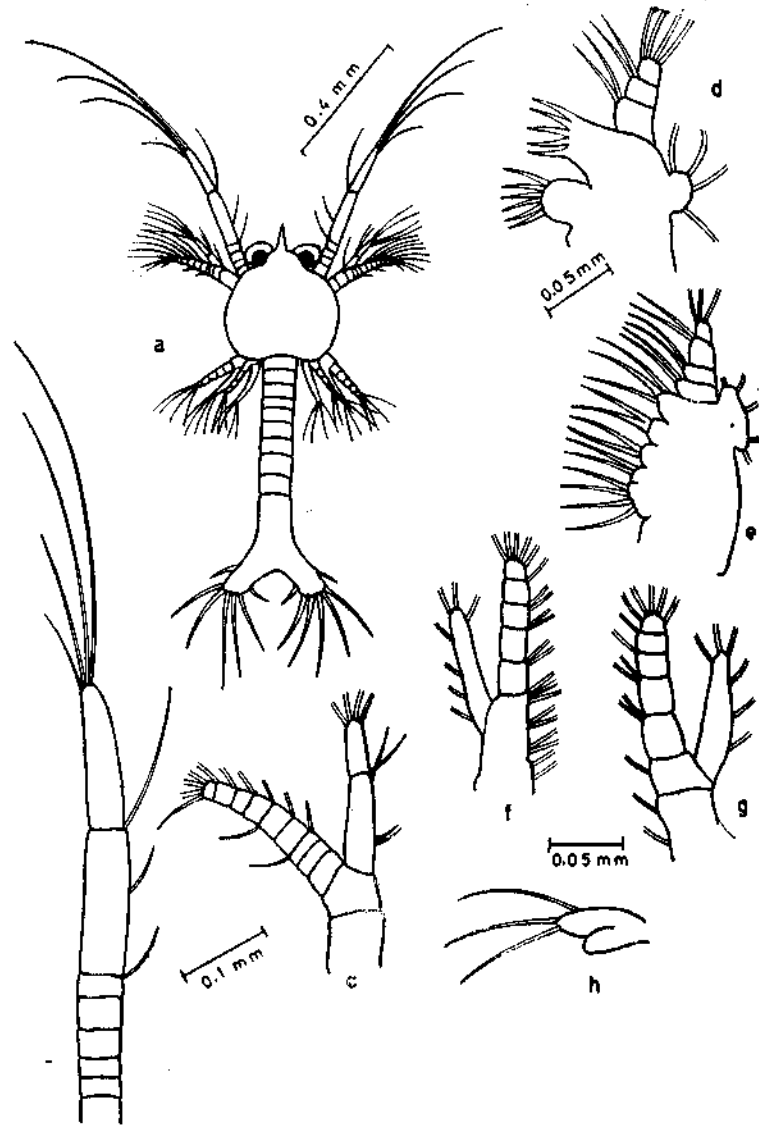


Fig. 3. *Parapenaopsis acclivirostris*: a. Protozoa II, b. Antennule, c. Antenna, d. Maxilla I, e. Maxilla II, f. Maxilliped I, g. Maxilliped II, and h. Maxilliped III.

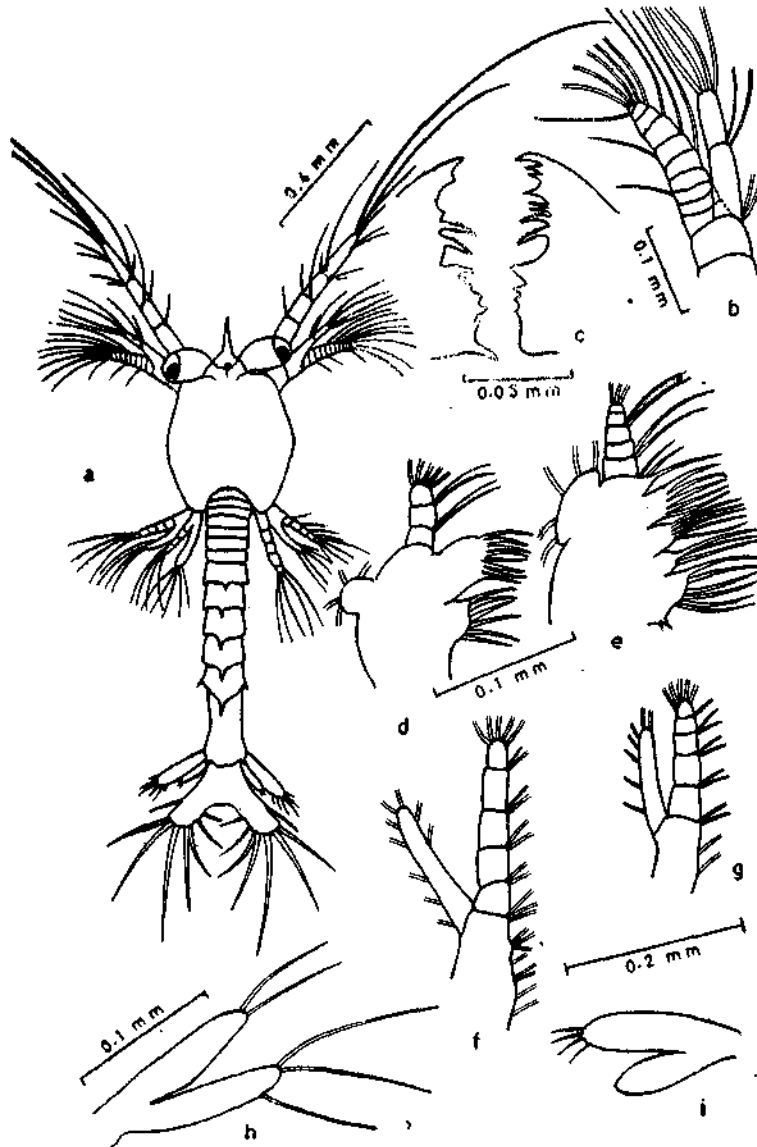


Fig. 4. *Parapenaeopsis acclivirostris*: a. Protozoa III, b. Antenna, c. Mandible, d. Maxilla I, e. Maxilla II, f. Maxilliped I, g. Maxilliped II, h. Maxilliped III, and i. Buds of 1st pair of pereopod.

mentary. All thoracic and 6 abdominal segments distinct; 6th abdominal segment longer than others. Each lobe of telson with 7 spines.

Protozoa III (Fig. 4 a): TL—1.44-1.61 mm; CL—0.53-0.56 mm; CW—0.36-0.38 mm.

Presence of spines on abdominal segments and development of uropods are the remarkable changes in this stage. Carapace with a rostrum anteriorly, and posterior part of it extends upto 2 to 3 thoracic segments. Compound eyes with stout stalks. *Antennule* (Fig. 4 a)—uniramous, 4-segmented; 3 small setae, one each at the joints and one pair just below the tip; distal segment bear 1 long seta about double the size of the antennular peduncle and 3 more unequal setae at its tip. *Antenna* (Fig. 4 b), *Mandible* (Fig. 4 c), *Maxilla I* (Fig. 4 d), *Maxilla II* (Fig. 4 e), *Maxilliped I* (Fig. 4 f) and *Maxilliped II* (Fig. 4 g) remain unchanged. *Maxilliped III* (Fig. 4 h)—biramous and unsegmented; exopod with 3 and endopod with 2 long plumose setae. Pereiopods 1-5 biramous. The exopod of first pereopod with 4 small setae while others bare; length of the first five segments of abdomen longer than that of thorax; each segment with a backwardly directed dorsomedian spine. The posterior border of the 5th abdominal segment with an additional pair of posterolateral spines; 6th segment the longest and carries a spine on each posterolateral corner. Uropod biramous; exopod longer than endopod; exopod and endopod each with 2 small setae. Telson cut off from 6th abdominal segment and each lobe with 8 spines. *Colouration*—Tips and joints of antennule and antenna with brownish chromatophores; on the bifurcation of exopod and endopod of antenna with reddish lengthy branched chromatophores. One pair of orange-red chromatophores at the bases of 2nd and 3rd maxillipeds; dot-like bright red chromatophores on the lateral side of each abdominal segment; tip of exopod and endopod of uropod with orange-red chromatophores; branched orange-red chromatophores confined to posterior border of telson.

A comparative study of essential characters of egg, nauplius and protozoa of *P. acclivirostris* has been made with that of its cogener, *P. stylifera* and is presented in Table 2.

TABLE 2. Comparison of egg, nauplius and protozoa of *P. acclivirostris* and *P. stylifera* (data on *P. stylifera* from Thomas et al., 1974)

Stage and structure	<i>P. acclivirostris</i>	<i>P. stylifera</i>
<i>Egg</i>		
Shape	spherical	Spherical.
Diameter	0.32-0.34 mm	0.32-0.37 mm.
<i>Nauplius I</i>		
Total length	0.23-0.25 mm	0.19-0.22 mm.
Antennule	with 3 terminal and 3 lateral setae.	with 3 terminal setae only.
Caudal spines	1+1	1+1.
<i>Nauplius II</i>		
Total length	0.25-0.26 mm	0.24-0.26 mm.
Antenna	Endopod with 2 terminal and 2 lateral setae; exopod unsegmented, with 3 terminal and 3 lateral setae	Endopod with 3 terminal and 2 lateral setae; exopod unsegmented, with 4 terminal and 3 lateral setae.
Mandible	Masticatory process absent	Masticatory process absent.
Caudal spines	2+2	2+2.

TABLE 2—(contd.)

<i>Nauplius III</i>			
Total length	.. 0.26-0.28 mm	.. ..	.. 0.27-0.28 mm.
Caudal spines	.. 3+3	.. ..	.. 3+3.
<i>Nauplius IV</i>			
Total length	.. 0.28-0.30 mm	.. ..	.. 0.28-0.29 mm.
Antenna	.. Endopod unsegmented, with 3 terminal and 2 lateral setae; exopod with 3 terminal and 4 lateral setae.	.. ..	.. Endopod segmented; exopod with 4 terminal and 3 lateral setae.
Caudal spines	.. 6+6	.. ..	.. 6+6.
<i>Nauplius V</i>			
Total length	.. 0.35-0.37 mm	.. ..	.. 0.27-0.29 mm.
Antenna	.. Exopod with 3 terminal and 4 lateral setae; no spine-like rudiment proximally	.. ..	.. Exopod with 4 terminal and 4 lateral setae; no spine-like rudiment proximally.
Caudal spines	.. 7+7	.. ..	.. 7+7.
<i>Protozoa I</i>			
Total length	.. 0.71-0.74 mm	.. ..	.. 0.53-0.63 mm.
Frontal organ	.. present	.. ..	.. present.
Antennule	.. with 3 terminal and 3 lateral setae	.. ..	.. with 3 terminal and 2 lateral setae.
Antenna	.. Exopod with 4 terminal setae	.. ..	.. Exopod with 4 terminal setae.
Maxilla I	.. Distal segment of endopod with 5 apical setae	.. ..	.. Distal segment of endopod with 4 apical setae.
Maxilla II	.. Exopod with 5 setae	.. ..	.. Exopod with 5 setae.
Maxilliped I	.. Endopod 5-segmented; exopod with 8 setae	.. ..	.. Endopod 5-segmented; exopod with 7 setae.
Maxilliped II	.. Endopod 5-segmented; exopod with 6 setae	.. ..	.. Endopod 4-segmented; exopod with 6 setae.
Maxilliped III	.. Biramous, unsegmented; exopod with 2 setae	.. ..	.. Biramous, unsegmented; exopod with 2 setae.
Telson spines	.. 7+7	.. ..	.. 7+7.
<i>Protozoa II</i>			
Total length	.. 1.04-1.06 mm	.. ..	.. 0.85-0.87 mm.
Maxilliped III	.. Biramous, unsegmented; exopod with 3 setae	.. ..	.. Biramous, unsegmented; exopod with 3 setae.
Telson spines	.. 7+7	.. ..	.. 7+7.
<i>Protozoa III</i>			
Total length	.. 1.44-1.61 mm	.. ..	.. 1.00-1.16 mm.
Supraorbital spine	.. Absent	.. ..	.. Absent.
Antennule	.. Peduncle 4-segmented	.. ..	.. Peduncle 3-segmented.
Maxilliped III	.. Biramous, unsegmented; endopod with 2 and exopod with 3 setae	.. ..	.. Biramous, unsegmented; endopod with 2 and exopod with 3 setae.
Telson spines	.. 8+8	.. ..	.. 8+8.

REMARKS

The eggs, naupliar and protozoal stages of *P. acclivirostris* obtained during the present investigations have been compared with that of *P. stylifera*, the only species of the genus *Parapenaeopsis* whose larval development is completely known. In general, the pattern of larval development in *P. acclivirostris* is similar to that of *P. stylifera* (Rao, 1974 ; Thomas *et al.*, 1974). Though the adult of *P. acclivirostris* is smaller than that of *P. stylifera*, the naupliar and protozoal stages of the former are larger in size when compared to those of the latter (Table 2). The setation also differs considerably between these two species. There are 3 lateral setae on the antennule in addition to 3 terminal ones in Nauplius I of *P. acclivirostris* while in *P. stylifera* only 3 terminal setae are present. Similarly, in Nauplius II the number of setae is reduced by one in the terminal groups of endopod and exopod of antenna in *P. acclivirostris*. In Nauplius IV the antennal exopod is unsegmented in *P. acclivirostris* whereas it is segmented in *P. stylifera*. Besides, the number of caudal spines is less by one in Nauplius I and II of *P. acclivirostris*, although, thereafter the number become equal in both the species. In the protozoal stages the setae are longer and placed more apart in the posterior margin of telson of *P. acclivirostris* than in *P. stylifera*.

Though there are some similarities as well as variations in different parts of the larval forms of these two species, *P. acclivirostris* can easily be identified from *P. stylifera* by its elongated appendages in naupliar and protozoal stages and the remarkable colouration on the antennules, antennae, abdomen and telson.

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