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INTRODUCTION

Seven species of the freshwater prawns of the atyid genus *Caridina* viz *Caridina gracilirostris, C. gracilipes, C. bengalensis, C. williamsoni, C. kunnathurensis, C. gurneyi and C. jalihali* occurs in the Kanchipuram and Thiruvallur Districts of Tamilnadu as reported by Mariappan and Richard, 2006. Of these, larvae were reared in all but the larval development of *C. gracilirostris (=C. pseudogracilirostris* Thomas *et al.*, 1973) has been described by Pillai (1975). Prolonged larval development of this species well conforms to the earlier description and therefore stagewise description is not provided to avoid repetition. *C. bengalensis* de Man (1908) and *C. gracilipes* de Man (1892) were described as two distinct varieties of *C. nilotica* (de Man 1908b). Later these two varieties were considered as full species (Ravindranath 1977). The larval development of these two species is completed in the present work and the differences between the two are discussed. *C. gurneyi* Jalihal *et al.*, 1984 and *Caridina jalihali* Mariappan and Richard, 2006 are two closely resembling species. In the present work larvae of these two species are compared and the distinction of these two species is further established. The *C. williamsoni* and *C. kunnathurensis* were also studied up to the post larval stages. Thus stage wise description is given for all the six species of *Caridina*.i.e *C. gracilipes, C. bengalensis, C. williamsoni, C. kunnathurensis, C. gurneyi and C. jalihali.*

DESCRIPTION OF LARVEL STAGES

Caridina gracilipes de Man, 1892

(Figs. 1-9)

Berried female of *C. gracilipes* were collected from the Ennore pond. The berried females were available throughout the year. However the berried female populations notably increase during rainy season. Eggs are yellow in colour. They are smaller in size measuring 0.24 to 0.37 x 0.40 to 0.56 mm and the number varies from 150 to 850. Hatching were obtained from berried females of this experiment was collected on 13.11 .93. Hatching started on 5 am on 15.11.93 and continued till 5.30 am. Development is prolongd with 7+1 post larval stages taking 14 to 15 days for completion of development. The larval development was completed fully in freshwater. Temperature ranged from 24° to 28° C.

I Zoea

(Fig. 1)

Total length : 1.46 to 1.6 mm. Duration 2 days.

Rostrum : Shorter than the sessile eye. Smooth except for a sharp pterygostomial spine.

Antennule (Fig. 1, b) : Peduncle unsegmented, inner flagellum represented by long plumose seta. Outer short flagellum bears 2 aesthetascs, one plain and a bristle like setae.

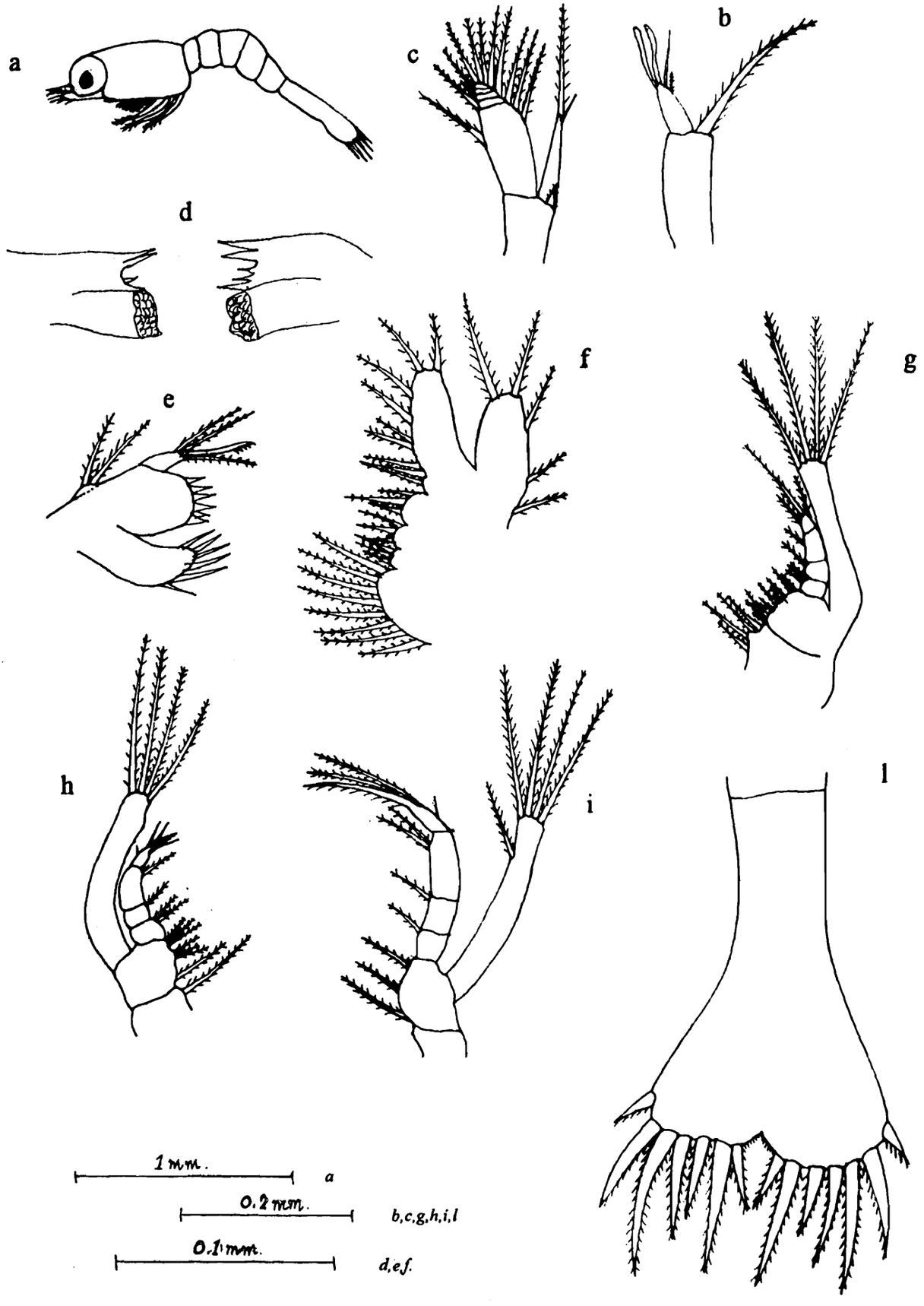

Fig. 1 : *Caridina gracilipes* (I Zoea)

Antenna (Fig. 1, c) : The unsegmented short peduncle short peduncle bears a short serrated spine. Unsegmented endopod reaches 2/3rd of the scale and bears 1 plumose and 1 small plain setae terminally. Scale 3 times as long as broad with 4 anterior segments. Scale with 9 long plumose setae at the inner and 2 plumose on the outer margins, besides 1 small plain seta terminally.

Mandible (Fig. 1, d) : Slightly asymmetrical, incisors and molar processes clearly differentiated.

First Maxilla (Fig. 1, e) : Coxal and basal entites with 6 plain setae each. Palp bears 3 plumose and 1 setae. Exopod bears 2 plumose setae.

Second Maxilla (Fig. 1, f) : Coxal and basal entites with 8+3 and 3+3 setae. Endopod overreaches scaphognathite and bears 3,2,1,1 & 2 setae distalwards. Scaphognathite with 5 plumose setae, proximal lobe yet to be formed.

First Maxilliped (Fig. 1, g) : Coxa with 4 somewhat long plumose setae. Basis at sinuous inner margin bears 10 small plumose setae. A 4 segmented endopod with 3,1,1, & 3 setae distalwards. Exopod distinctly longer than endopod, bears 4 natatory setae.

Second Maxilliped (Fig. 1, h) : Coxa with a characteristic long plumose seta. Basis at its slightly sinuous inner margin bears 1 long, 3 & 3 setae distal wards. The 4 segmented endopod bends inwards bearing 2,1,1 and terminal setae. Exopod longer than endopod with 4 natatory setae.

Third Maxilliped (Fig. 1, i) : Basis setation 3 on inner margin. Endopod 4 segemented with 1,1,2 & 1 outer + 3 long terminal setae. Exopod shorter than endopod, with 4 terminal and 1 subterminal natatory setae.

Pereiopods : First pair as small uniramous buds.

Abdomen : Five segmented all segment smooth.

Telson (Fig. 1, l) : Triangular with median notch on posterior margin, process formula 7+7. All process plumose, first 2 on the inner margin only. Median notch with 14 to 16 minute hairs.

II Zoea

(Fig. 2)

Total length : 1.75 to 2.00 mm. Duration : 2 days.

Rostrum : Smooth, reaches 2nd antennular peduncle segment. Eyes stalked, free from carapace.

Antennule (Fig. 2, b) : Peduncle segmented, 2nd segment with a mark of faint segmentation in the middle and bears 2 distal setae.

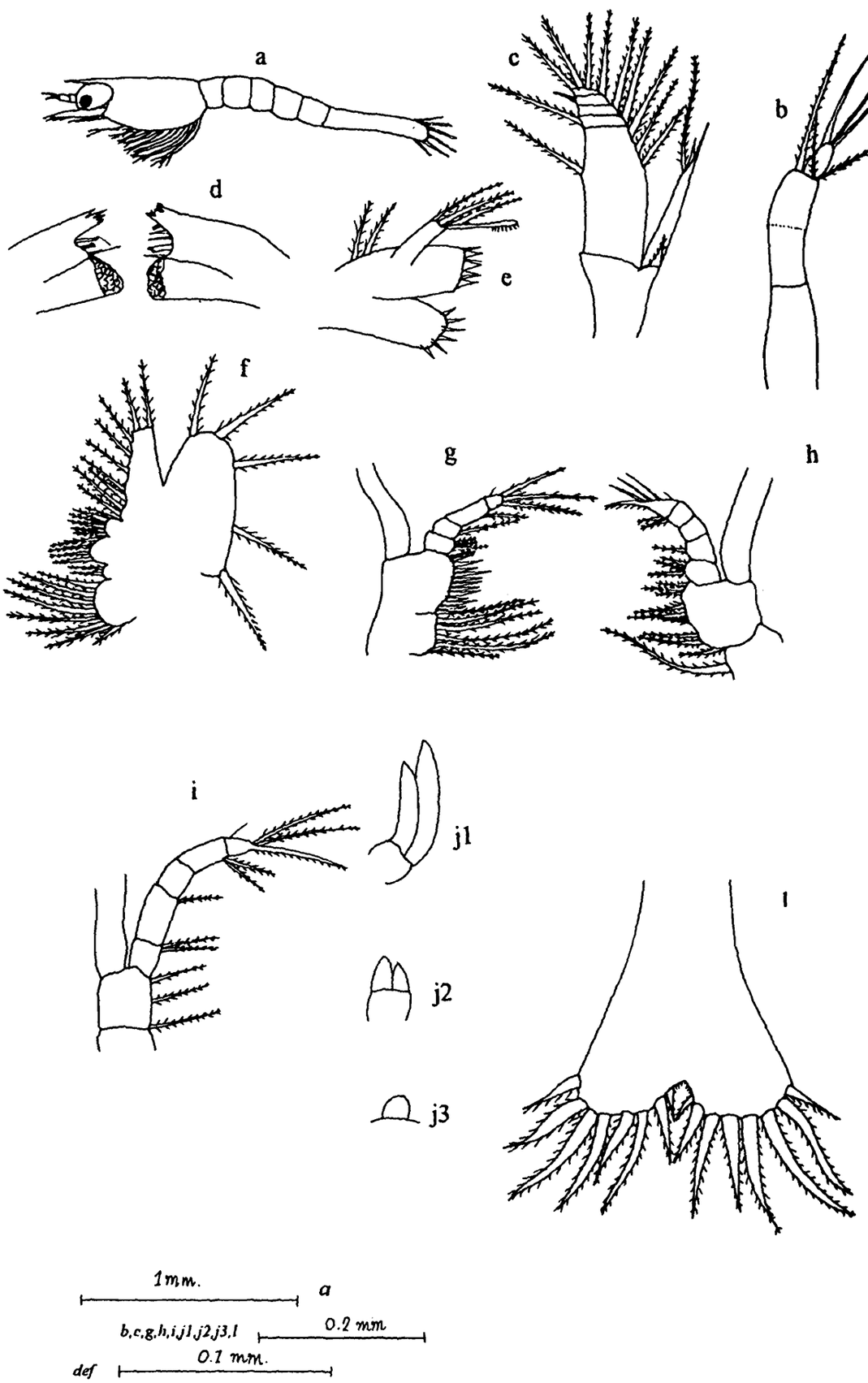

Fig. 2 : *Caridina gracilipes* (II Zoea)

Antenna (Fig. 2, c) : No change

Mandible (Fig. 2, d) : Incisors of both sides with 5 teeth each. Cutting edge with spinuous setae.

First Maxilla (Fig. 2, e) : Exhibits no change.

Second Maxilla (Fig. 2, f) : Endopod reduced and equals scaphognathite.

First Maxilliped (Fig. 2, g) : Increase in number of setae of the basis.

Second Maxilliped (Fig. 2, h) : Endopod 5 segmented 3,1,0,2 & 1 outer + 4 terminal setae distalwards.

Third Maxilliped (Fig. 2, i) : Endopod 5 segmented with setation 2,1,0,2 & 1 outer + 3 terminal.

Pereiopods (Figs. 2, j1 - j3) : First 3 represented as buds. First long biramous, second small biramous and third uniramous.

Telson (Fig. 2, l) : With an additional median pair of small plumous setae process formula 8+8. Second process plumose now on either side.

III Zoea

(Fig. 3)

Total length : 1.90 to 2.30 mm. Duration : 2 days

Rostrum : No change in rostrum and carapace.

Antennule (Fig. 3, b) : Peduncle 3 segmented two rami well demarcated. Outer ramus with sparsely plumose seta. 2nd segment of peduncle with 3 plumose setae.

Antenna (Fig. 3, c) : Endopod much reduced in size. Scale now with 3 segments and the terminal seta reduced to a small denticle.

Mandible (Fig. 3, d) : Setation increased on the cutting edge.

First Maxilla (Fig. 3, e) : Exopod still with outer 2 setae.

Second Maxilla (Fig. 3, f) : Further incresed in setation.

Maxillipeds (Figs. 3, g, h, & i) : No change other than increase of setation in the basis of I & II maxillipeds

Pereiopods (Figs. 3, j1 - j4) : Four pairs, first pair functional with 5 segmented endopod and exopod with 4+1 natatory setae, 2nd pair represents as elongated biramous buds, 3rd & 4th pairs as small biramous buds.

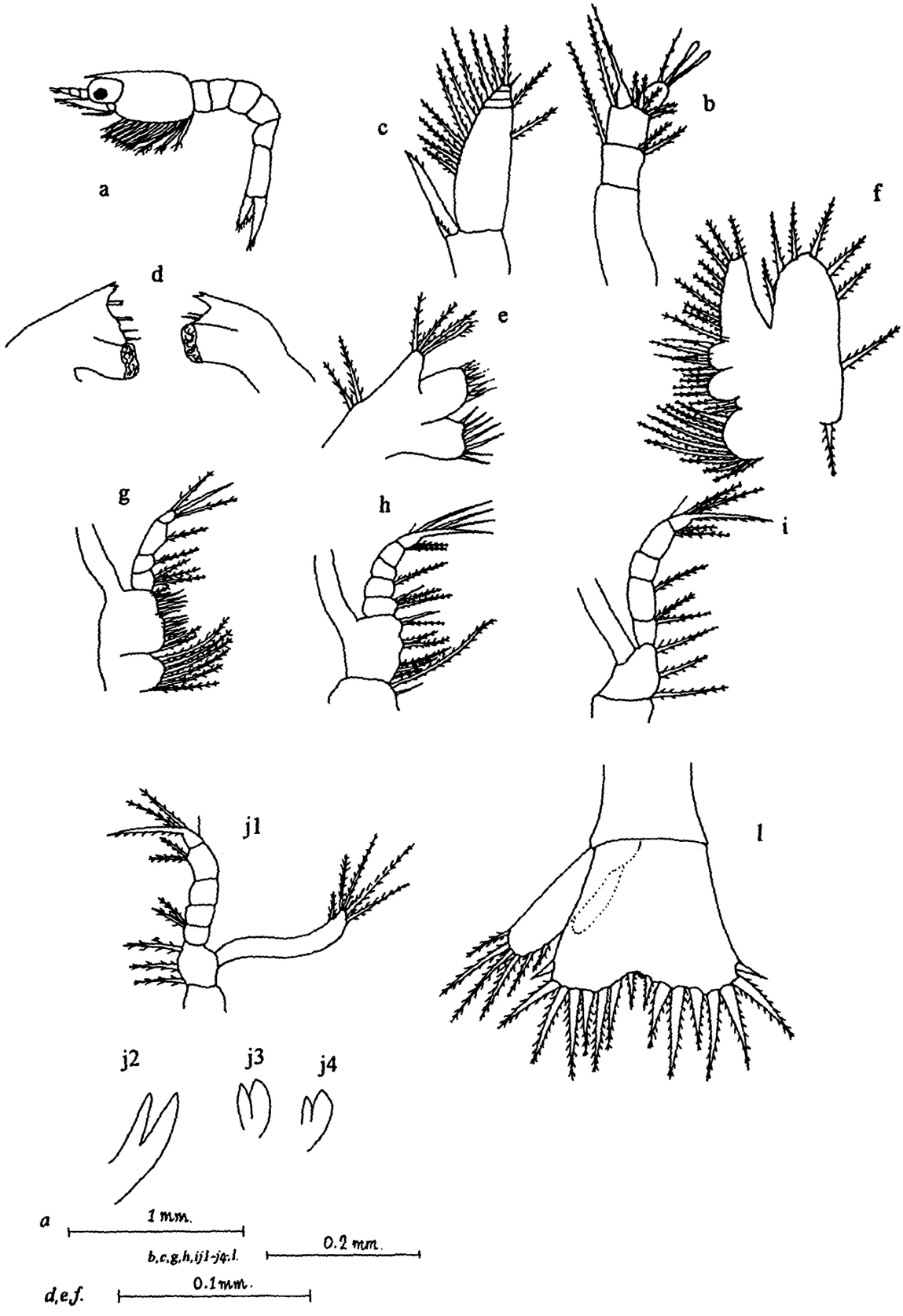

Fig. 3 : *Caridina gracilipes* (III Zoea)

Abdomen : Sixth segment separated from the telson with a pair of small posterolateral spine.

Telson (Fig. 3, l) : 8+8 process formula, the first process transformed into a pair of lateral spines.

Uropods (Fig. 3, l) : Only exopod functional, with 6 plumose setae. Endopod represents as a small bud.

IV Zoea
(Fig. 4)

Total length : 2.2 to 2.8 mm. Duration : 2 days.

Rostrum and Carapace : No appreciable change.

Antennule (Fig. 4, b) : Basal segment bears a bristle-like seta at future stylocerite location and a ventral spine.Outer ramus with 2 aesthetascs + 1 plumose seta; terminal seta of inner ramus now naked.

Antenna (Fig. 4, c) : Scale devoid of segmentation, terminally bearing a small spine and fringed along inner margin with 14 setae. Endopod tiped with denticle and a minute seta.

Mandible (Fig. 4, d) : No appreciable change.

First Maxilla (Fig. 4, e) : Exopod setae completely lost.

Second Maxilla (Fig. 4, f) : Scaphognathite with well developed proximal lobe, setation increased on endities.

Maxilliped (Figs. 4, g, h & i) : Outer plumose setae present on 1st endopod segment of second maxilliped and 2nd endopod segment of third maxilliped.

Pereiopods (Figs. 4, j1 - j5) : All 5 pairs present. First 2 pairs functional, last 3 pairs present as biramous buds.

Abdomen : First 5 segment now bearing uniramous pleopod buds.

Telson (Fig. 4, l) : Longer, narrow and gradually broadening posteriorly. The first pair of spines now shifted more laterally 2nd and 3rd more spine-like. Process formula 5+5.

Uropods (Fig. 4, l) : Both rami funtional and setose. Outermost seta of exopod now transformed into spine.

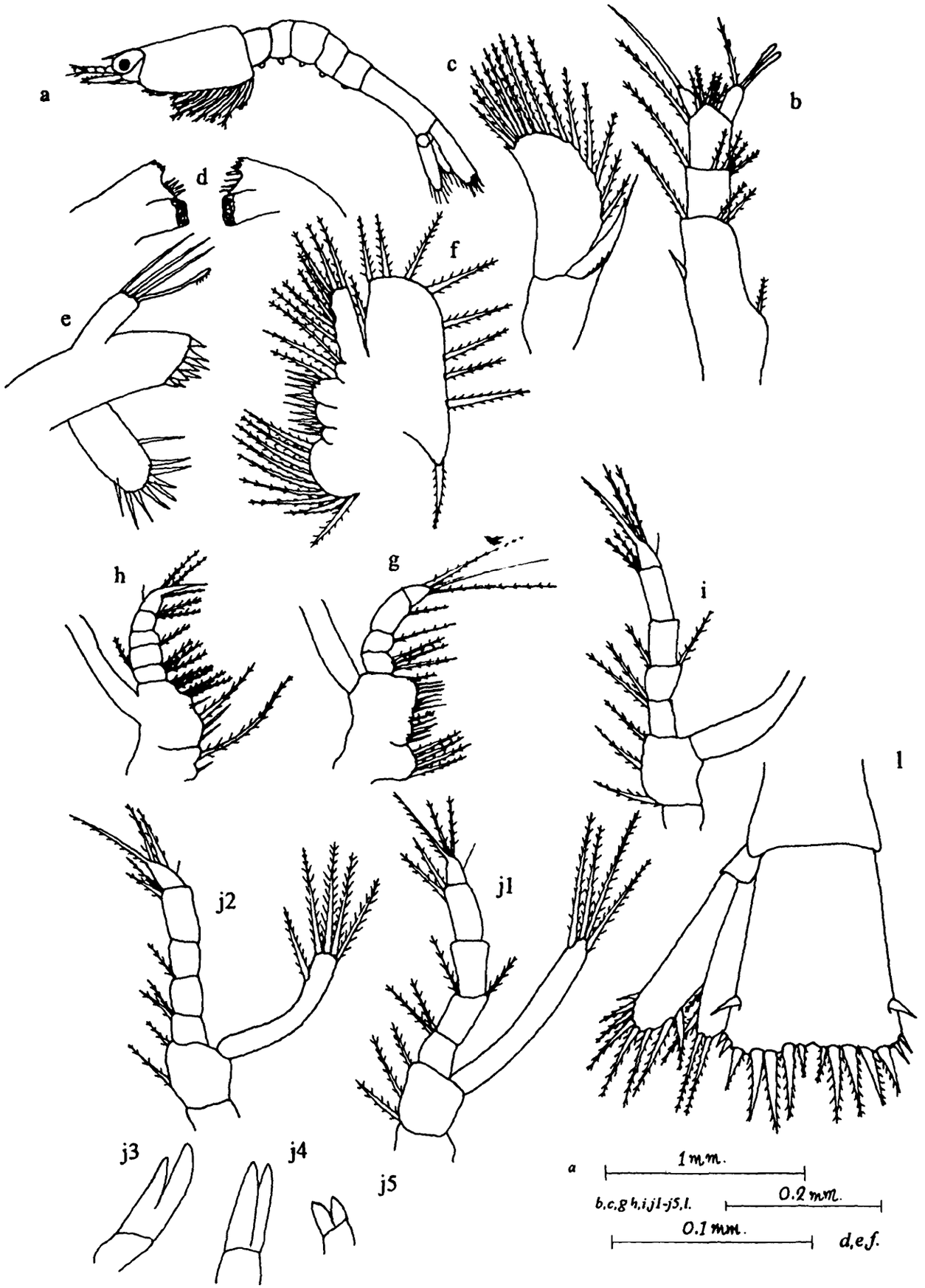

Fig. 4 : *Caridina gracilipes* (IV Zoea)

V Zoea
(Fig. 5)

Total length : 2.56 to 3.0 mm. Duration : 2 days.

Antennule (Fig. 5, b) : Stylocerite now with 2 bristles on inner margin. Ventral spine now elongated with serration on its inner margin. Inner ramus unsegmental with 2 terminal setae.

Antenna (Fig. 5, c) : Endopod elongated and now 2- segmented with a small terminal naked seta. Peduncle spine reduced in size.

Mandible (Fig. 5, d) : No change.

First Maxilla (Fig. 5, e) : Setation increased.

Second Maxilla (Fig. 5, f) : Endopod reduced in length.

Maxillipeds (Figs. 5, g, h & i) : No appreciable change.

Pereiopods (Figs. 5, j1 - j5) : First 4 pairs functional. 5th pair still biramous bud.

Pleopods (Figs. 5, k1, k2) : Now biramous, unsegmented.

Telson (Fig. 5, l) : Rectangular, with 3 pairs of more laterally shifted spines. Median notch completly lost, more convex posterior margin with process formula 5+5.

Uropods (Fig. 5, l) : Increase in setation.

VI Zoea
(Fig. 6)

Total length : 2.8 to 3.3 mm. Duration : 2 days

Rostrum : Still smooth. Pterygostomial and antennal spine well formed.

Antennule (Fig. 6, b) : Inner flagellum two segmented.

Antenna (Fig. 6, c) : Peduncle with a small spine at base of scale. Endopod 6-segmented and more than 1/2 of scale in lenth.

Mandible (Fig. 6, d) : No appreciable change.

First & Second Maxilla (Figs. 6, e & f) : More setation.

Maxillipeds (Figs. 6, g, h & i) : No change.

Pereiopods (Figs. 6, j1 - j5) : All 5 pairs well developed. First 2 pairs showing traces of chetate nature. Exopod of first 4 pairs with 6,6,5 and 4 natatory setae respectively.

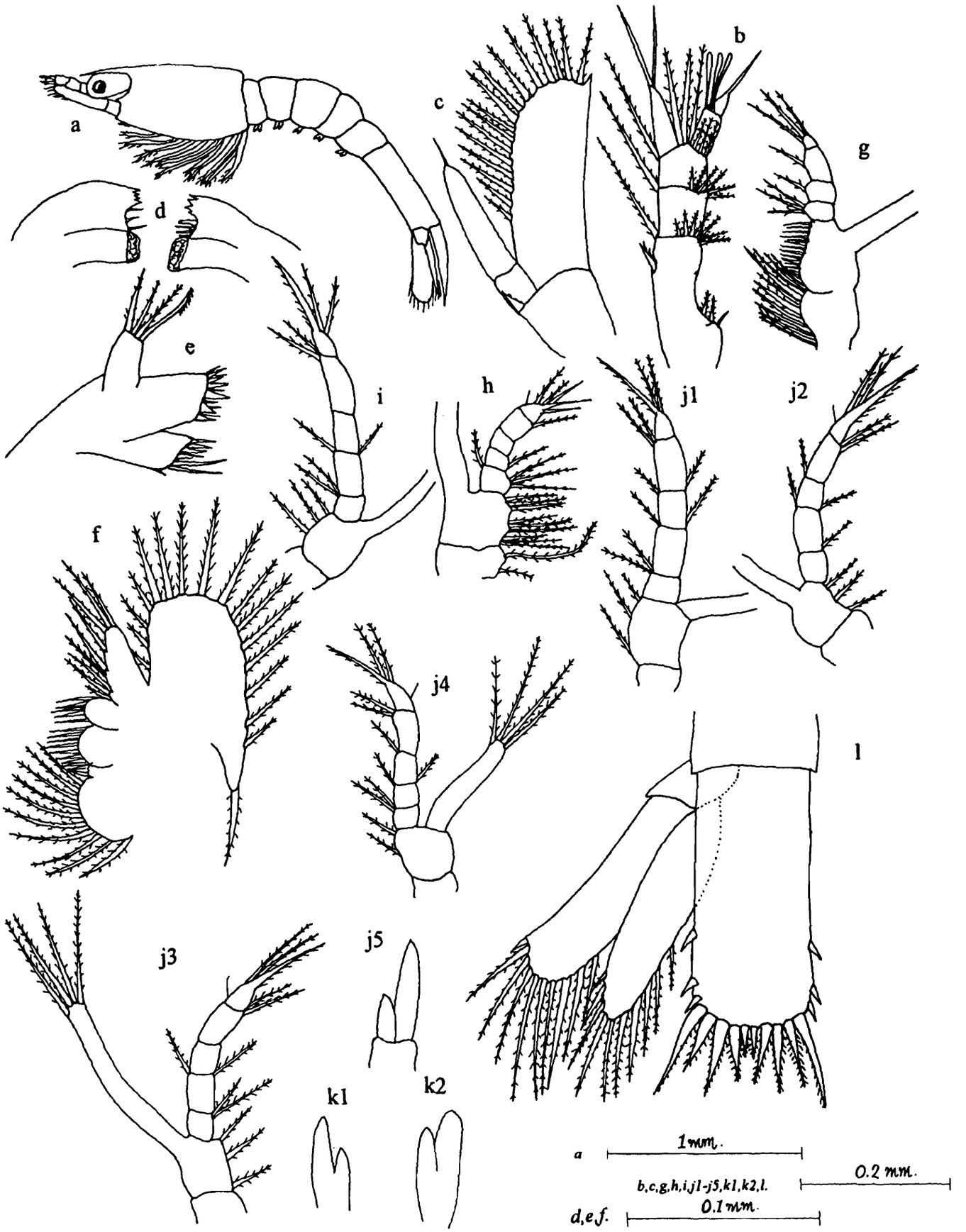

Fig. 5 : *Caridina gracilipes* (V Zoea)

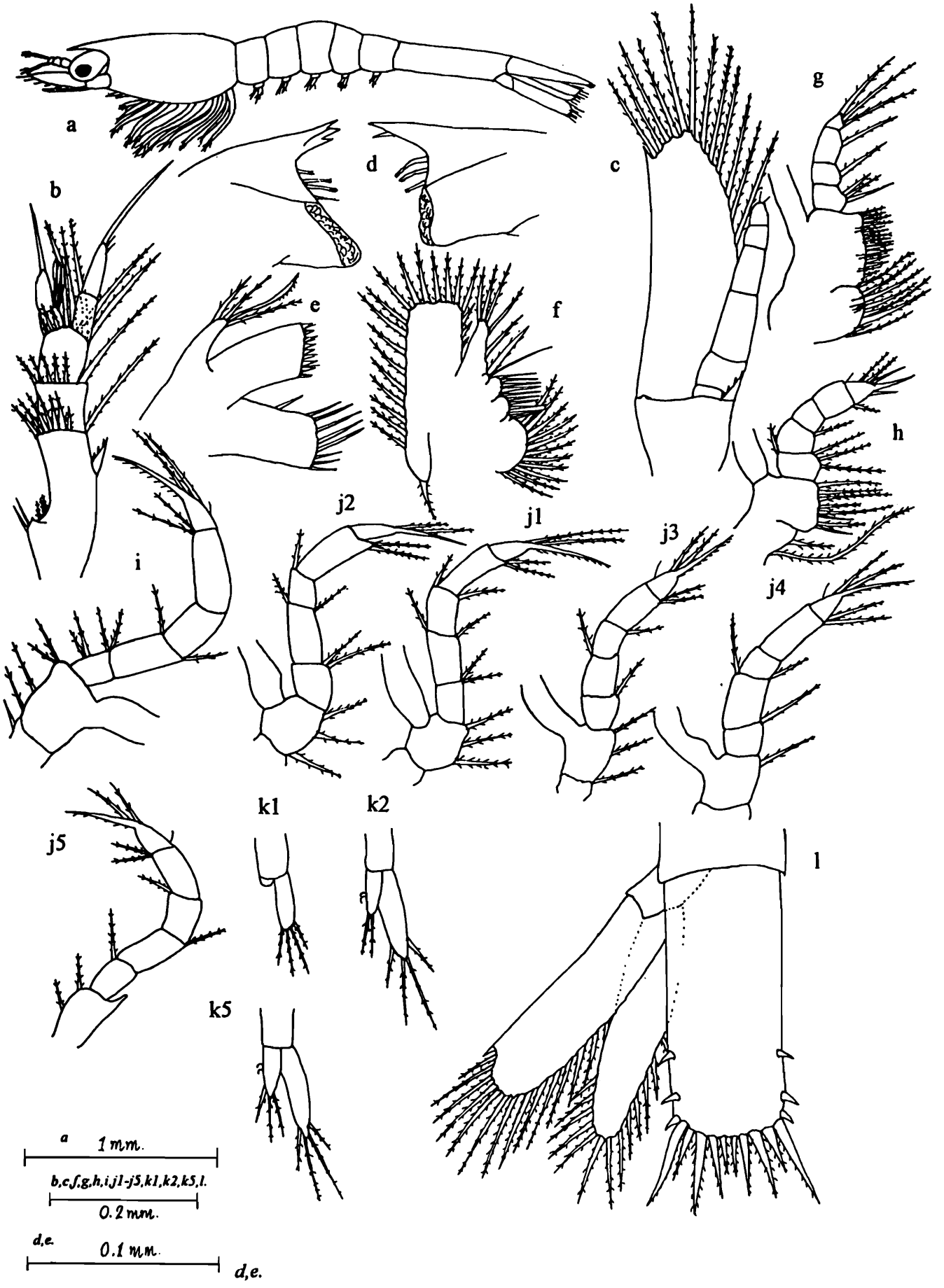

Fig. 6 : *Caridina gracilipes* (VI Zoea)

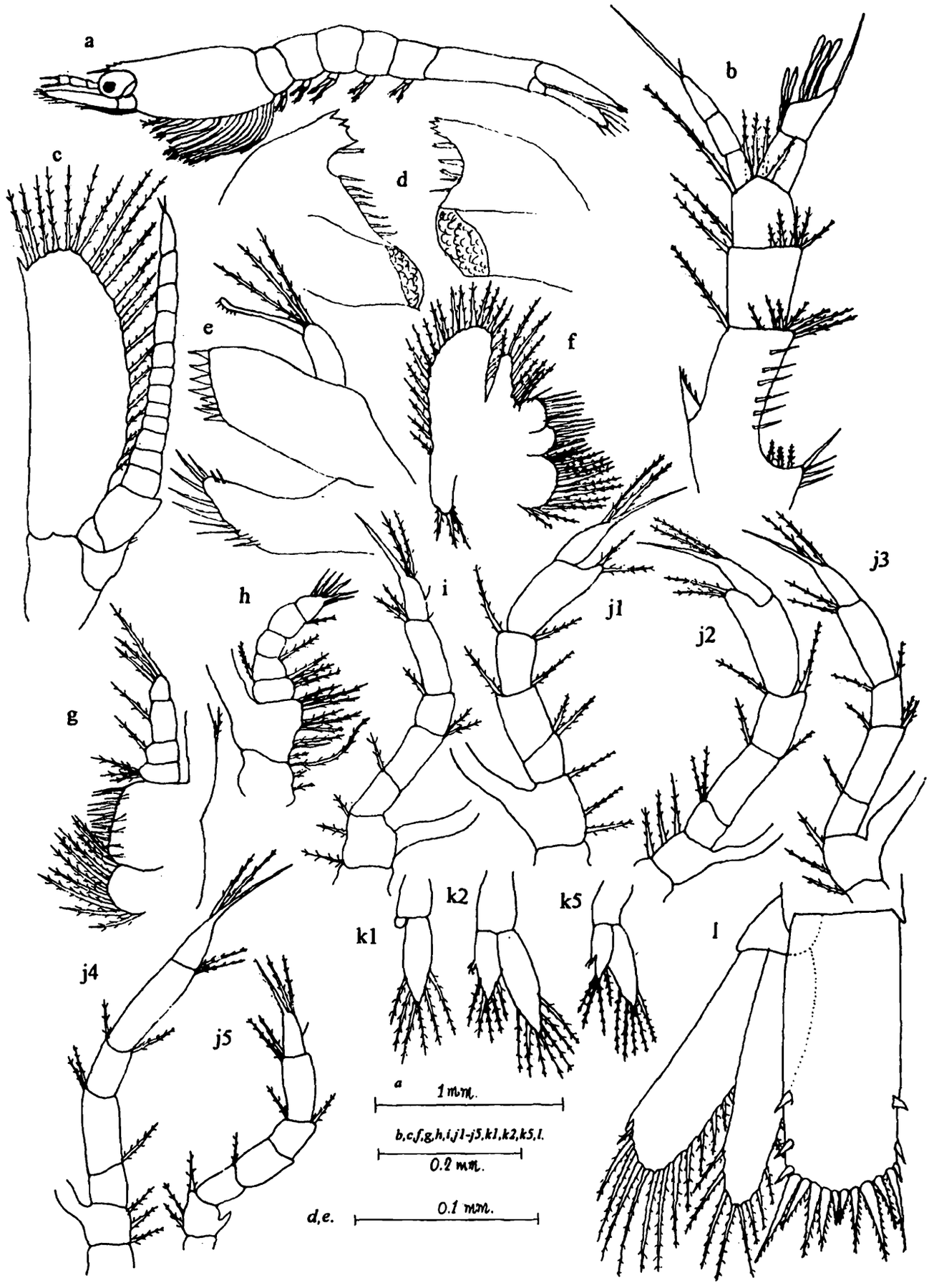

Fig. 7 : *Caridina gracilipes* (VII Zoea)

Pleopods (Figs. 6, k1, k2 & k5) : Elongated, clearly segmented with 3 or 4 small. Endopods of 2nd to 5th pleopods exhibit on inner margin representing future appendix interna and bears 2 hooks.

Telson (Fig. 6, l) : More elongated with 5+5 process formula. Lateral spines shifted still more laterally.

Uropods (Fig. 6, l) : Increase in setation.

VII Zoea
(Fig. 7)

Total length : 3.0 to 3.5 mm. Duration : 2 days

Rostrum : Rostral formula $\frac{(3-4)}{0}$ Antennal spine more developed.

Antennule (Fig. 7, b) : Outer and inner rami flagellar; outer with 2 segments bearing 2 and 3 aesthetasc respectively; inner 3 segmented. Stylocerite pointed.

Antenna (Fig. 7, c) : Scale about 3 times as long as broad. 14-segmented endopod long and flagellar. Peduncle 2-segment with reduced serrated spine.

Mandible (Fig. 7, d), **First Maxilla** (Fig. 7, e) : No change.

Second Maxilla (Fig. 7, f) : More setose, scaphognathite now broad, proximal lobe well developed bearing 3 setae.

Maxilliped (Figs. 7, g, h & i) : No appreciable change.

Pereiopods (Figs. 7, j1 - j5) : First 2 pairs exhibit chelate nature clearly. Last three with no change. Exopod of 5th still as a small bud.

Pleopods (Figs. 7, k1, k2, k5) : Well developed with setae on endopod and exopods except that of endopod of the first pleopod. Appendix interna with two hooks.

Telson (Fig. 7, l) : Narrower than in previous stage.

Uropods (Fig. 7, l) : More setation.

Post - larva
(Figs. 8 & 9)

Total length : 3.2 to 3.8 mm.

Rostrum : Same as the previous stage. Carapace with well developed antennal and smaller pterygostomial spine.

Antennule (Fig. 8, b) : Peduncle with stylocerite sharp bearing 3 bristles on innerside

Fig. 8 : *Caridina gracilipes* (Postlarva)

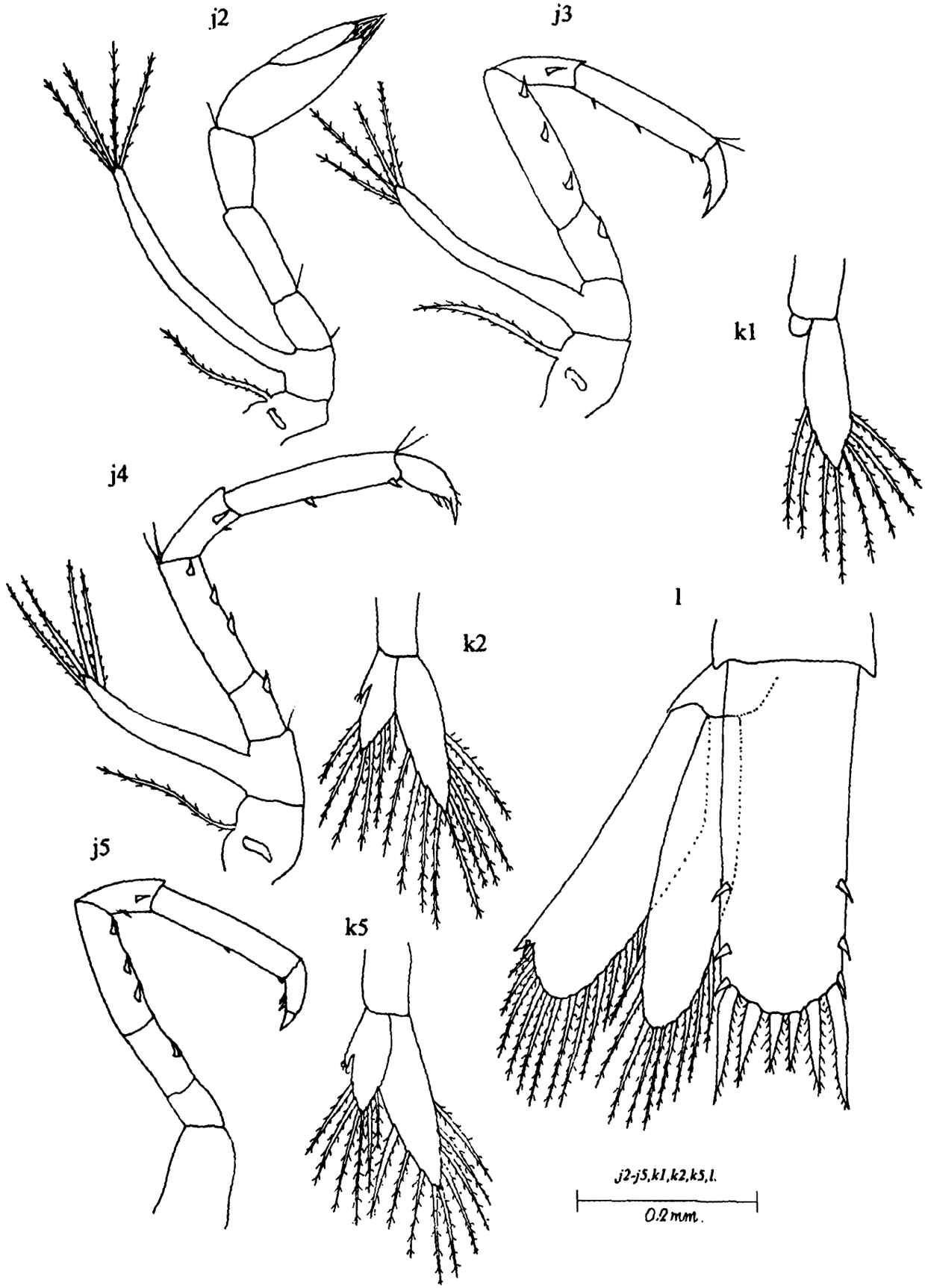

Fig. 9 : *Caridina gracilipes* (Postlarva)

and a row of five setae on outer margin. Ventral spine still serrated on inner margin. 1st and 2nd segment with 2 and 1 spines on anterolateral margin with usual circlet of setae. Inner flagellum now 5-segmented with 2 tires of setae and longer than the outer 4-segmented flagellum.

Antenna (Fig. 8, c) : Completely adult-like, serrated spines at the base of the flagellum absent. While outer spine of the peduncle well developed. Scale 3.3 times as long as broad. Flagellum long with 18 segments.

Mandible (Fig. 8, d) : Incisors on the right with 7 irregular and left with 4 subequal teeth and with serrated setae on cutting edges.

First Maxilla (Fig. 8, e) : Adult like but less setose.

Second Maxilla (Fig. 8, f) : Adult like but less setose.

Maxillipeds (Figs. 8, g, h & i) : Adult like but less setose 1st with basal part of exopod expanded and with about 10 setae on caridean lobe, 2nd with podobranch bud and 3rd with epipod.

Pereiopods (Fig. 8, j1 & Figs. 9, j2 - j5) : Adult like, except for presence of functional exopods except on 5th pereiopod where exopod totally lost. 1st and 2nd pair with characteristic brushes of hairs on chelae. Last 3 pairs with 1,1 and 2 spinules respectively on the posterior margin of dactylus. Which terminate into fairly long spine. Ischium and merus of last 3 pereiopods with 1 and 3 spines respectively.First to 4th pereiopods with epipods and 1 setobranch each.

Abdomen : With dorsal hump on 3rd segment.

Pleopods (Figs. 9, k1, k2, k5) : Setose functional, appendix interna with 3 hooks. Exopod of 1st pleopod likethat of adult much reduced and without setae.

Telson (Fig. 9, l) : Three pairs of dorsal spines. Process formula 3+3 outermost largest and plumose only on inner margin.

Uropods (Fig. 9, l) : Sub equal to telson, exopod with accessory sub apical spine indicating future diaeresis.

DESCRIPTION OF LARVAL STAGES

Caridina bengalensis de Man, 1908

(Figs. 10-18)

Berried female of *C.bengalensis* are found throughout the year, but available in plenty during the months of January to March and August to October. Eggs are yellowish in colour, smaller in size measuring 0.29 to 0.32x0.44 to 0.49 mm. Fecundity 115 to 260. The berried female from which the larvae were obtained was collected on 18.1.93. from

Sunnambukuam pond. The larvae hatched on 20.1.93. The process of hatching was over in 25 to 30 minutes. The development is prolonged with 7 zoeal + 1 postlarval stagees. The larval development was completed fully in freshwater. Temperature ranged from 24° to 27° C at the time of experiment, and the larvae took 14 to 15 days for completion of metamophosis.

I Zoea
(Fig. 10)

Total length : 1.5 to 1.6 mm. Duration : 2 days.

Rostrum (Fig. 10, a) : Short, smooth, bent downwards and not reaching beyond sessile eyes. Carapace smooth except for a sharp pterygostomial spine, antennal represented as an acute infraorbital angle.

Antennule (Fig. 10, b) : Peduncle narrow and unsegmented, inner flagellum represented by long plumose seta. Outer short flagellum short with 2 aesthetascs + 1 plain seta terminally and a single bristle-like seta subterminally.

Antenna (Fig. 10, c) : Peduncle short, unsegmented and bearing a sharp serrated spine about 1/2 th of endopod in length. Endopod unsegmented and reaches 2/3rd of scale and bears 1 long plumose + 1 small plain setae terminally. Scale 3.10 times as long as broad with 4 anterior segments and with 2 plumose setae on outer margin and 1 small plain + 9 long plumose setae on inner margin.

Mandible (Fig. 10, d) : Slightly asymmetrical. Incisors and molar processes clearly differentiated incisors of both with 3 teeth each.

First Maxilla (Fig. 10, e) : Coxal and basal entites with 5 big + 1 small and 3 big + 3 small setae respectively. Palp notched at tip terminally with 2 plumose setae and subterminally with a characteristic blunt seta with stiff hairs. Exopod with 2 well developed plumose setae.

Second Maxilla (Fig. 10, f) : Coxal and basal endites with 9+3 and 3+3 setae. Endopod distinctly over-reachin scaphognathite with 3,2,1,1 & 2 setae distalwards. Scaphognathite fringed with 6 plumose setae, proximal lobe yet to be formed.

First Maxilliped (Fig. 10, g) : Coxa with 4 long plumose setae. Basis broad with sinuous inner margin each margin each lobe carrying 2 or 3 setae. Endopod distinctly shorter than exopod, 4 segmented with 3,1, 1 & 3 setae distalwards. Exopod with 4 natatory setae.

Second Maxilliped (Fig. 10, h) : Coxa with a characteristic long seta. Basis with slightly sinuous inner margin bearing groups of 1,2 & 3 setae distalwards. The 4-segmented endopod bends inwards, setation distalward being 2,1,1 and 4 terminal + 1 outer setae. Exopod with 4 natatory setae.

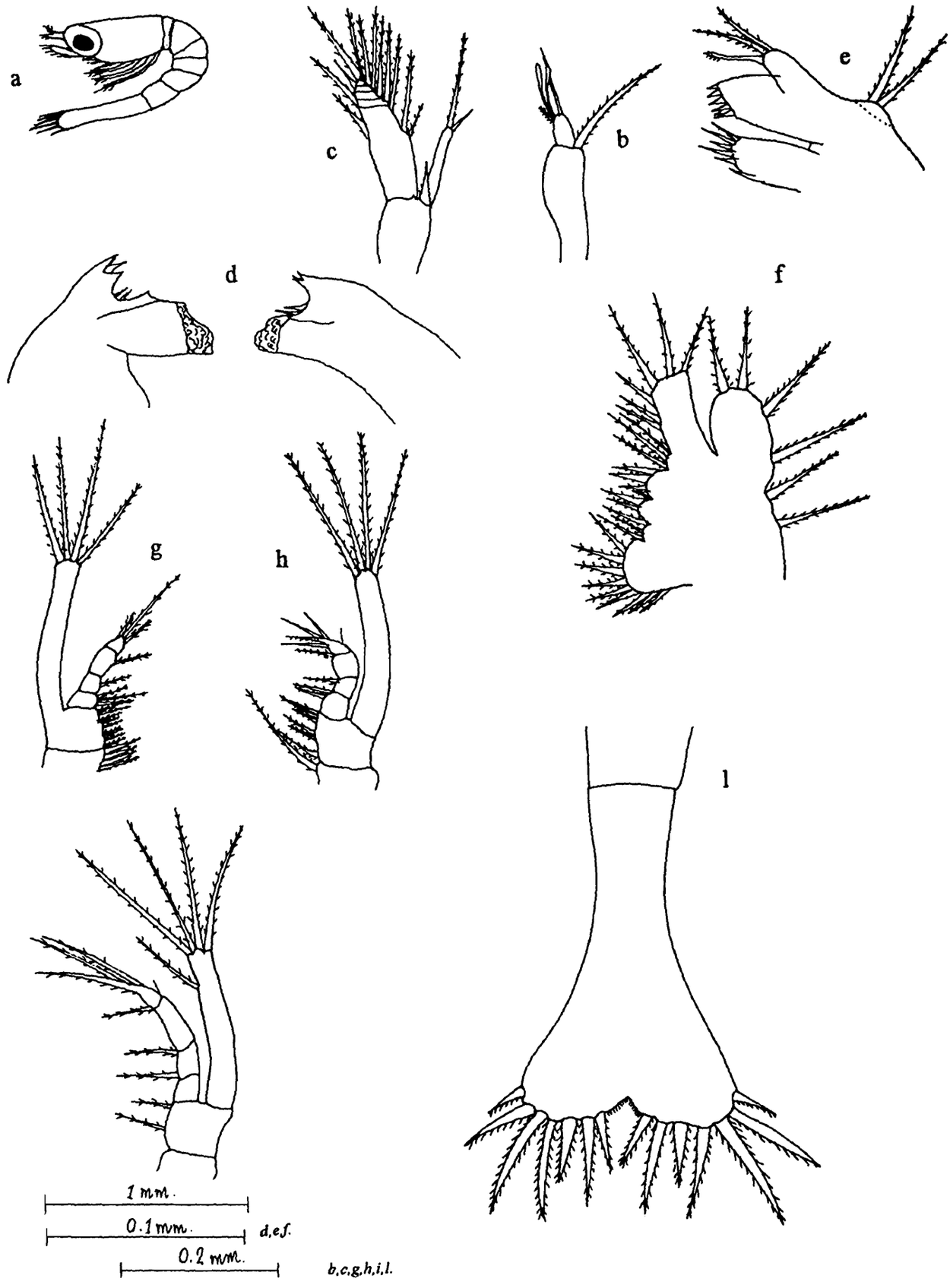

Fig. 10 : *Caridina bengalensis* (I Zoea)

Third Maxilliped (Fig. 10, i) : Basis small with 2 setae on inner margin. 4-segement endopod with 1, 1, 1 & 1 small outer + 3 long terminal setae. Exopod with 4+1 natatory setae.

Abdomen : 5 segmented, all segment smooth, 6th not seperated from telson.

Telson (Fig. 10, l) : Acutely triangular with a deep median notch, and with a typical process formula 7+7. All processes plumose, first 2 pairs on inner margin only. Median notch with 16 to 20 minute hairs.

II Zoea

(Fig. 11)

Total length : 1.60 to 1.75 mm. Duration : 2 days

Rostrum (Fig. 11, a) : Smooth, new extended fully and reaching upto tip of 1st segment of antennular peduncle. Antennal spine not yet fully formed. Eyes now stalked and free from carapace.

Antennule (Fig. 11, b) : Peduncle now 2 segmented, basal segment slightly broad in region of future stylocerite, 2nd segment with a faint demarcation in middle and bears 2 distal setae as in figure. Bristle-like subterminal setae of outer ramus lost.

Antenna (Fig. 11, c) : No change

Mandible (Fig. 11, d) : Now bigger in size. Incisors with 4 teeth. Cutting edge with spinuous setae.

First Maxilla and Second Maxilla (Figs. 11, e & f) : Palp with 3 plumose setae + 1 blunt seta with stiff hairs. Endopod of second maxilla overreaches the scaphognathite.

First Maxilliped (Fig. 11, g) : No change except for increase in number of setae of basis.

Second Maxilliped (Fig. 11, h) : Endopod 5-segmented with 3, 1, 0, 2, 1 outer + 4 terminal setae distalwards.

Third Maxilliped (Fig. 11, i) : Endopod now 5-segmented with setation distalward 2,1,0,2 & 1 outer + 3 terminal.

Pereiopods (Figs. 11, j1, j2, j3) : First pairs represented as long biramous buds, second small biramous buds while third pair still as uniramous buds.

Telson (Fig. 11, l) : Process formula now 8+8 with an additional median pair (8th) of small plumose setae, second process now plumose on both margins.

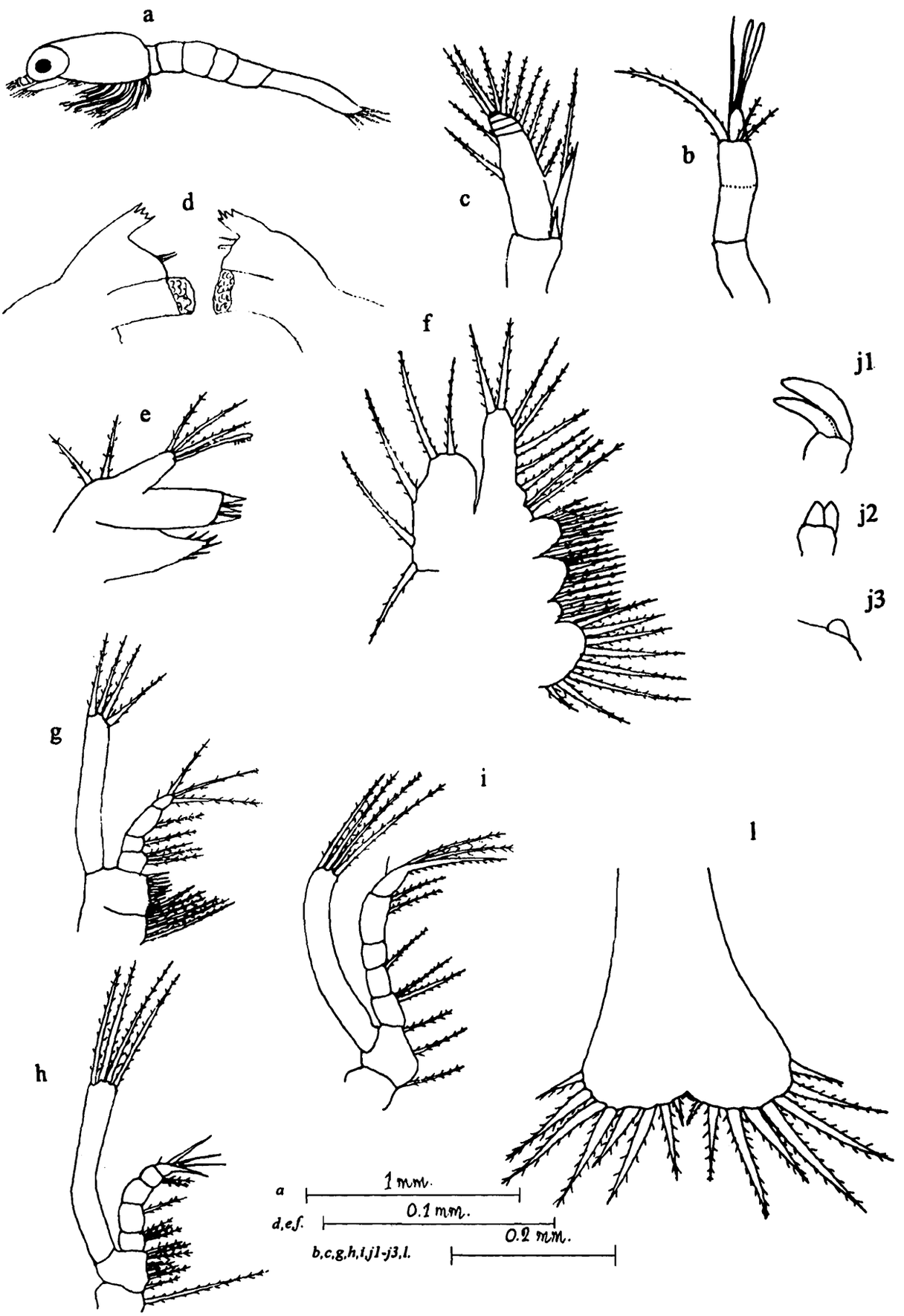

Fig. 11 : *Caridina bengalensis* (II Zoea)

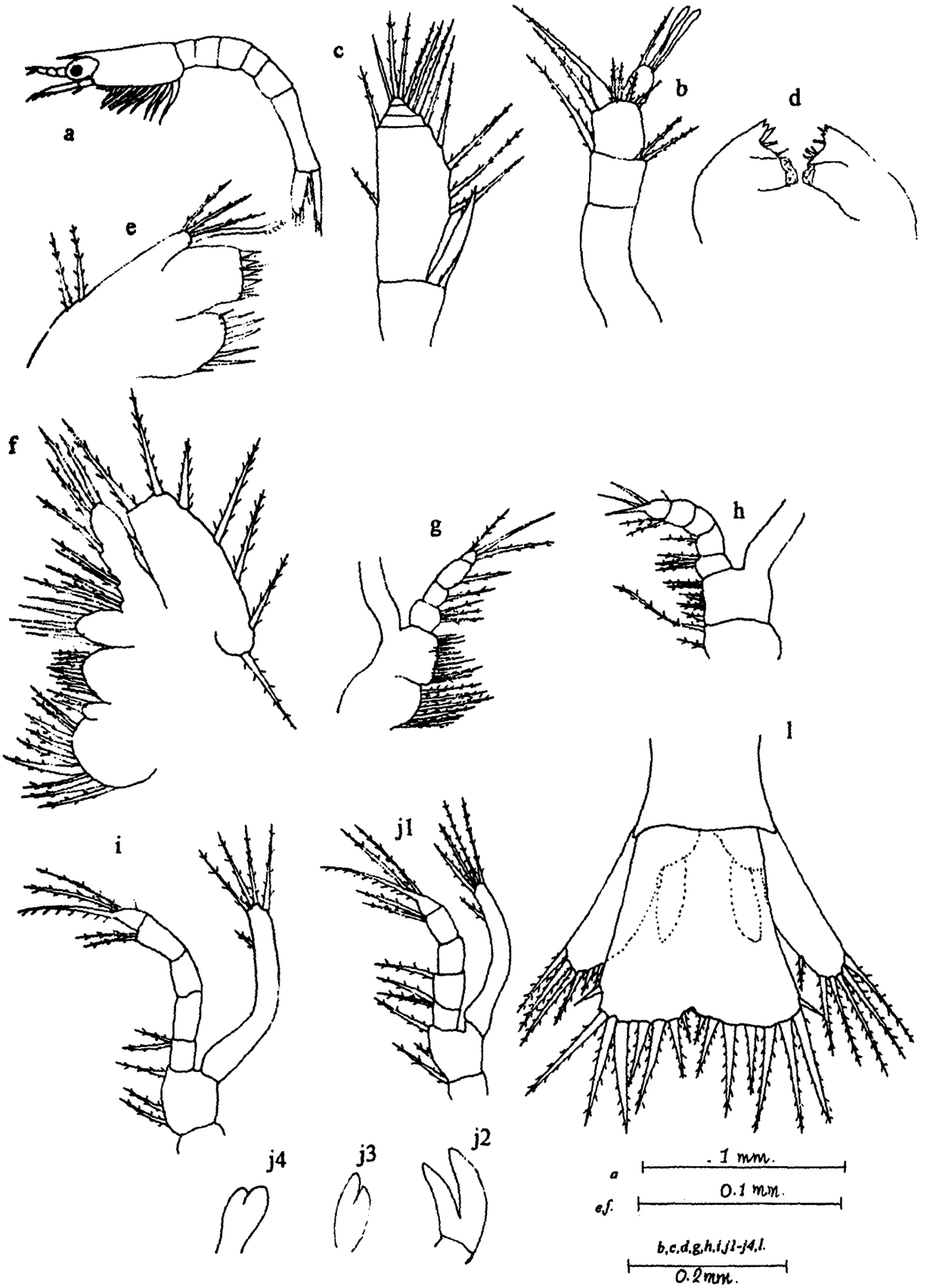

Fig. 12 : *Caridina bengalensis* (III Zoea)

III Zoea
(Fig. 12)

Total length : 1.80 to 1.90 mm. Duration : 2 days

Rostrum : No change in rostrum and carapace.

Antennule (Fig. 12, b) : Both ramus now clearly developed; inner terminating in a very sparsely plumose seta and outer bearing 2 aesthetascs and plain seta. Setation on peduncle as shown in figure.

Antenna (Fig. 12, c) : Scale now with only 3 distal segments. Endopod reduced in size and its terminal long seta reduced to a small denticle.

Mandible (Fig. 12, d) : No appreciable change except for increase in number of spines setae on cutting edge.

First Maxilla (Fig. 12, e) : Outer setae of exopod still present. Setae on endites increased in number and size.

Second Maxilla (Fig. 12, f) : Increase in number of setae on both nodites and scaphognathite.

Maxillipeds (Figs. 12, g, h, & i) : No change except for increase in number of basis setae of first and second maxillipeds.

Pereiopods (Figs. 12, j1 - j5) : Four pairs present in this stage. First pair functional with endopod 5-segmented exopod with 5 natatory setae. 2nd pair represented as elongated biramous buds, 3rd & 4th pairs still as small biramous buds.

Abdomen : Sixth segment now separated from telson and with a pair of small posterolateral spines.

Telson (Fig. 12, l) : Process formula still 8+8, but first process now transformed into a pair of lateral spines.

Uropods (Fig. 12, l) : Only exopod functional, with 6 plumose setae, while endopod still as narrow elongated bud.

IV Zoea
(Fig. 13)

Total length : 2.00 to 2.20 mm. Duration : 2 days.

Rostrum and Carapace : Still without any appreciable change.

Antennule (Fig. 13, b) : Basal segment bears a bristle-like seta at place of future stylocerite and an anteriorly directed ventral spine. The terminal seta of inner ramus now

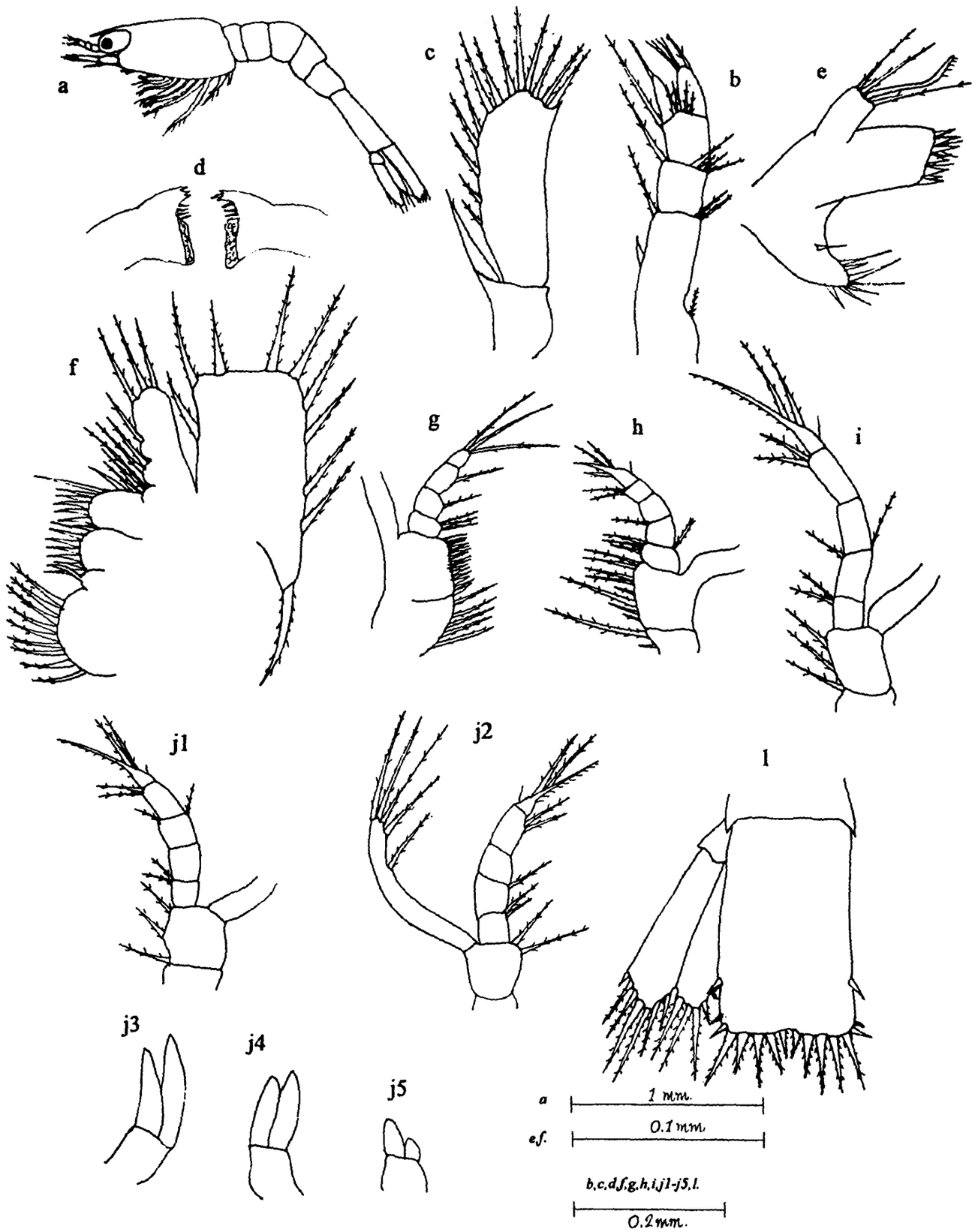

Fig. 13 : *Caridina bengalensis* (IV Zoea)

naked while aesthetascs of outer ramus now clearly demarcated into a basal stalk and distal end.

Antenna (Fig. 13, c) : Scale now devoid of any anterior segments, and with a terminal spine in place of small outer seta and fringed along its inner margin with 13 setae. Endopod tipped with a small denticle and a minute hair. Peduncle spine till with 4 well marked spinules on its inner margin.

Mandible (Fig. 13, d) : No appreciable change.

First Maxilla (Fig. 13, e) : Exopod and its setae completely lost, otherwise no change.

Second Maxilla (Fig. 13, f) : Increase in number of setae on endites scaphognathite now with a well developed proximal lobe bearing a stouter seta.

Maxillipeds (Figs. 13, g, h & i) : No change in first maxilliped while endopod segment of second maxilliped and second endopod segment of the third maxilliped now with an outer plumose seta.

Pereiopods (Figs. 13, j1 - j5) : Now all 5 pairs present. First 2 pairs functional with setation as in figure. Last 3 pairs present as biramous buds, decreasing in size posteriorwards.

Telson (Fig. 13, l) : Longer and narrower than in previous stage. First pair of spine-like processes of last stage now shifted more laterally as in figure, 2nd and 3rd processes now spine-like and more lateral in position. Process formula 5+5.

Uropods (Fig. 13, l) : Both rami now functional and setose; outermost seta of exopod now transformed into a spine.

V Zoea
(Fig. 14)

Total length : 2.30 to 2.63 mm. Duration : 2 days.

Rostrum (Fig. 14, a) : Reaching tip of 1st segment of antennular peduncle. Antennal spine now fairly well formed.

Antennule (Fig. 14, b) : Stylocerite more developed with 2 bristles on its inner margin. Ventral spine elongated and distinctly serrated, on its inner margin. Inner ramus unsegmented bearing 2 terminal setae;outer ramus 2-segment with 2 subterminal aesthetascs and a terminal seta.

Antenna (Fig. 14, c) : Endopod now a little elongated, 2 segmented with a small terminal naked seta. Peduncle spine reduced in size and with serration on lower 3/4 of inner margin.

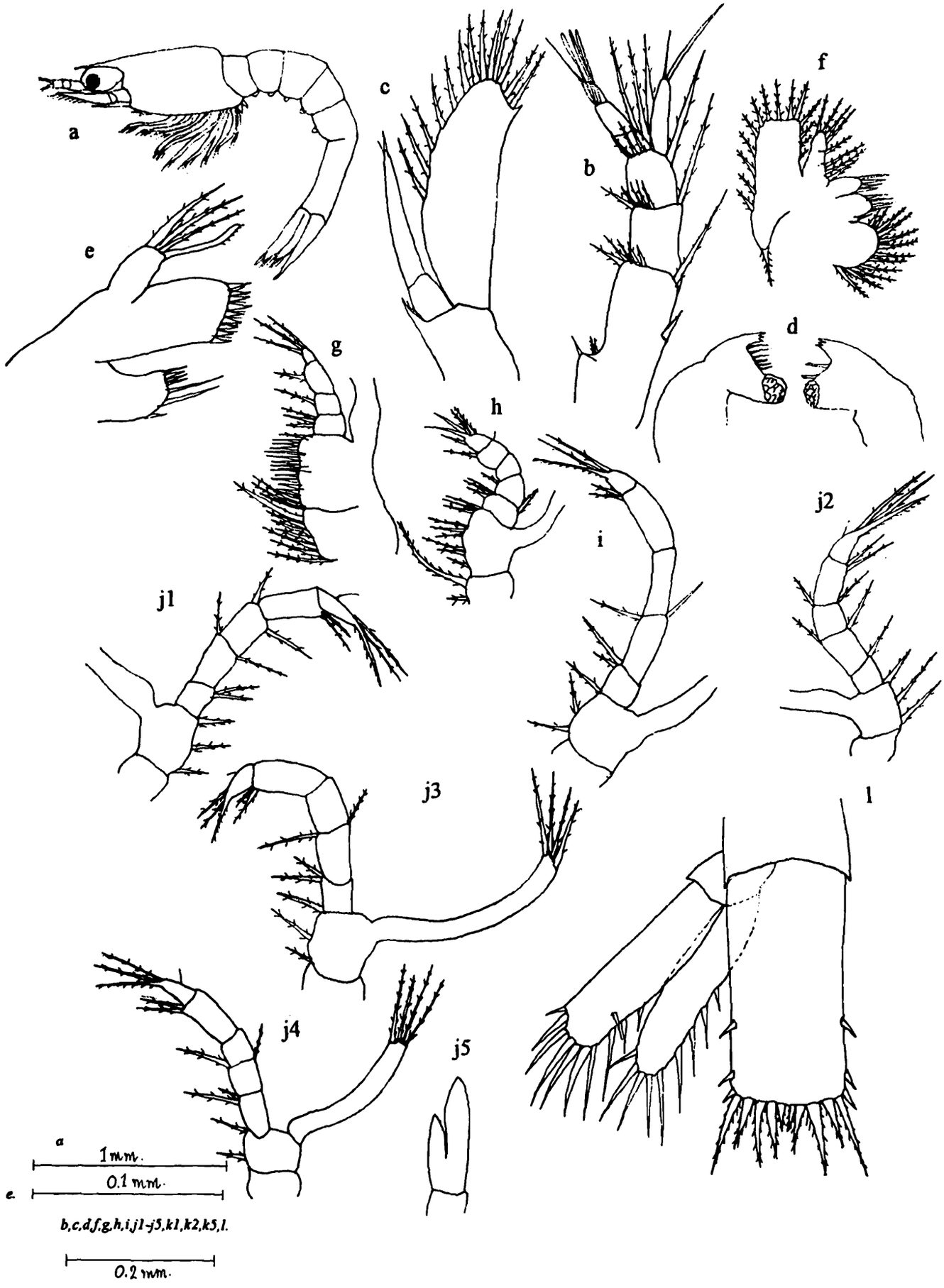

Fig. 14 : *Caridina bengalensis* (V Zoea)

Mandible (Fig. 14, d) : No change.

First & Second Maxillae (Figs. 14, e & f) : Number of spines and setae on endites and scaphognathite increased. Endopod of second maxilla reduced.

Maxillipeds (Figs. 14, g, h & i) : No noticeable change over that of previous stage.

Pereiopods (Figs. 14, j1 - j5) : First 4 pairs functional with setation as in the figure. 5th pair still as biramous bud.

Pleopods : In form of 5 pairs uniramous bud.

Telson (Fig. 14, l) : Rectangular in shape with posterior margin becoming still narrowed. First 2 pairs of spines shifted more laterally as in figure. Median notch completly lost, posterior margin now convex with process formula 5+5.

Uropods (Fig. 14, l) : No change except for increase in number of setae.

VI Zoea
(Fig. 15)

Total length : 2.60 to 2.70 mm. Duration : 2 days

Rostrum (Fig. 15, a) : Now serrated in many cases. Rostral formula $\frac{0\ 2}{0}$ Still smooth. Pterygostomial and antennal spines well formed and equal to ptergostomial spine size.

Antennule (Fig. 15, b) : Almost same as in previous stage except that even inner flagellum now 2 -segmented.

Antenna (Fig. 15, c) : Peduncle with a new small spine at base of the scale in addition to eaarlier serrated one at base of endopod. Endopod now flagellar, more than 1/2 of scale and 5-segmented, scale with about 17 setae.

Mandible (Fig. 15, d) : No appreciable change.

First & Second Maxilla (Figs.15, e & f) : More setose than in previous stage..

Maxillipeds (Figs. 15, g, h & i) : No change.

Pereiopods (Figs. 15, j1 - j5) : All 5 pairs well developed and functional; First 2 pairs showing traces of chelate nature. Exopod of first 4 pairs with 6, 6, 5 and 4 natatory setae respectively while that of fifth pair in form of small bud.

Pleopods (Figs. 15, k1 - k5) : Now biramous.

Telson (Fig. 15, l) : More elongated with a distinct convex posterior margin. Lateral spines shifted more upwards than in previous stage.

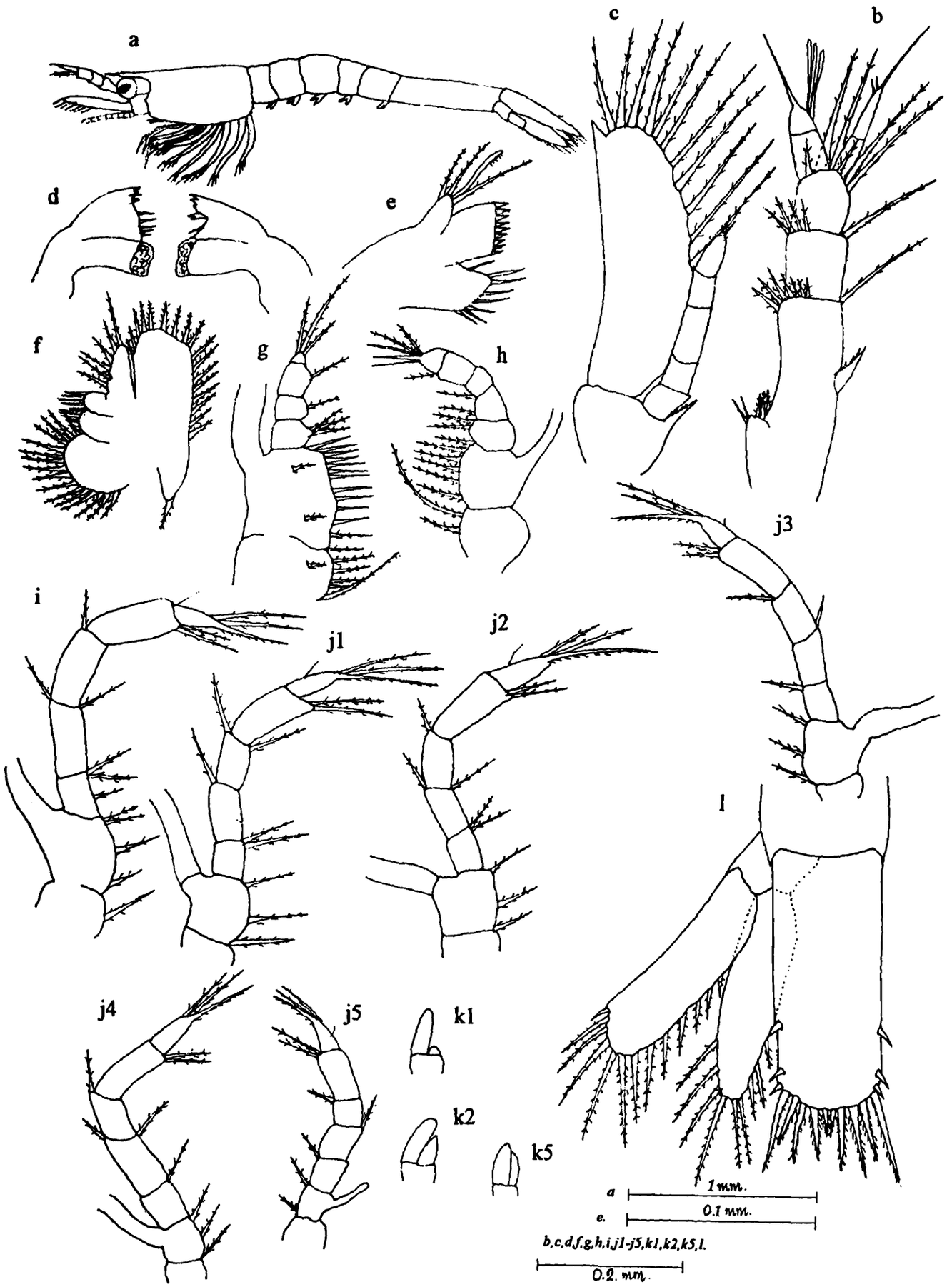

Fig. 15 : *Caridina bengalensis* (VI Zoea)

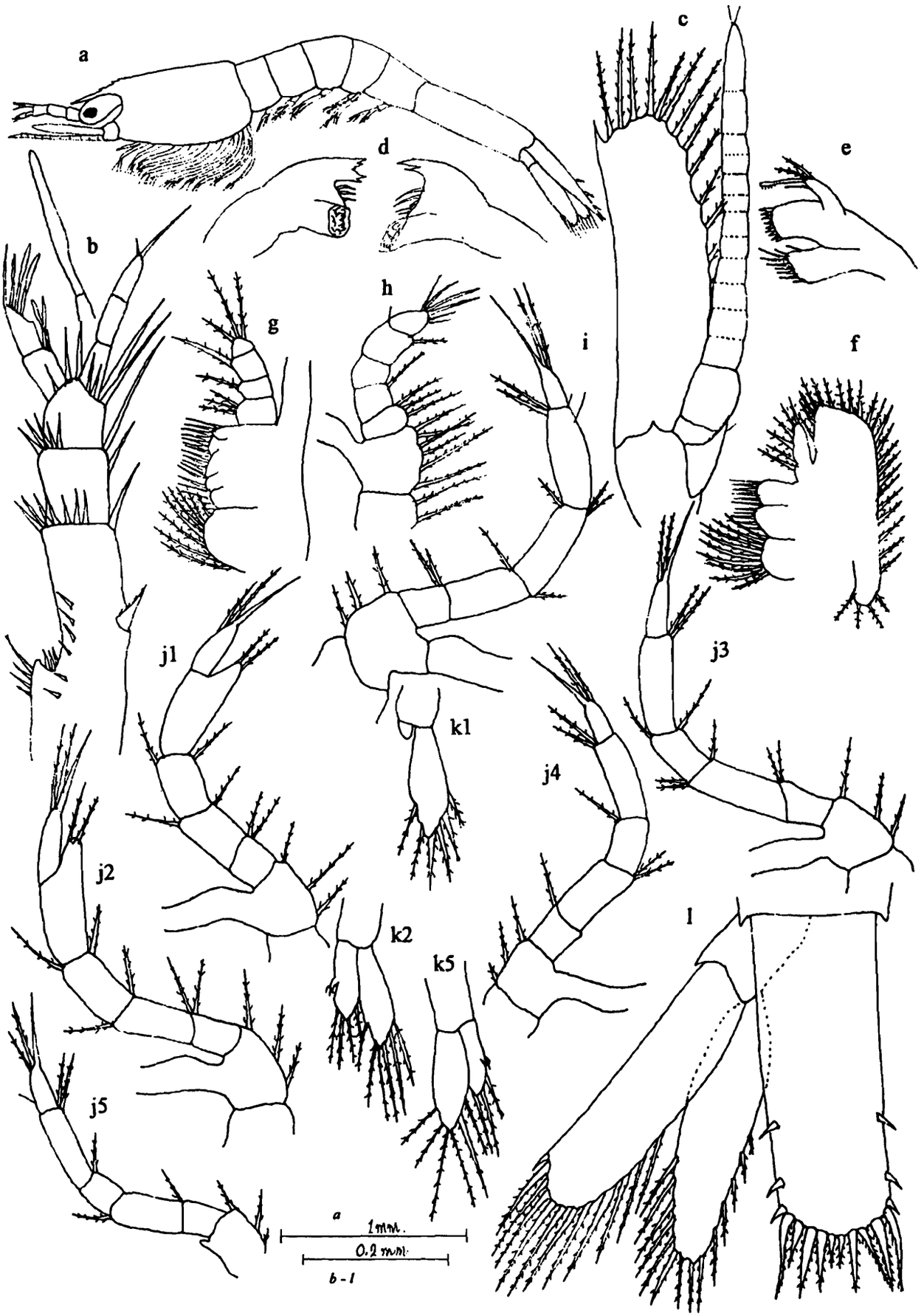

Fig. 16 : *Caridina bengalensis* (VII Zoea)

VII Zoea
(Fig. 16)

Total length : 2.95 to 3.40 mm. Duration : 2 days

Rostrum (Fig. 16, a) : Reaching up to tip of 1st segment of antennular peduncle Rostral formula $\frac{(3-4)}{0}$ carapace with small papilla behind first rostral tooth; antennal spine longer than pterygostomial.

Antennule (Fig. 16, b) : Both outer and inner rami flagellar. Outer with 2 segments bearing 2 and 3 aesthetasc respectively, inner longer and 3 segmented; Stylocerite more pointed.

Antenna (Fig. 16, c) : Scale about 3.55-times as long as broad. Endopod now elongated and flagellar, 14-segmented and slightly longer than scale. Peduncle 2 segmented, 2nd segment with a reduced serrated spine.

Mandible (Fig. 16, d) : No change.

First & Second Maxilla (Figs. 16, e & f) : More setose, scaphognathite broad; proximal lobe well developed bearing 4 setae.

Maxillipeds (Figs. 16, g, h & i) : No appreciable change over that of previous stage.

Pereiopods (Figs. 16, j1 - j5) : Chelate nature of first and second pairs clearly developed. Last three with no change. Exopod of the 5th still small bud. All pereiopods with pleurobranchs.

Pleopods (Figs. 16, k1, k2, k3) : Well developed and setose on endopods and exopods. (except endopods of 1st). Appendix interna with 3 hooks each.

Telson (Fig. 16, l) : Posterior margin narrower than base, lateral spines shifted a little dorsally.

Uropods (Fig. 16, l) : More setation.

Postlarva
(Figs. 17 & 18)

Total length : 3.20 to 3.65 mm.

Rostrum (Fig. 17, a) : Still reaching only upto tip of 1st segment of antennular peduncle. Rostral formula $\frac{(3-4)}{0}$ but no postorbitals. Carapace with a well developed antennal and a smaller pterygostomial spines.

Antennule (Fig.17, b) : Stylocerite sharp with 3-bristles like setae on inner side and a row of 5 or 6 setae on the outer margin. Anterolateral margins of 1st and 2nd segments with

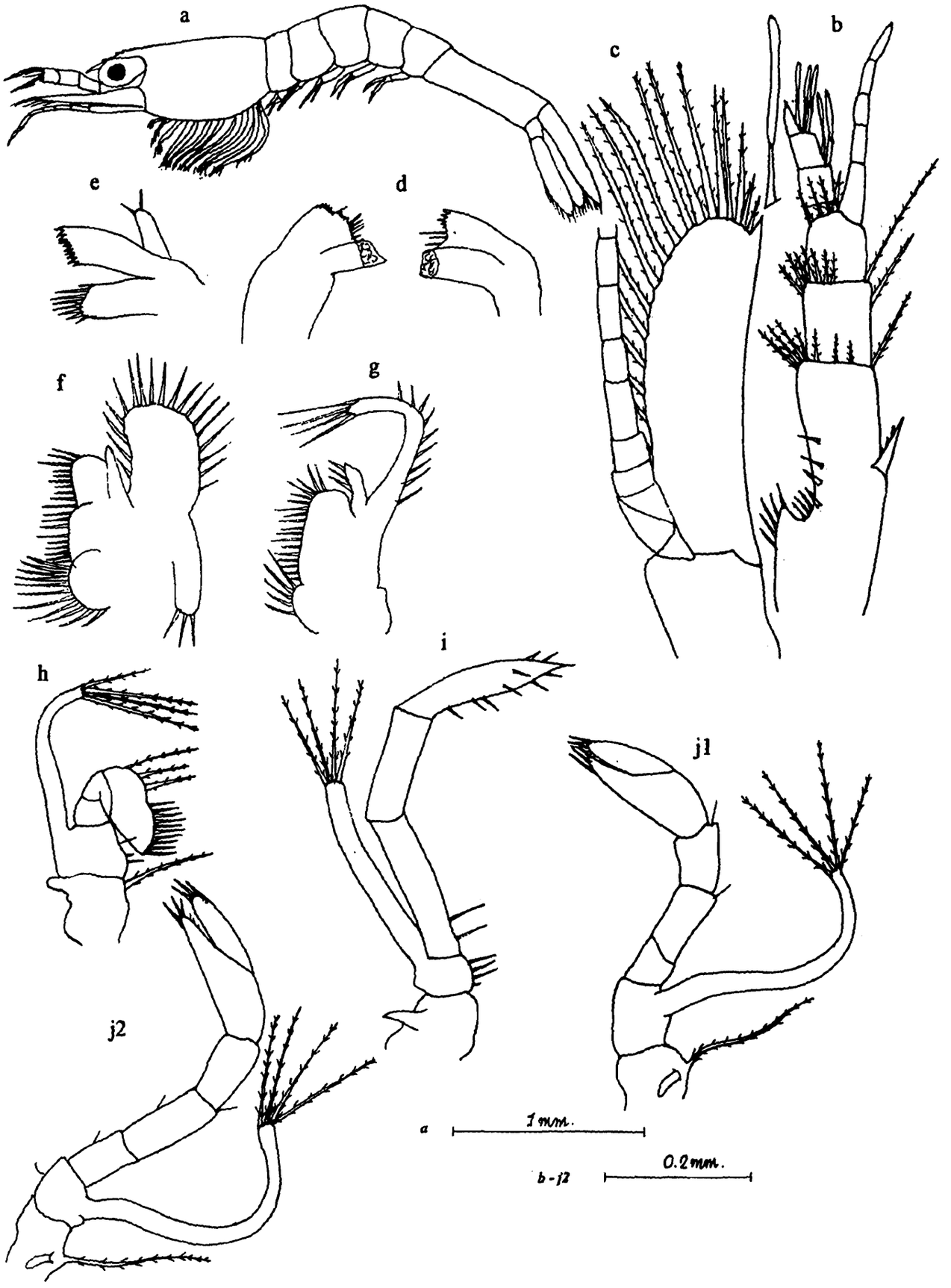

Fig. 17 : *Caridina bengalensis* (Postlarva)

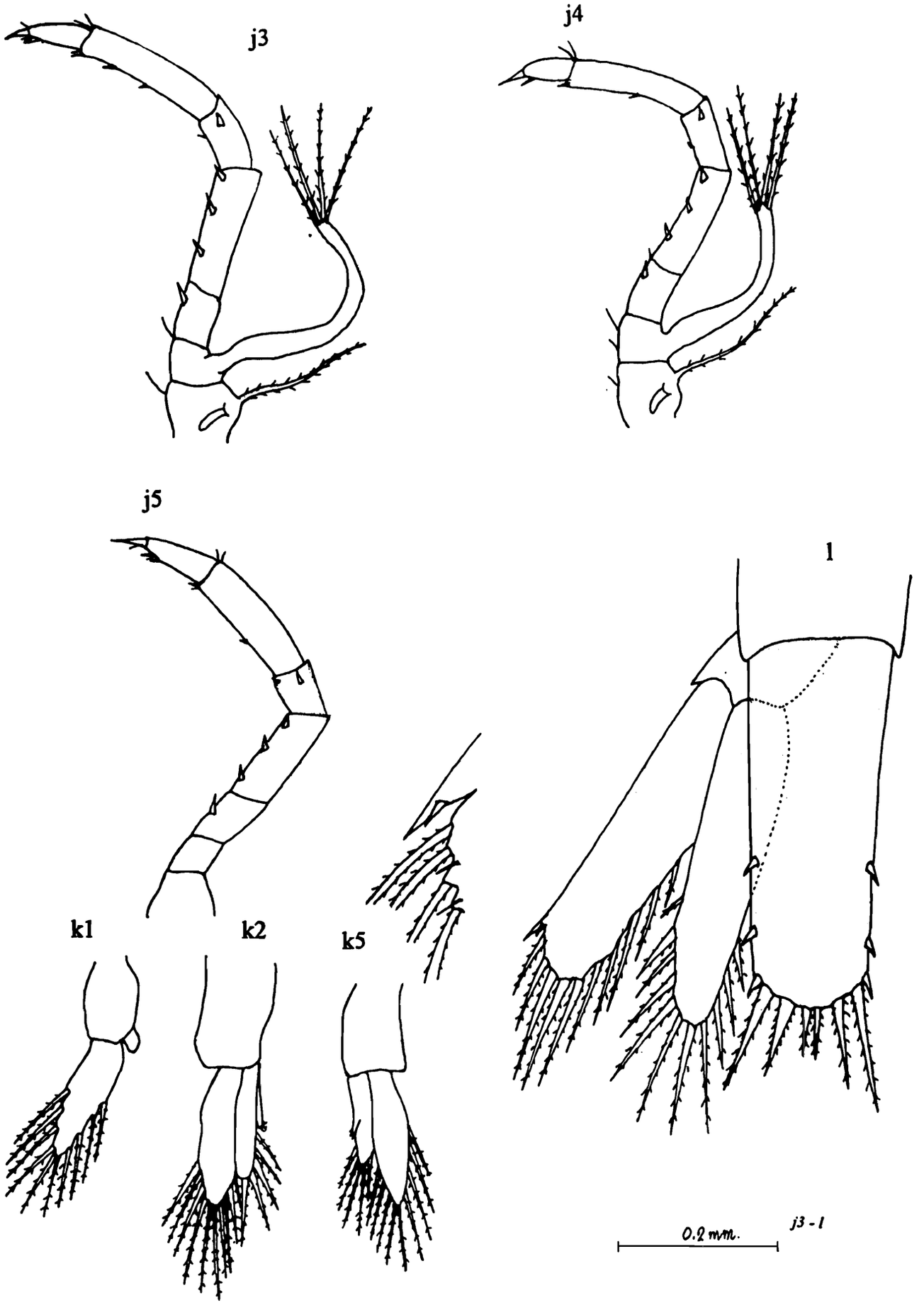

Fig. 18 : *Caridina bengalensis* (Postlarva)

circlet of setae as shown in figure. Inner flagellum longer than outer and 5 segmented; outer 4-segmented, 2nd and 3rd segments bearing 2 and 3 aesthetascs respectively.

Antenna (Fig. 17, c) : Now completly adult like, serrated spines at base of the flagellum lost. Outer spine of peduncle well developed. Scale 3.45-times as long as broad.Terminal of scale i.e. outer spine over reaching lamella. Flagellum fairly long.

Mandible (Fig. 17, d) : Incisors on right with 6 irregular and left with 5 subequal teeth as in adult but still with serrated setae on cutting edges instead of fine hairs.

First & Second Maxillae (Figs. 17, e & f) : Adult like but less setose.

Maxillipeds (Figs. 17, g, h & i) : Adult like, less setose, 1st maxilliped with basal part of exopod expanded bearing 9 setae, 2nd with podobranch bud and 3rd with epipod.

Pereiopods (Figs. 17, j1, j2 & Figs. 18, j3, j4, j5) : Adult like, except for presence of functional exopods (except on the 5th pereiopod). 1st and 2nd pairs with characteristic brushes of hairs on chelae. Last 3 pairs with 1, 1 and 2 spinules respectively on posterior margin of dactylus. Dactylus terminate fairly long spine. Ischium and merus of the last 3 pereiopods with 1 and 3 spine respectively 1st to 4th pereiopods with epipods and setobranchs (1 each).

Abdomen : With a characteristic dorsal hump on the 3rd segment.

Pleopods (Figs. 18, k1, k2, k5) : Now fully setose and functional; appendix interna on last 4 pairs well developed with 3 hooks. Endopod of 1st pleopod much reduced and still without setae.

Telson (Fig. 18, l) : Posterior margin distinctly narrower than base. Three pairs of marginal spines of which anterior 2 pairs submarginal as in figure. Process formula 3 + 3 outermost largest.

Uropods (Fig. 18, l) : Almost equal to telson. Exopod with an accessory spine inside the subapical spine indicating future diaeresis. A few marginal hairs present both on exopod and endopod.

Description of Larval stages

Caridina williamsoni Jalihal *et al.*,1984
(Figs. 19-26)

Berried female of *C. williamsoni* was collected from the Thenneri lake. Eggs small, greenish brown in colour, measuring 0.30 to 0.48x0.50 to 0.65 mm. Fecundity 185 to 320. The berried female of this experiment was collected on 22.11.94. Larvae hatched on

24.11.94 at 6 am and continued till 6.45 am. The development is prolongd with 6 zoeal + 1 postlarval stages. Temperature ranged from 23° to 27°C at the time of experiment, and the larvae took 12 to 14 days for completion of development.

I Zoea
(Fig. 19)

Total length : 1.50 to 1.60 mm. Duration : 2 days

Rostrum (Fig. 19, a) : Shorter than sessile eyes. A sharp pterygostomial spine on carapace.

Antennule (Fig. 19, b) : Peduncle unsegmented, inner flagellum represented by long plumose seta. Outer short flagellum short with 2 aesthetascs + 1 plain and a bristle-like setae.

Antenna (Fig. 19, c) : Peduncle unsegmented with short serrated spine. Endopod with 1 plumose + 1 small plain setae, terminally. It is less than 2/3rd of scale. Scale 2.9 times as long as broad with 4 anterior segments. Inner margin with 8 long plumose + 1 plain and 3 plumose setae on outer margin.

Mandible (Fig. 19, d) : Slightly asymmetrical. Incisors and molar processes clearly differentiated.

First Maxilla (Fig. 19, e) : Coxal and basal entites with 6 plain setae each. Palp bears 3 plumose and one blunt setae. Exopod bears 3 plumose setae.

Second Maxilla (Fig. 19, f) : Coxal and basal endites with 6+3 and 3+4 setae respectively. Endopod overreaching scaphognathite with 2,3,1,1 & 2 setae distalwards. Scaphognathite with 5 plumose setae, proximal lobe yet to be formed.

First Maxilliped (Fig. 19, g) : Coxa with 3 plumose setae. Basis broad at its sinuous inner margin bears 6 plumose setae. Four segmented endopod with 3,1,1,&3 terminal setae distalwards. Exopod distinctly longer than endopod with 4 natatory setae.

Second Maxilliped (Fig. 19, h) : Coxa with a characteristic long plumose seta. Basis at its slightly sinuous inner margin bears 1,3 & 3 setae distalwards. Four segmented endopod bends inwards, with 2,1,1 and 3 terminal setae. Exopod long with 4 natatory setae.

Third Maxilliped (Fig. 19, i) : Basis with 3 plumose setae. Endopod 4-segmented with 1,1,2 & 3 long terminal setae. Exopod shorter than endopod with 4 natatory setae.

Abdomen : Five segmented, all segment smooth, 6th not seperated from telson.

Telson (Fig. 19, l) : Triangular with median notch, process formula 7+7. All processes plumose, first pair on inner margin only. Median notch with 13 to 15 minute hairs.

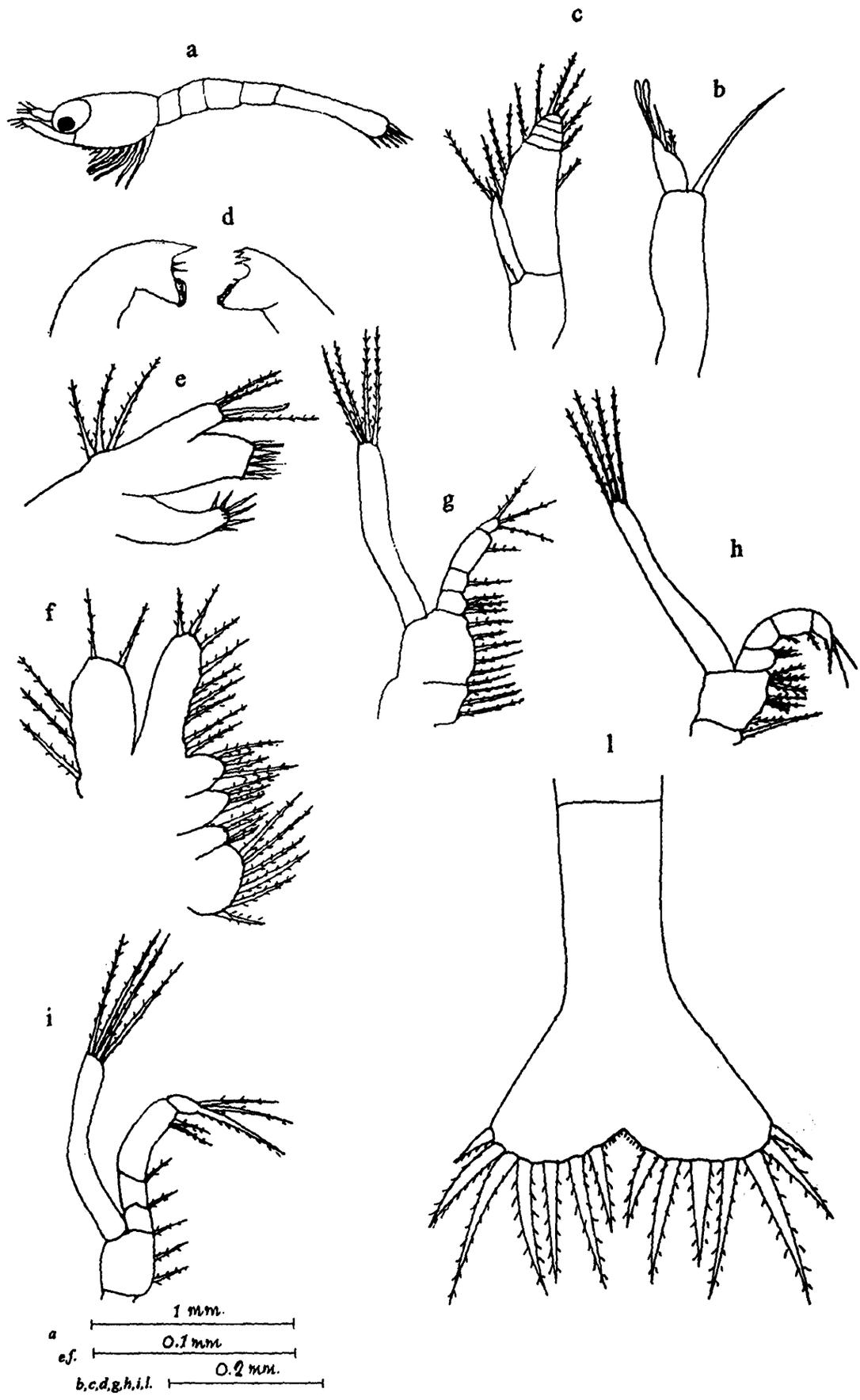

Fig. 19 : *Caridina williamsoni* (I Zoea)

II Zoea
(Fig. 20)

Total length : 1.75 to 1.90 mm. Duration : 2 days

Rostrum (Fig. 20, a) : Smooth reaches 2nd segment of antennular peduncle. Eyes stalked and free from carapace.

Antennule (Fig. 20, b) : Peduncle 2-segmented; 2nd segment with 1 distal setae.

Antenna (Fig. 20, c) : Scale symmetrical.

Mandible (Fig. 20, d) : Incisors of both sides with 5 teeth each. Cutting edges with spinuous setae.

First Maxilla (Fig. 20, e) : No change.

Second Maxilla (Fig. 20, f) : Endopod equals scaphognathite.

First Maxilliped (Fig. 20, g) : Increase in number of setae of basis.

Second Maxilliped (Fig. 20, h) : Endopod 5-segment with 3,1,0,2 and 1 outer + 4 terminal setae distalwards.

Third Maxilliped (Fig. 20, i) : Endopod 5-segmented with setation 2,1,0,2 & 1 outer + 3 terminal.

Pereiopods (Figs. 20, j1, j2,) : First 2 pairs as biramous buds.

Telson (Fig. 20, l) : Process formula now 8+8 with an additional median pair (8th) of small plumose setae. Minute hairs on median notch.

III Zoea
(Fig. 21)

Total length : 1.90 to 2.15 mm. Duration : 2 days

Rostrum : No change in rostrum and carapace.

Antennule (Fig. 21, b) : Peduncle 3 segmented. Two rami now clearly developed; outer with a sparsely plumose seta. 2nd segment with 3 plumose setae.

Antenna (Fig. 21, c) : Endopod much reduced in size. Scale with 3 segments and the terminal seta reduced.

Mandible (Fig. 21, d) : Setation increased on cutting edges.

First Maxilla (Fig. 21, e) : Exopod lost totally outer setae.

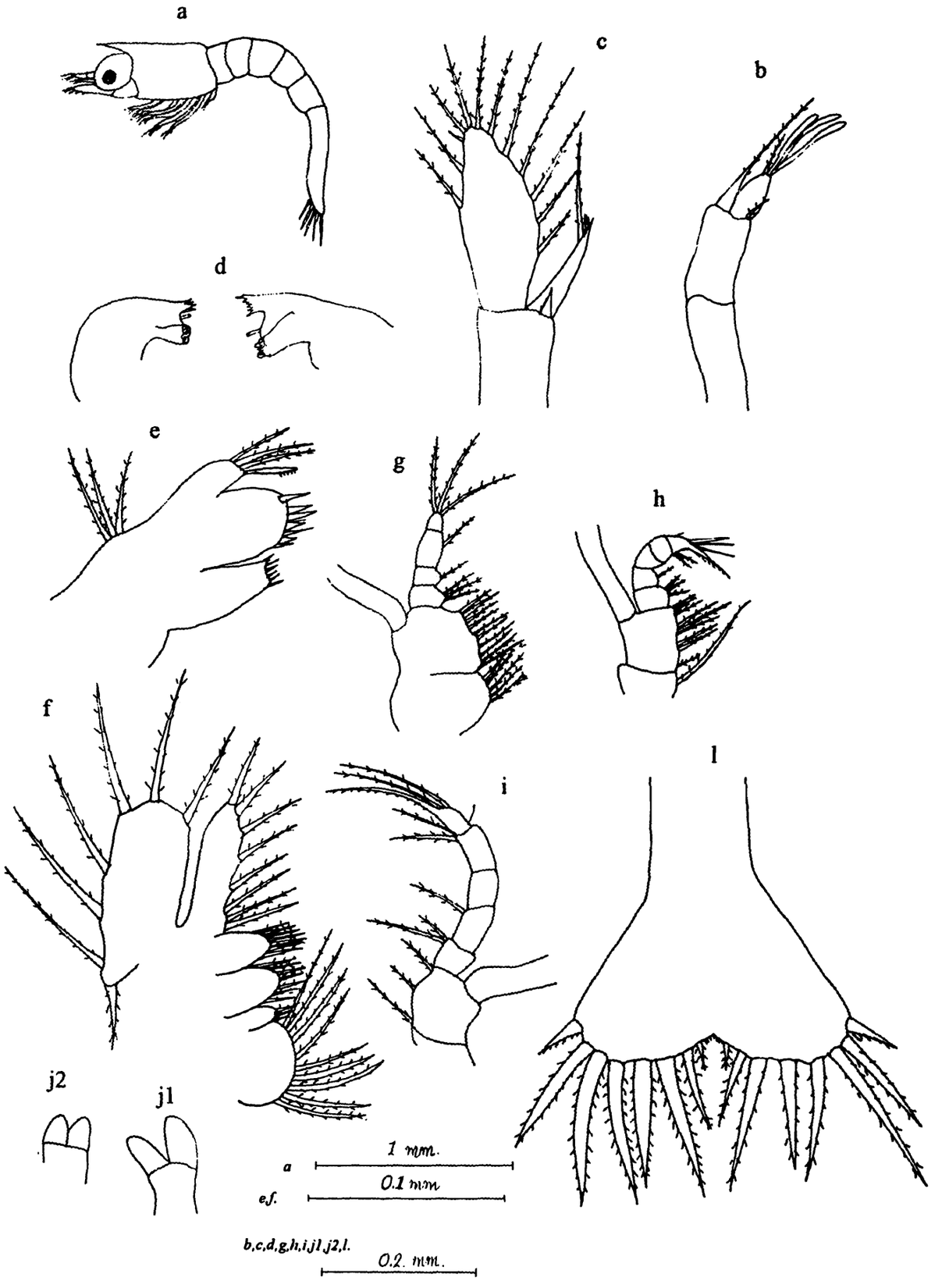

Fig. 20 : *Caridina williamsoni* (II Zoea)

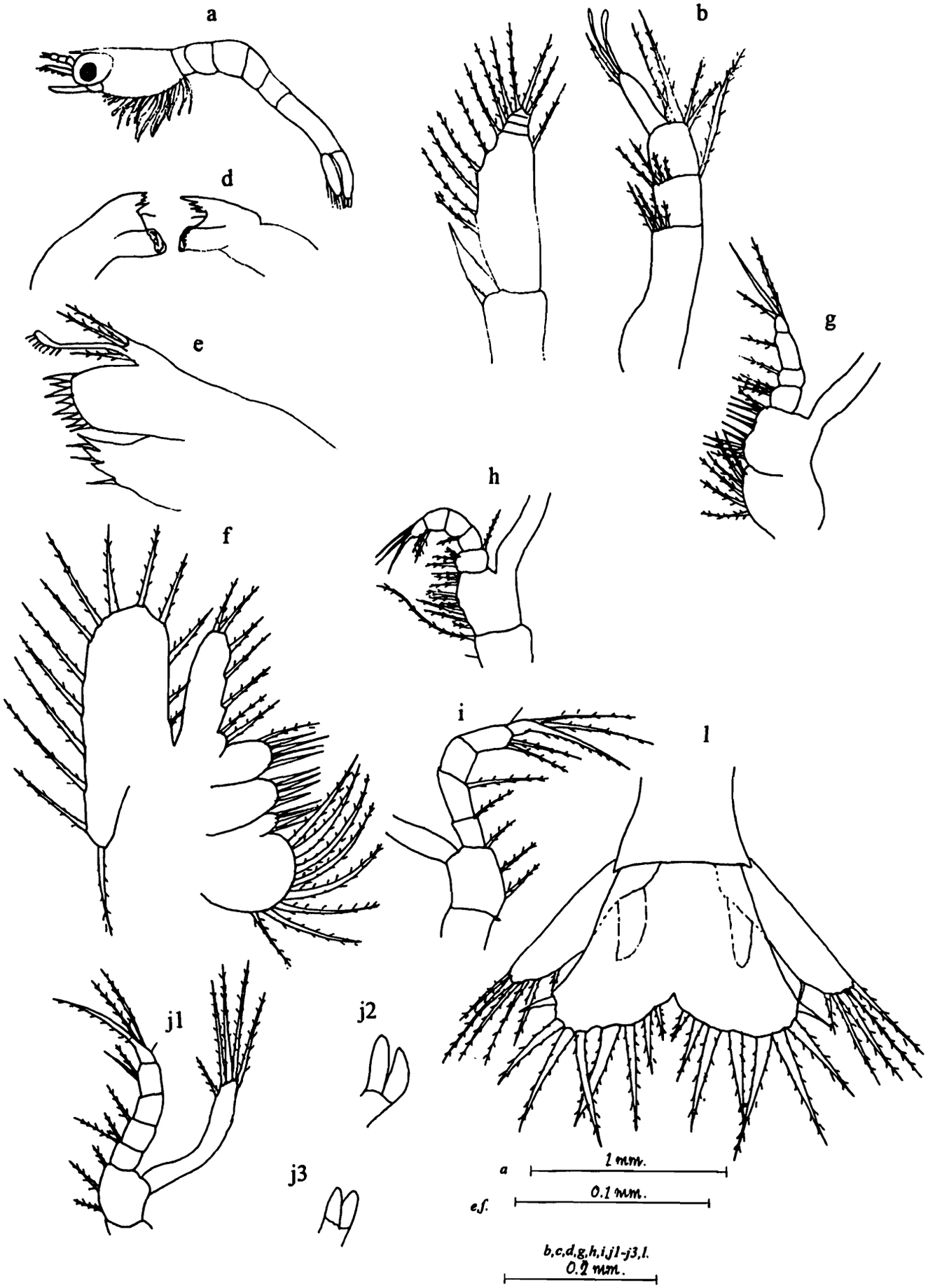

Fig. 21 : *Caridina williamsoni* (III Zoea)

Second Maxilla (Fig. 21, f) : Further incresed in setation.

Maxillipeds (Figs. 21, g, h, & i) : No change other than increase of setation on basis of first and second maxillipeds.

Pereiopods (Figs. 21, j1- j3) : Three pairs ,first pair functional with 5-segmented, endopod and exopod with 5 natatory setae. 2nd pair represented as elongated biramous buds, 3rd pair as small biramous buds

Abdomen : Sixth segment separated from telson with a pair of small posterolateral spines.

Telson (Fig. 21, l) : Process formula still 8+8, but first processes now transformed into a pair of lateral spines.

Uropods (Fig. 21, l) : Only exopod functional, with 6 plumose setae,while endopod still as a bud.

IV Zoea
(Fig. 22)

Total length : 2.25 to 2.35 mm. Duration : 2 days.

Rostrum and Carapace : No change.

Antennule (Fig. 22, b) : Basal segment bears a bristle-like seta at future stylocerite location and a ventral spine. Terminal seta of inner ramus now naked. Outer ramus with 3 aesthetascs.

Antenna (Fig. 22, c) : Scale without anterior segmentation, terminally bearing a small spine on outer margin and fringed along the inner margin with 15 setae. Endopod tipped with 1 or 2 minute hair.

Mandible (Fig. 22, d) : No appreciable change.

First Maxilla (Fig. 22, e) : No change.

Second Maxilla (Fig. 22, f) : Scaphognathite with well developed proximal lobe. Setation increased on endites.

Maxillipeds (Figs. 22, g, h & i) : Outer plumose seta continued on 1 st endopod segment of second maxilliped..

Pereiopods (Figs. 22, j1 - j5) : All 5 pairs present. First 2 pairs functional, last 3 pairs present as biramous buds.

Telson (Fig. 22, l) : Longer, narrower and gradually broadening posteriorly. First pair of spines now shifted more laterally, 2nd and 3rd processes spine-like and more lateral in position. Process formula 5+5.

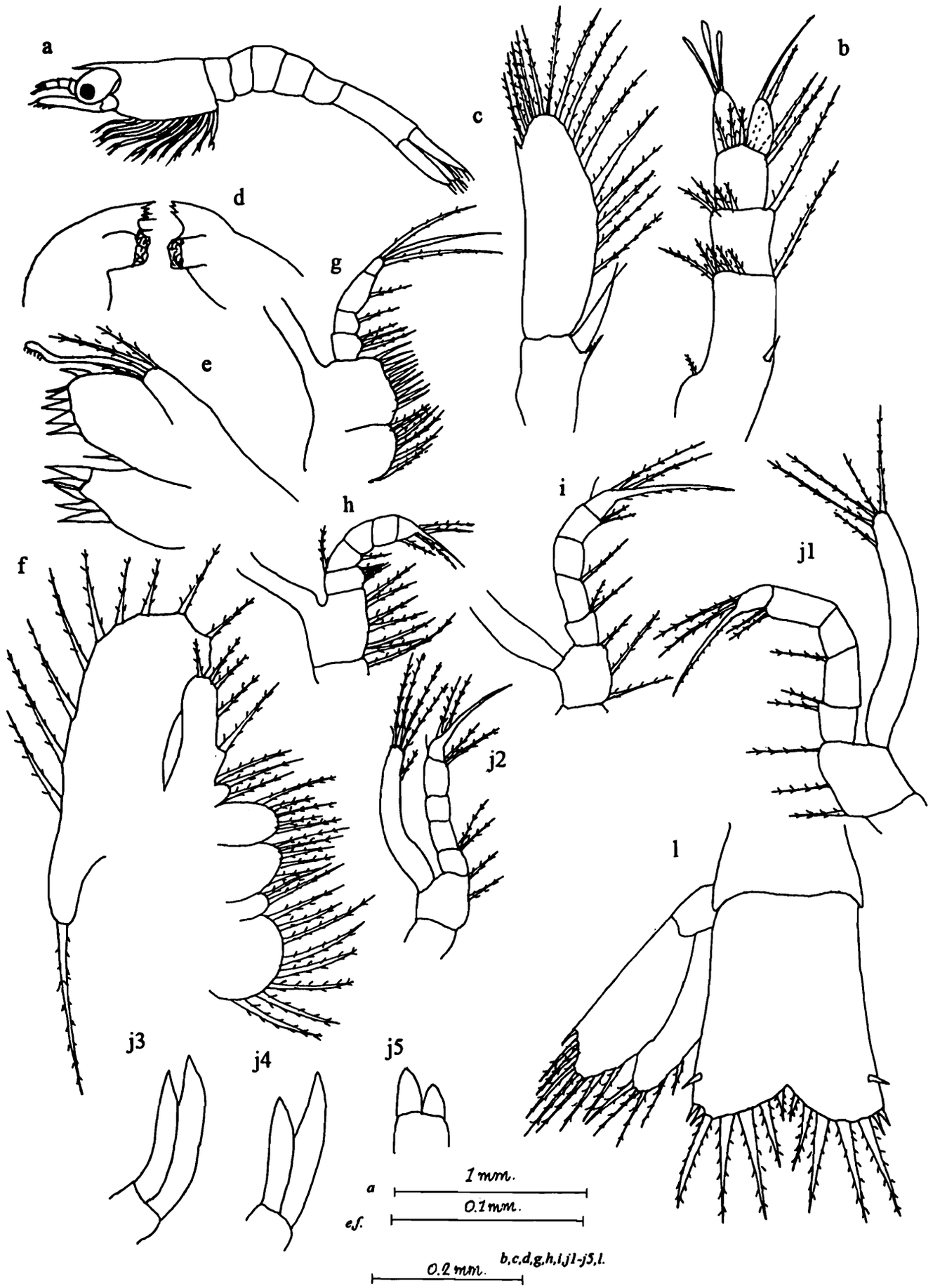

Fig. 22 : *Caridina williamsoni* (IV Zoea)

Uropods (Fig. 22, l) : Both rami now functional and setose. Outermost seta of exopod now transformed into a spine.

V Zoea
(Fig. 23)

Total length : 2.40 to 2.55 mm. Duration : 2 days.

Antennule (Fig. 23, b) : Stylocerite now with 2 bristles on its inner margin, ventral spine elongated. Inner ramus unsegmented bearing 1 terminal seta. Outer ramus 2-segmented with 3 aesthetascs.

Antenna (Fig. 23, c) : Endopod elongated and 2-segmented with a terminal naked seta. Peduncle spine reduced.

Mandible (Fig. 23, d) : No change.

First & Second Maxillae (Figs. 23, e & f) : Setations increased on first maxilla. Endopod of second maxilla reduced.

Maxillipeds (Figs. 23, g, h & i) : No noticeable change.

Pereiopods (Figs. 23, j1 - j5) : First 3 pairs functional. 4th and 5th pairs still biramous bud.

Pleopods (Figs. 23, k1, k2 & k5) : Five pairs as biramous buds.

Telson (Fig. 23, l) : Rectangular, with 3 pairs of more laterally shifted spines. Median notch completly lost. Process formula 5+5.

Uropods (Fig. 23, l) : Increase in setation.

VI Zoea
(Fig. 24)

Total length : 2.65 to 3.00 mm. Duration : 2 days

Rostrum (Fig. 24, a) : Now serrated. Rostral formula $\frac{3\ \ 5}{0}$

Antennule (Fig. 24, b) : Outer and inner rami flagellar, outer bearing 2 and 3 aesthetasc respectively. Inner ramus 3 segmented. Stylocerite pointed.

Antenna (Fig. 24, c) : Scale about 3.1-times as long as broad with about 17 setae. Segmented endopod long and flagellar. Peduncle with reduced serrated spine.

Mandible (Fig. 24, d) : No appreciable change.

First & Second Maxilla (Figs. 24, e & f) : No change in first maxilla, 2nd maxilla more setose, broader, proximal lobe well developed.

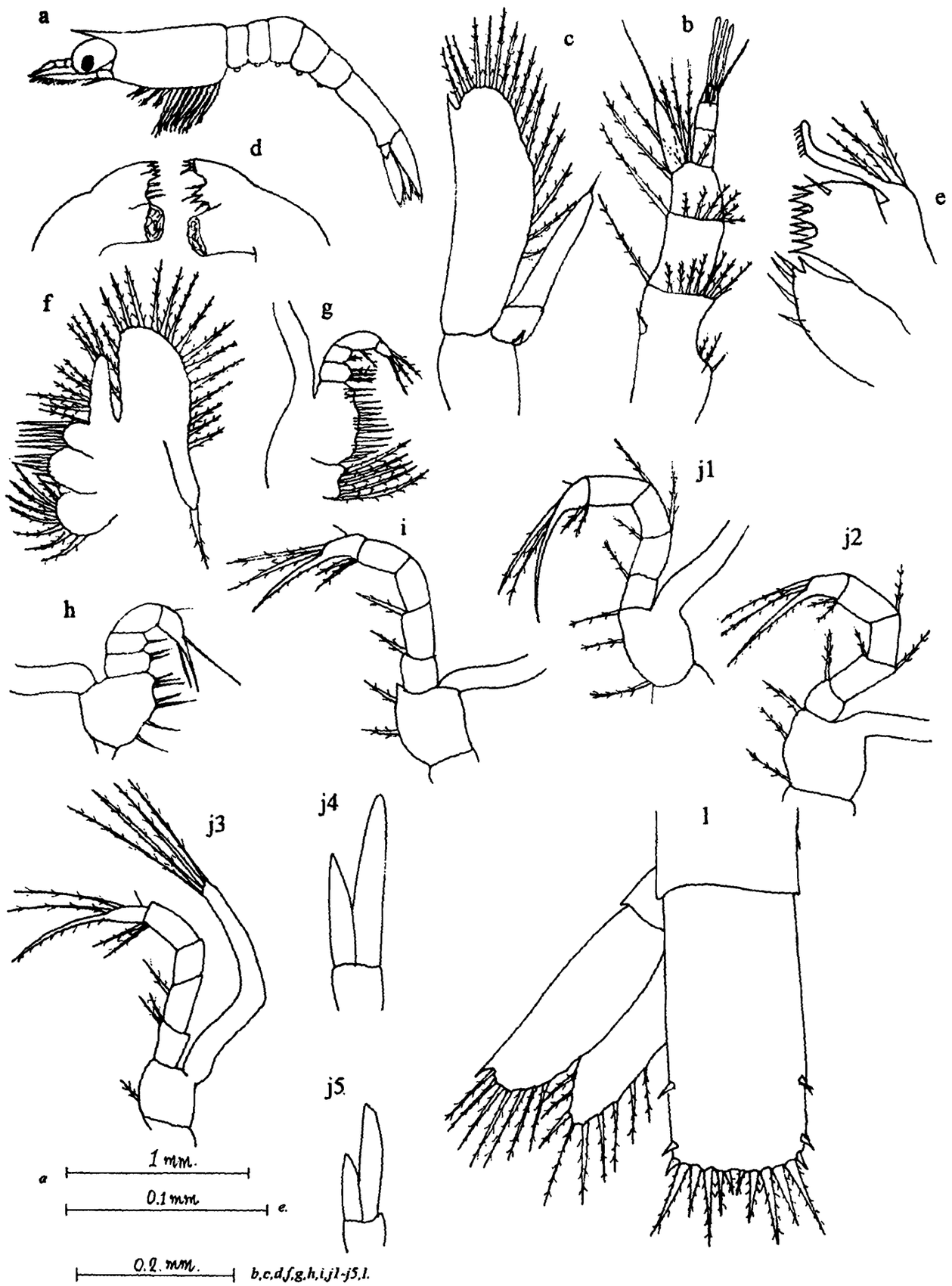

Fig. 23 : *Caridina williamsoni* (V Zoea)

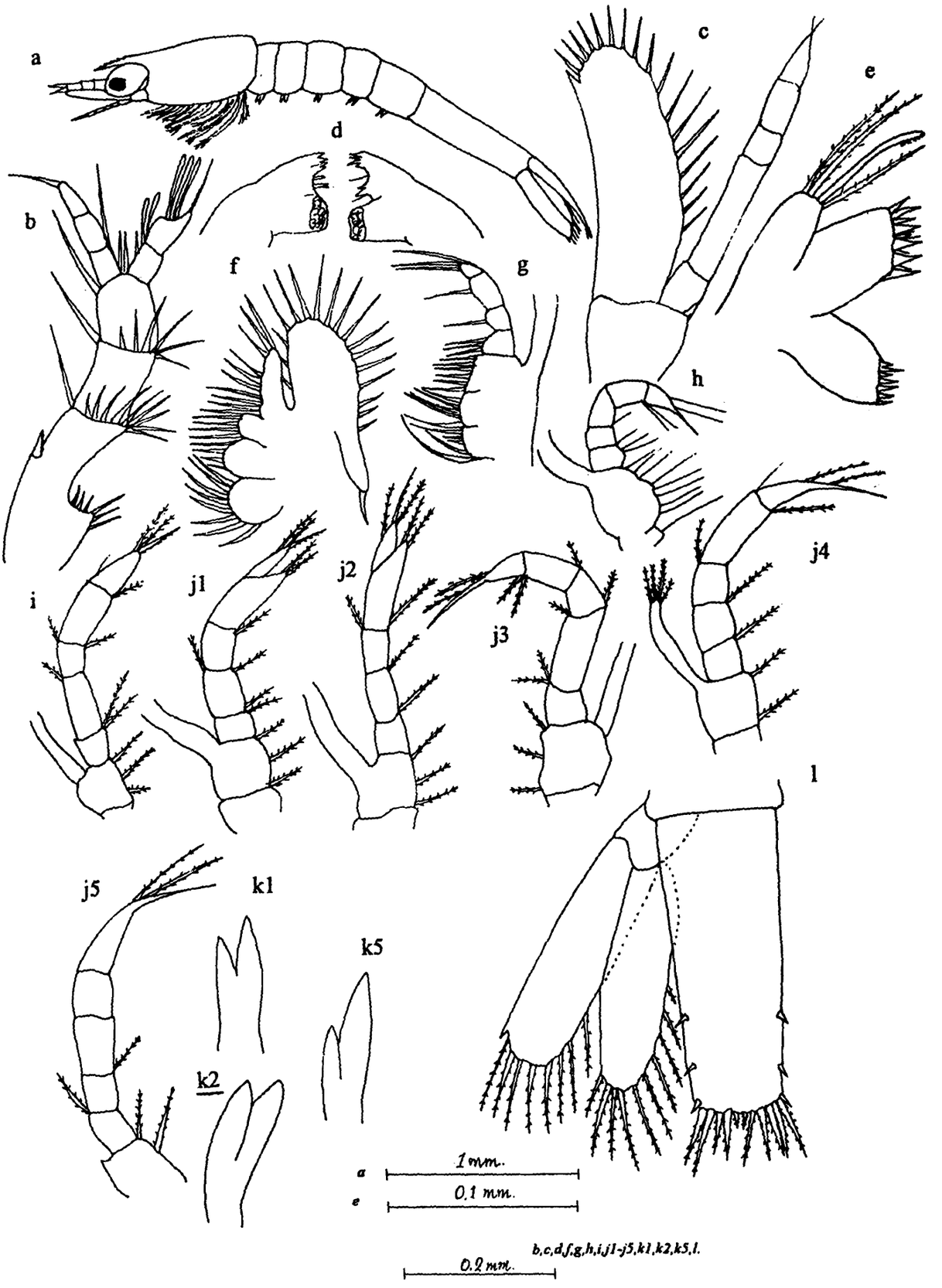

Fig. 24 : *Caridina williamsoni* (VI Zoea)

Maxillipeds (Figs. 24, g, h & i) : No change.

Pereiopods (Figs. 24, j1 - j5) : All 5 pairs well developed, in first 2 pairs chelate nature clear. Last 3 pairs with no change. Exopod of 5th pair a small bud.

Pleopods (Figs. 24, k1, k2, k5) : Long biramous with setose endopods and exopod Appendix interna with 2 hooks.

Telson (Fig. 24, l) : Narrower than in previous stage.

Uropods (Fig. 24, l) : More setation.

Post - larva
(Figs. 25 & 26)

Total length : 3.00 to 3.15 mm.

Rostrum (Fig. 25, a) : Rostrum same as the previous stage with formula $\frac{3\ 0}{0}$ Carapace with well developed antennal and smaller pterygostomial spines.

Antennule (Fig. 25, b) : Stylocerite sharp with 3 bristles on inner side and a row of 5 setae on outer margin. First and 2nd segment with 2 and 1 spines on anterolateral margin with circlet of setae. Inner flagellum 5-segmented and longer than outer 4 segmented flagellum.

Antenna (Fig. 25, c) : Now completely adult like, serrated spines at base of flagellum disappear. Outer spine of peduncle well developed. Scale 3.1 times as long as broad. Outer spine overreaches lamella.

Mandible (Fig. 25, d) : Incisor process on right with 6 irregular and left with 4 subequal teeth and with serrated setae on cutting edges.

First & Second Maxilla (Figs. 25, e & f) : Adult like but less setose.

Maxillipeds (Figs. 25, g, h & i) : Adult like, less setose, 1st maxilliped with basal part of exopod expanded with about 8 setae, with podobranch bud and 3rd with epipod.

Pereiopods (Figs. 25, j1, j2 & Figs. 26, j3, j4, j5) : Adult like, except for the presence of functional exopods (but not 5th pereiopod). 1st and 2nd pairs with characteristic brushes of hairs on chelae. Last 3 pairs with 1,1 and 2 spinules respectively on posterior margin of dactylus, dactylus terminates in a fairly long spine; ischium and merus of last 3rd pereiopods with 1 and 3 spines respectively, pereiopods 1 to 4 with epipods and a setobranch each.

Abdomen : With a characteristic dorsal hump on the 3rd segment like in adult.

Pleopods (Figs. 26, k1, k2, k5) : Now fully setose and functional; appendix interna with 3 hooks. Endopod of 1st pleopod much reduced and without setae.

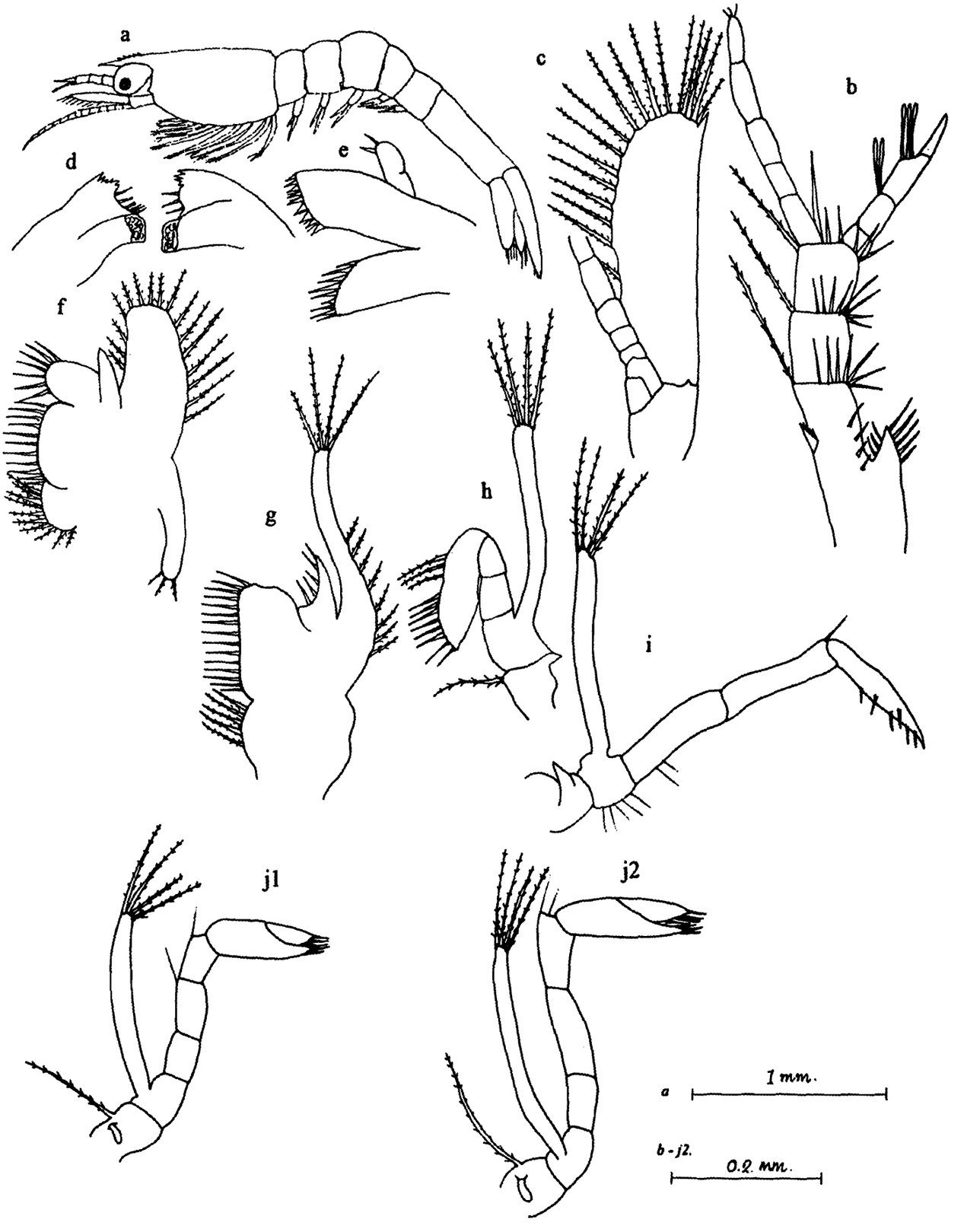

Fig. 25 : *Caridina williamsoni* (Postlarva)

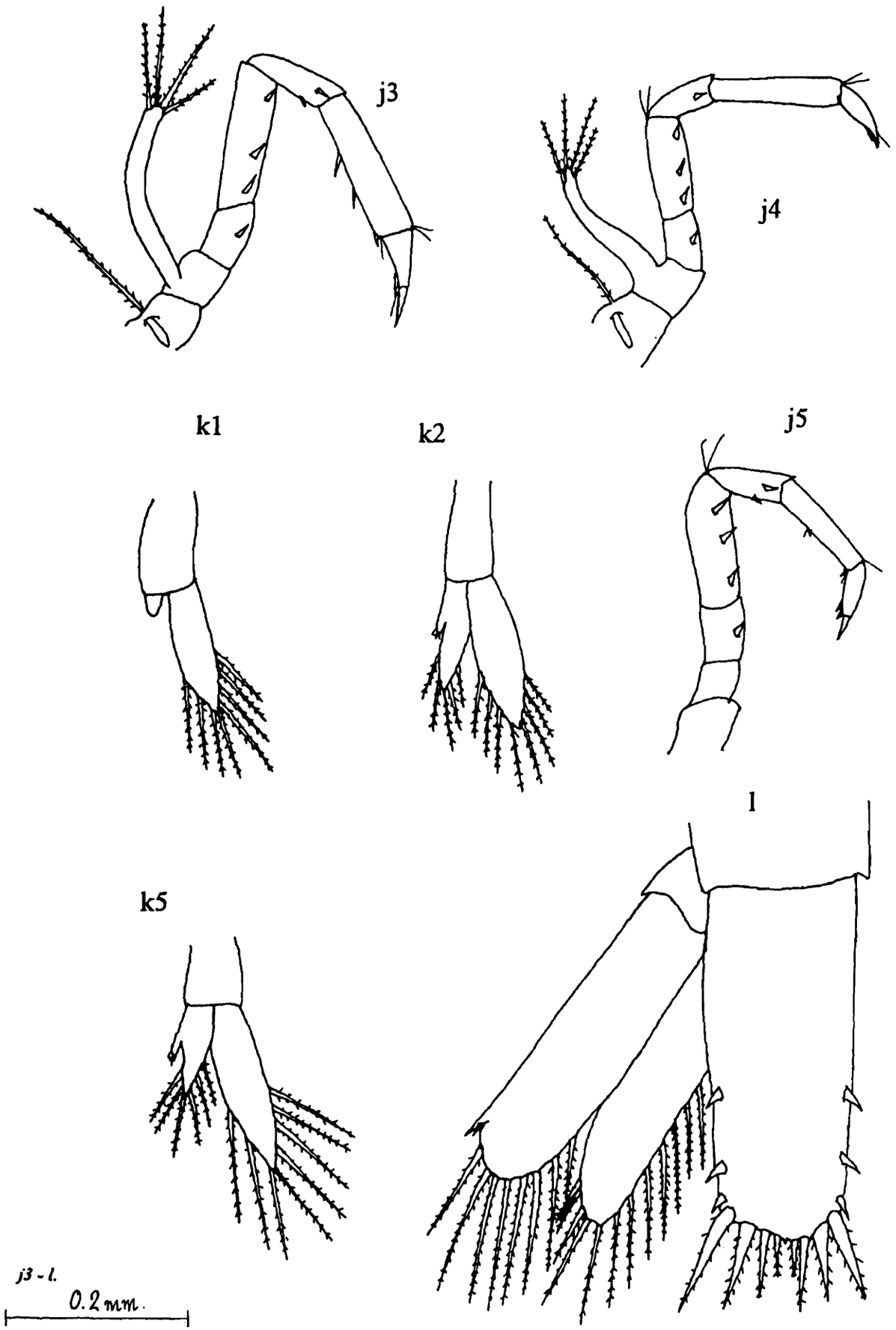

Fig. 26 : *Caridina williamsoni* (Postlarva)

Telson (Fig. 26, l) : Three pairs of dorsal spines. Process formula 4+4, outermost largest.

Uropods (Fig. 26, l) : Subequal or slightly shorter than telson, exopod with accessory spine to subapical spine indicating future diaeresis.

Description of Larval stages

Caridina kunnathurensis Richard and Chandran, 1994
(Figs. 27-31)

Berried females are found throughout the year but available in plently during months of January to March and August to October. Berried female from which larvae were obtained was collected from Manimangalam pond. The yellowish eggs, are fairly big and less in number. Measuring 0.45 to 0.60x0.70 to 1.00 mm and the numbers vary from 50 - 150. Larvae hatched on 18.3.93. Process of hatching extending for about 2 hours. Development is partially abbreviated with 3 larval + 1 post larval stages. Temperature ranged from 22° to 27° C at the time of experiment, and larvae took 4 to 5 days for completion of development.

I Zoea
(Fig. 27)

Total length : 2.20 to 2.40 mm. Duration : 1 days

Rostrum (Fig. 27, a) : Short, smooth, bent downwards and not reaching beyond sessile eyes. Carapace smooth, except for a well developed pterygostomial spine; antennal spine not yet formed.

Antennule (Fig. 27, b) : Peduncle unsegmented, inner flagellum represented by plumose seta. Two long aesthetascs + 1 plain seta + shorter bristle like plumose seta terminally.

Antenna (Fig. 27, c) : Peduncle short bearing a small, smooth spine at base of endopod. Endopod slightly smaller than scale, 4-segmented and with a long plumose seta + a small plain seta terminally. Scale with 4 distal segments and with 2 plumose setae on outer margin and 1 small plain + 9 long plumose setae on inner margin.

Mandible (Fig. 27, d) : Incisors and molar processes not yet clearly differentiated. Incisor of right with 3 and left with 2 teeth each. Molar processes in both with well developed grinding processes.

First Maxilla (Fig. 27, e) : Coxal and basal entites with 4 and 2 big + 2 small spines respectively. Palp slightly bifid with 3 plumose setae and I strong characteristic bristle-like seta terminally. Exopod absent.

Second Maxilla (Fig. 27, f) : Coxal and basal endites with 8+2 and 2+3 setae respectively. Endopod slightly smaller than scaphognathite bearing along its inner margin 3,2,1 and 1 subterminal setae + 2 terminal setae. Scaphognathite with 5 setae; posterior most being stouter than rest.

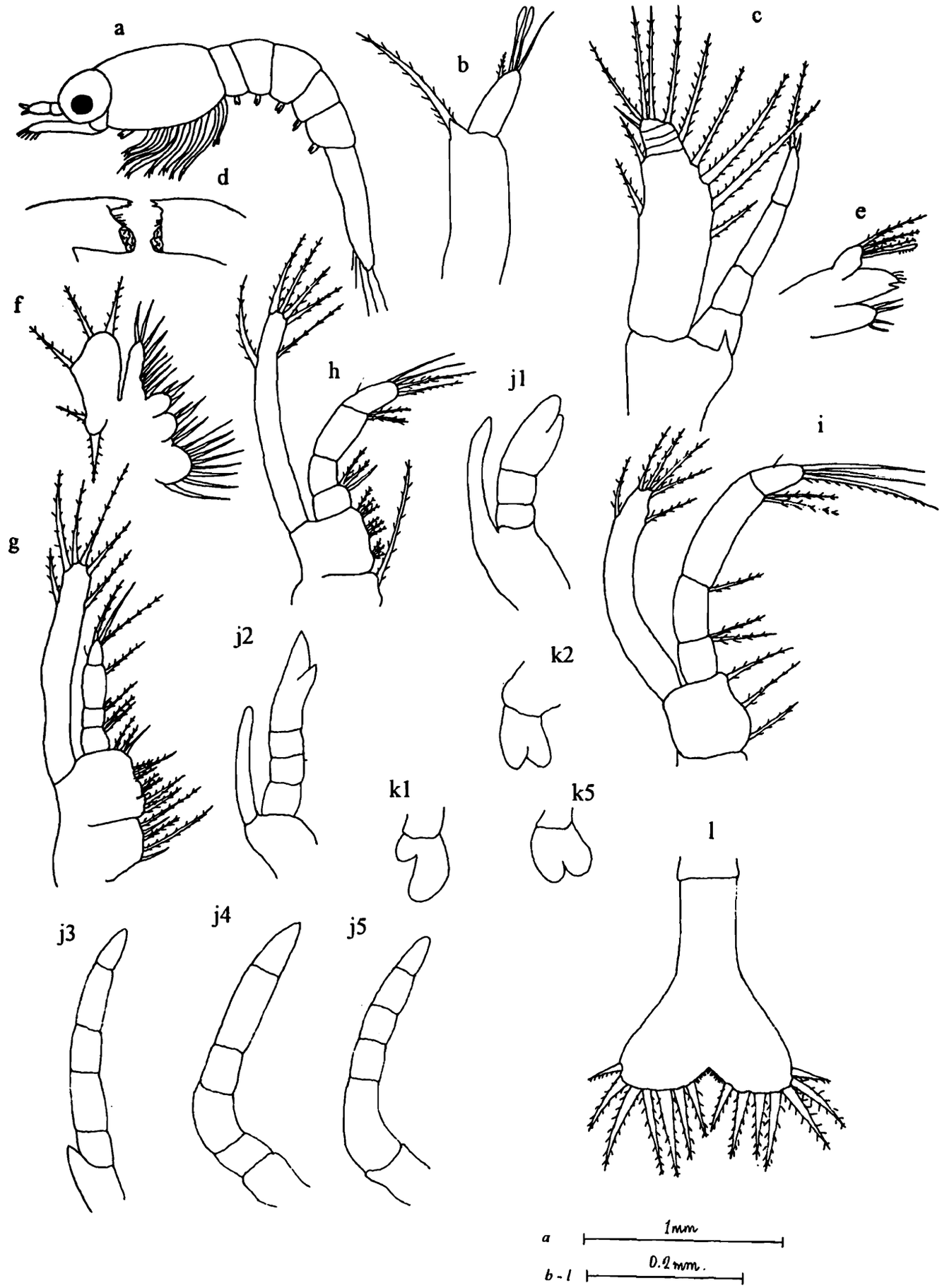

Fig. 27 : *Caridina kunnathurensis* (I Zoea)

First Maxilliped (Fig. 27, g) : Basis rather rectangular bordered along its inner margin by groups of 2,3 & 3 setae and with 2 plumose + 1 plain setae proximally. Endopod distinctly shorter than exopod, 4-segmented, setation distalwards being 2,2,1 & 3 (1 plain seta) long terminal + 1 small outer setae. Exopod with 4 terminal + 2 subterminal natatory setae.

Second Maxilliped (Fig. 27, h) : Coxa with a characteristic long plumose seta. Basis broad with its inner margin bearing 3 groups each of 3 plumose setae as in the figure. Four segmented endopod with 3, 0, 2 and 4 terminal (2 palin and 2 plumose) + 1 small outer distalwards. Exopod with 4 terminal + 2 subterminal natatory setae.

Third Maxilliped (Fig. 27, i) : Basis small with 3 plumose setae on the inner margin. Four segement endopod with 2,1,2,3 long terminal (2 plain and 1 plumose on the inner margin) + 1 small stouter setae distalward. Exopod with 4 terminal + 2 subterminal natatory setae.

Pereiopods (Figs. 27, j1 - j5) : All 5 pairs well developed showing traces of segmentation; first 3 pairs biramous and first 2 pairs showing chelate nature, last 2 pairs uniramous, terminally on their endopod.

Abdomen : Five segmented all segments smooth. Five pairs of well developed biramous pleopod buds.

Telson (Fig. 27, l) : Typical with process formula 7+7. Posterior margin with a deep median notch possessing about 19–21 minute hairs. All processes plumose, but first on their inner margin only.

II Zoea

(Fig. 28)

Total length : 2.50 to 2.92 mm. Duration : 1 or 2 days

Rostrum (Fig. 28, a) : Now straight but with a small papillar protuberance behind orbital region and extending upto the tip of 1st segment of antennular peduncle. Antennal spine not yet developed; Eyes stalked and free from carapace.

Antennules (Fig. 28, b) : Peduncle 3-segmented with long inner and clusters of small setae distally as in figure. Basal segment with a well developed, sharp stylocerite, and an anteriorly directed ventral spine well above its level; stylocerite with 2 inner and an outer setae. Both rami now flagellar and 2 segmented, outer with 2 aesthetascs and a terminal seta, inner with 1 long + 2 small setae.

Antenna (Fig. 28, c) : Scale now with 3 distal segments, an outer subterminal spine and 16 (15 long plumose + 1 small plain) setae along its inner margin. Endopod now more than 2-times longer than scale and with about 13 segments.

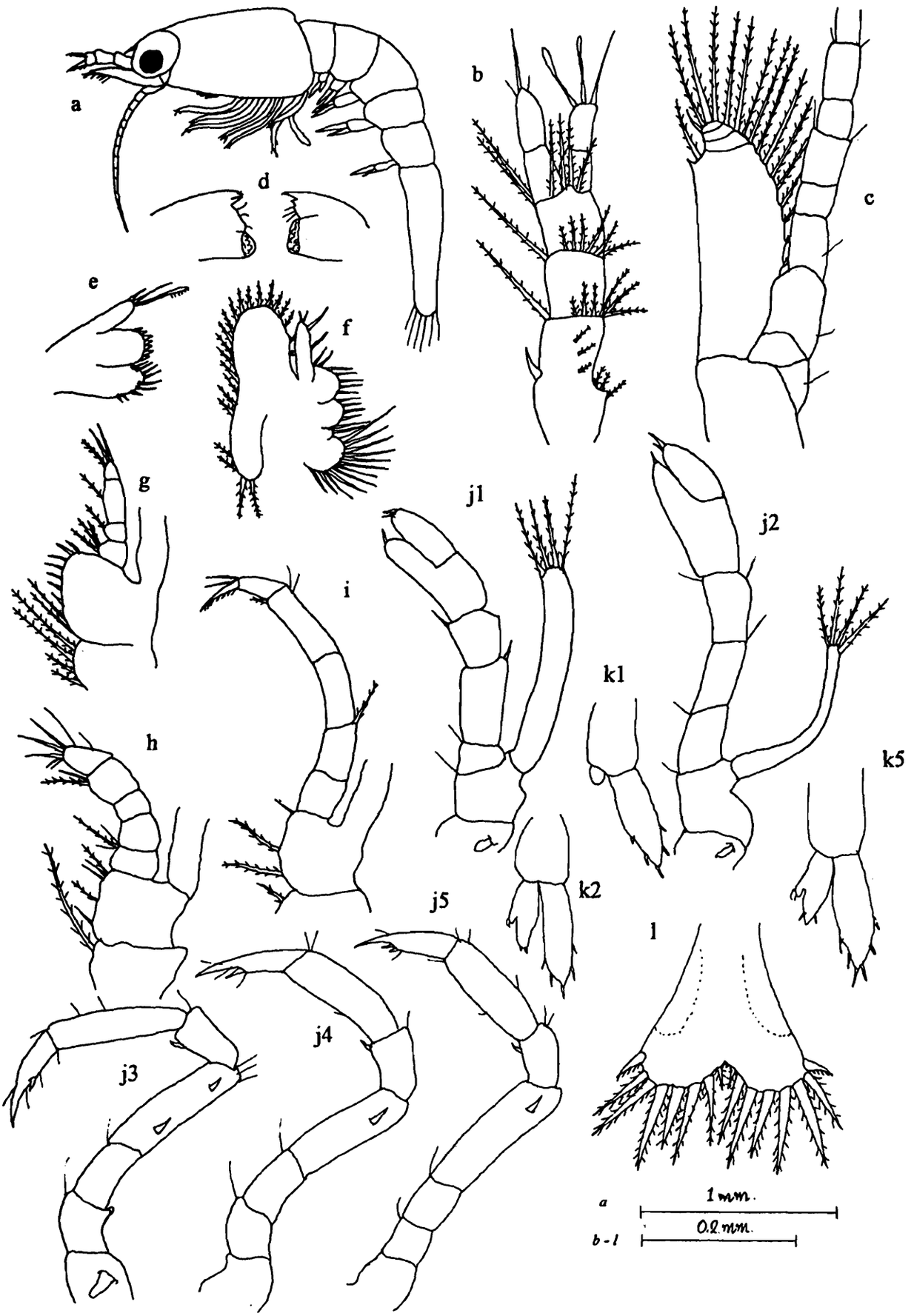

Fig. 28 : *Caridina Kunnathurensis* (II Zoea)

Mandible (Fig. 28, d) : Incisors and molar parts now clearly differentiated; Incisors of right side with 4 subterminal and of left with 4 unequal teeth; Molar with well developed grinding processes.

First Maxilla (Fig. 28, e) : No change except for increase in number of setae.

Second Maxilla (Fig. 28, f) : Coxal and basal endites with 12+2 and 4+5 setae respectively. Terminal setae of endopod reduced. Scaphognathite now fringed with about 22 setae.

First Maxilliped (Fig. 28, g) : Inner margin of basis with more setae.

Second Maxilliped (Fig. 28, h) : Endopod 5-segmented with setation distalwards being 3,0,0,2,6 terminal (2 being stouter than the rest) + 1 outer, no change in basis and exopod.

Third Maxilliped (Fig. 28, i) : Endopod now 5-segmented setation distalward being 0,1 outer, 0,3 and 3 terminal. No change in basis and exopod.

Pereiopods (Figs. 28, j1- j5) : All 5 pairs of pereiopod now distinctly segmented and functional. Exopods of chelipeds with 4 natatory setae; exopod of third pair continues as a small bud while last 2 pairs without exopods. Each of last 3 pereiopods terminally into a spine + 1 or 2 hairs.

Pleopods (Figs. 28, k1, k2, k5) : Now elongated, clearly segmented, showing traces of future setae. Last 4 pairs with appendix interna buds each with 2 hooks. Endopod of first as usual much reduced.

Telson (Fig. 28, l) : Process formula now 8+8 with an additional median pair (8th) of plumose setae.

Uropods (Fig. 28, l) : Uropod buds though elongated still seen only within telson cuticle.

III Zoea
(Fig. 29)

Total length : 3.00 to 3.20 mm. Duration : 2 or 3 days.

In this stage, almost all appendages except uropods are postlarval like and therefore, it is considered as third zoea, next stage being postlarva.

Rostrum (Fig. 29, a) : Still without any teeth and extending nearly upto tip of basal segment of antennular peduncle. Carapace with distinct antennal spine besides pterygostomial.

Antennule (Fig. 29, b) : Peduncle more setose; both rami now flagellar; inner slightly longer than outer and 4-segmentes, outer 3 segmented with 2 aesthetascs.

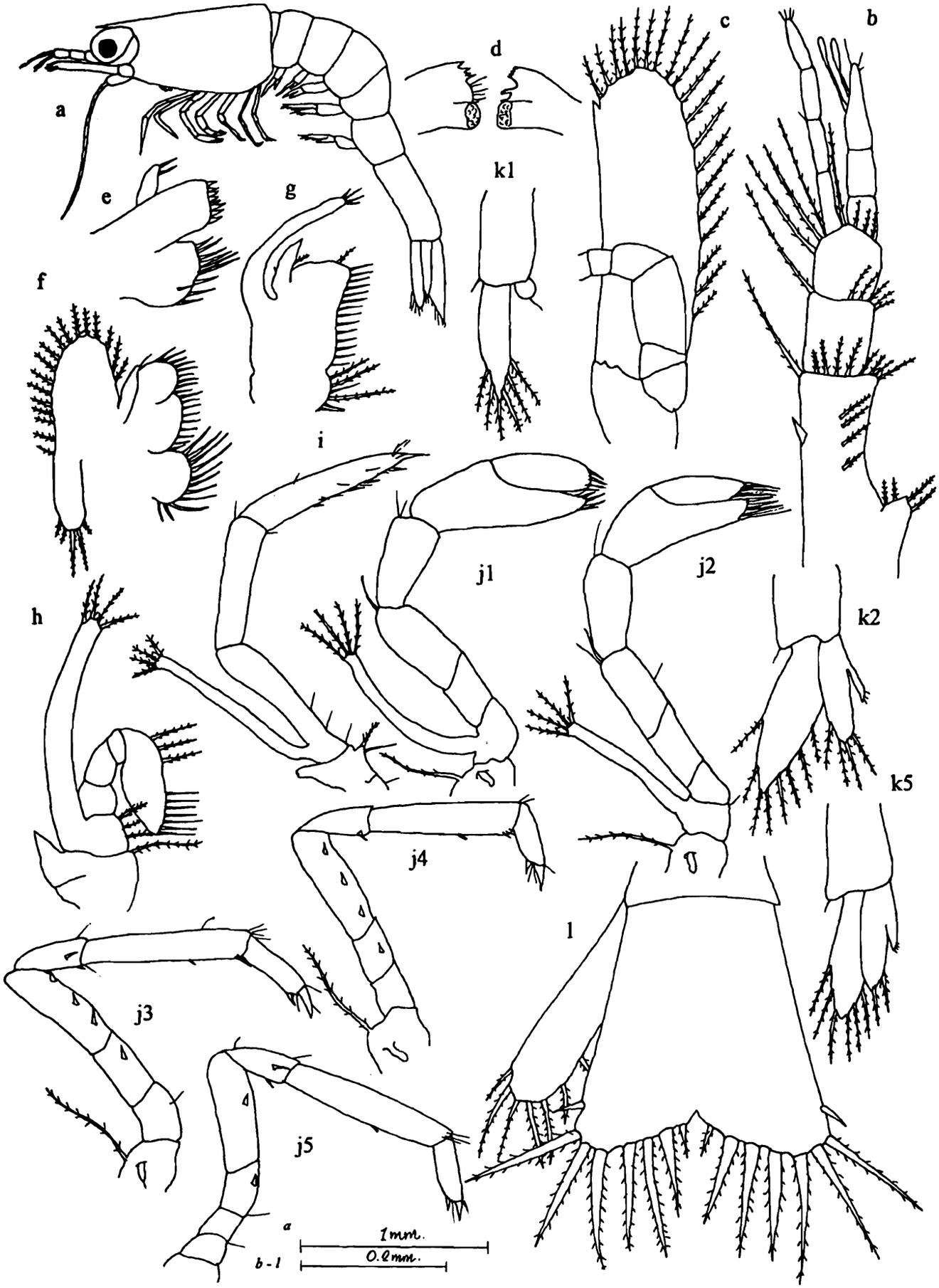

Fig. 29 : *Caridina kunnathurensis* (III Zoea)

Antenna (Fig. 29, c) : Peduncle now 4 segmented; basal segment with a small spine at the base of scale. Scale without any distal segments and its lamella over reaching outer terminal spine. Flagellum increased in length and with about 15 segments.

Mandible (Fig. 29, d) : Incisors of right side with 4 unequal and that of left with 5 subequal teeth.

First Maxilla (Fig. 29, e) : Palp reduced and adult like.

Second Maxilla (Fig. 29, f) : Almost as in postlarva but less setose. Smaller lobe of coxal endite lost in this stage.

Maxillipeds (Figs. 29, g, h, & i) : Almost postlarval in appearance but less setose. Second maxilliped with small podobranch bud and third with an epipod bud.

Pereiopods (Figs. 29, j1 - j5) : Almost as in postlarvae except for presence of functional exopods on chelipeds, fingers of which now with brushes of hairs. Third pereiopod without even traces of exopod. Ischium, merus, carpus and propodus of last 3 pereiopods with spines, while dactylus with subterminal spine on posterior margin apart from terminal one.

Abdomen (Fig. 29, a) : Sixth segment separated from the telson and with a pair of small posterolateral spines.

Pleopods (Figs. 29, k1, k2, k5) : Now setose and functional; appendix interna with 3 hooks each.

Telson (Fig. 29, l) : Posterior margin now narrow and deeply notched in middle. Process formula 8+8, first process being transformed into a spine.

Uropods (Fig. 29, l) : Both rami well developed, though peduncle not yet separated. Exopod functional, with 7 or 8 setae and endopod non functional.

Post - larva
(Figs. 30 & 31)

Total length : 3.15 to 3.55 mm

This stage is characterized by appearance of almost all adult characters. However rostrum (Fig. 30, a) is still straight failing to reach tip of basal segment of antennular peduncle without or with a single dorsal tooth situated a little ahead of orbital margin and with both antennal and pterygostomial spines subequal in size.

Antennule (Fig. 30, b) : Basal segment of peduncle with a broad but pointed stylocerite and anteriorly directed ventral spine slightly above it. Inner flagellum 5-segmented; and slightly longer than outer; outer 3-segmented, with 2 aesthetascs arranged on terminal segment as shown in figure.

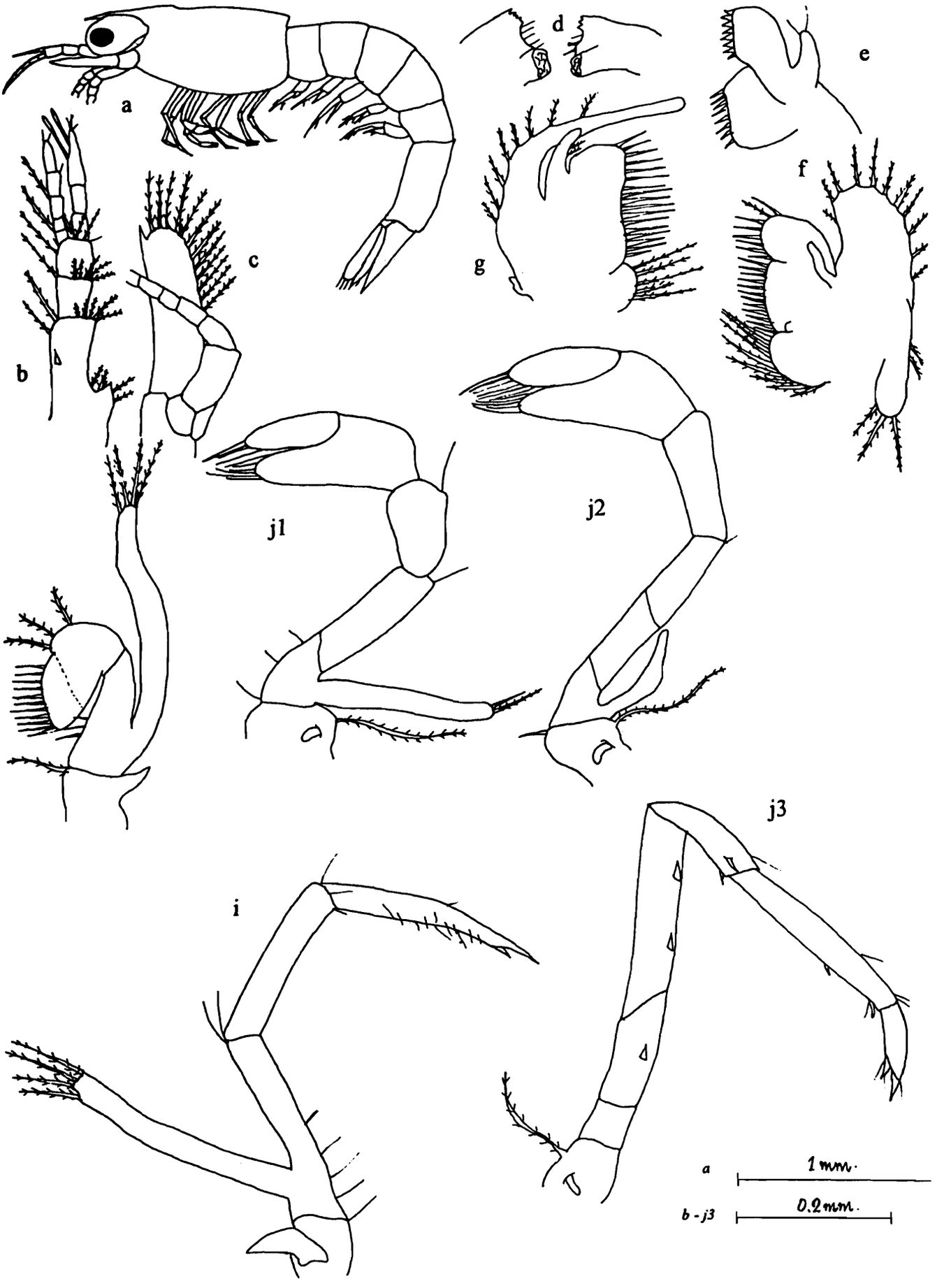

Fig. 30 : *Caridina Kunnathurensis* (Postlarva)

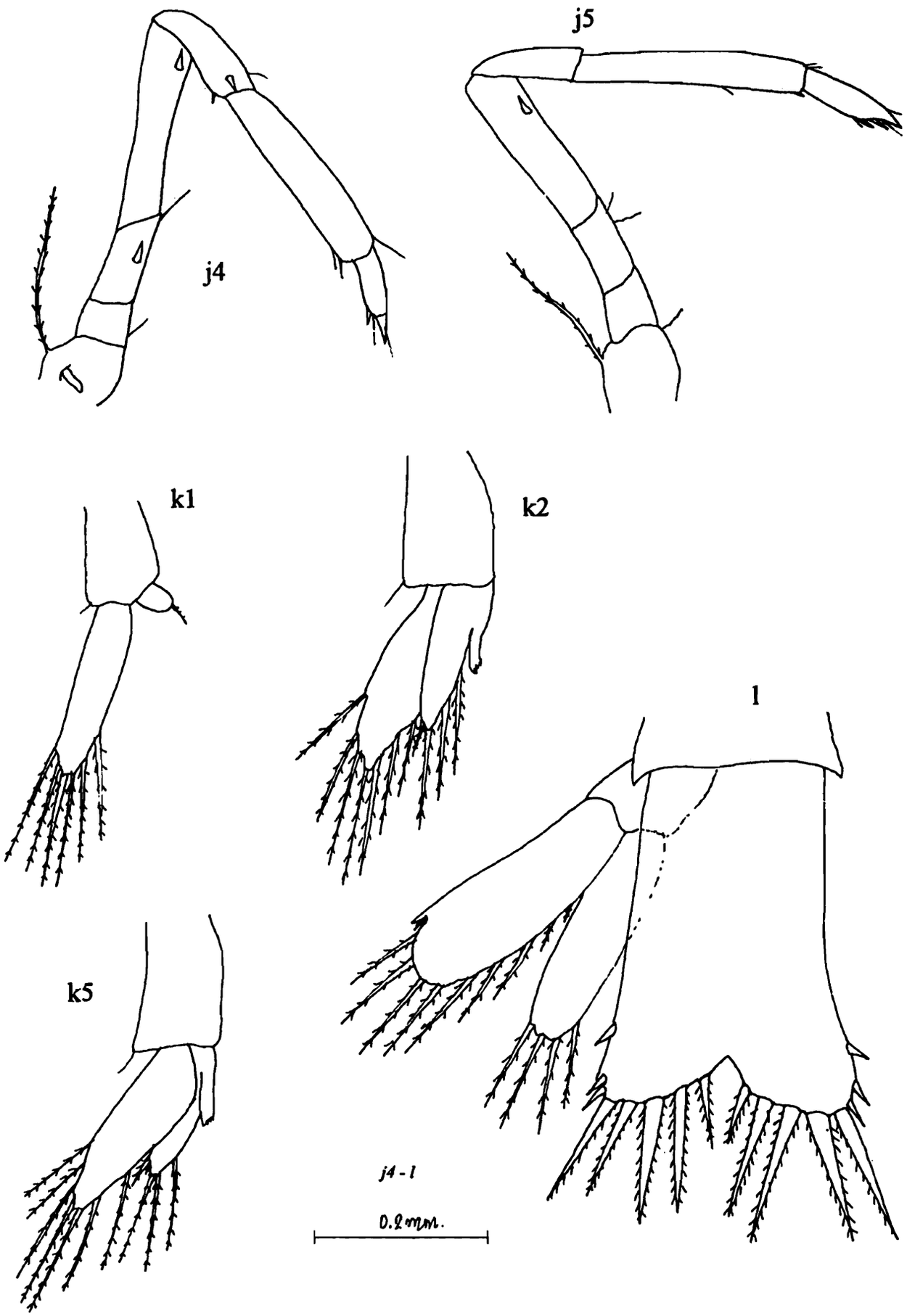

Fig. 31 : *Caridina kunnathurensis* (Postlarva)

Antenna (Fig. 30, c) : Adult like, but terminal spine overreaching scale unlike in adult.

Mandible (Fig. 30, d) : Adult like with fully developed incisors and molar processes.

Maxillae (Figs. 30, e & f) : Adult like with reduced palp but endites less setose.

Maxillipeds (Figs. 30, g, h & i) : Almost as in adults but less setose; 2nd with podobranch and 3rd with epipod buds. Exopods still larval with 6 to 8 indistinct annulations.

Pereiopods (Figs. 30, j1, j2, j3 & Figs. 31, j4, j5) : Exopods on 1st and 2nd pairs reduced to bud-like processes those of 1st with small setae. Chelipeds with brushes of hairs as in adult. Dactylus of last 3 pereiopods with 1,1 and 2 subterminal spines respectively on its posterior margin. Each of first 4 pereiopods with a setobranch each and an epipod.

Abdomen (Fig. 30, a) : Adult like with dorsal hump.

Pleopods (Figs. 31, k1, k2, k5) : Endopod reduced in first. Exopod setae 6 to 8 endopod with 4 (only one on first pleopod) setae. Appendix interna with 2 to 4 hooks.

Telson (Fig. 31, l) : Posterior margin much narrowed with a deep median notch. First pair of spines of last stage shifted anteriorly and 2 more smaller spines terminally. Process formula 5+5 outermost being largest and slightly plumose only on its inner margin.

Uropods (Fig. 31, l) : Unlike in adult, not longer than telson. Both rami functional with well developed setae. Outer margin of exopod with subapical and accessory subapical spines.

Description of Larval stages

Caridina gurneyi Jalihal *et al.*, 1984
(Figs. 32-36)

Berried females of this experiment were collected from Roshan Nagar on 19.1.93. The eggs are large measuring 0.50 to 0.57 x 0.74 to 0.85 mm. Fecundity 90 to 190. The larvae hatched on 22.1.93 at 5.30 am and the hatching process continued till 6.20 am. The development is partially abbreviated with 3 zoeal + 1 postlarval stages. Temperature ranged from 23° to 27° C at the time of experiment and larvae took 4 to 5 days for completion of development.

I Zoea
(Fig. 32)

Total length : 2.10 to 2.28 mm. Duration : 1 day

Rostrum (Fig. 32, a) : Short, smooth, bent downwards and not reaching beyond sessile eyes. Carapace smooth, except for a small pterygostomial spine; antennal spine not yet formed.

Antennule (Fig. 32, b) : Peduncle unsegmented. Inner flagellum represented by plumose seta; outer with 2 long aesthetascs, a plain seta and a small bristle like seta terminally.

Antenna (Fig. 32, c) : Peduncle unsegmented bearing a small, smooth spine at the base of the endopod. Endopod unsegmented, about 3/4th of scale and terminated by a long plumose seta + a smaller stouter spine having a minute basal spine; scale with 4 distal segments, with 2 plumose setae on outer and 1 small plain + 10 long plumose setae on the inner margin.

Mandible (Fig. 32, d) : Incisors and molar processes clearly differentiated. Incisors with 2 or 3 sharp teeth, molar with grinding projections and remaining as cutting edge with a single spinuous seta.

First Maxilla (Fig. 32, e) : Coxal and basal entites with 5 plain + 2 bristle like setae and 4 spines + 1 plain setae respectively. Palp slightly bifid with 3 plumose setae and 1 characteristic stout bristle like seta on subterminal lobes. Exopod absent.

Second Maxilla (Fig. 32, f) : Coxal and basal endites with 7+2 and 4+4 setae respectively. Endopod slightly shorter than scaphognathite bearing 3 terminal setae, its inner lobes carrying 3, 2 and 1 setae distalwards. Scaphognathite with 9 setae; posterior being stouter than the rest.

First Maxilliped (Fig. 32, g) : Basis broad and bordered along its inner margin by groups of 2 or 3 setae, 4 setae proximally as shown in figure. Endopod shorter than exopod, 4 segmented setation distalwards being 3,1,0 & 3 long + 1 small outer. Exopod with 4 natatory setae.

Second Maxilliped (Fig. 32, h) : Inner margin of basis lobed carrying 1,2,2, and 3 setae distalwards; proximal lobe carrying a characteristic long + 1 small setae. The 4 segmented endopod with 3,1,2 and 1 small outer + 3 long bristle like setae distalwards. Exopod with 4 natatory setae.

Third Maxilliped (Fig. 32, i) : Basis comparatively small with 3 plumose setae. Endopod longer than exopod, 4 segmented with 1,1,2 and 1 small outer + 3 long bristle like setae distalwards. Exopod with 4 natatory setae.

Pereiopods (Figs. 32, j1, j5) : All 5 pairs represented as elongated biramous buds; endopod showing traces of segmentation. 1st and 2nd showing traces of chelate nature.

Abdomen 5-segmented, all segment smooth, 6th not yet seperated from telson. Five pairs of biramous pleopod buds on 1st to 5th segments.

Telson (Fig. 32, l) : Broadly triangular with process formula 7+7. All processes plumose, but first on their inner margin.

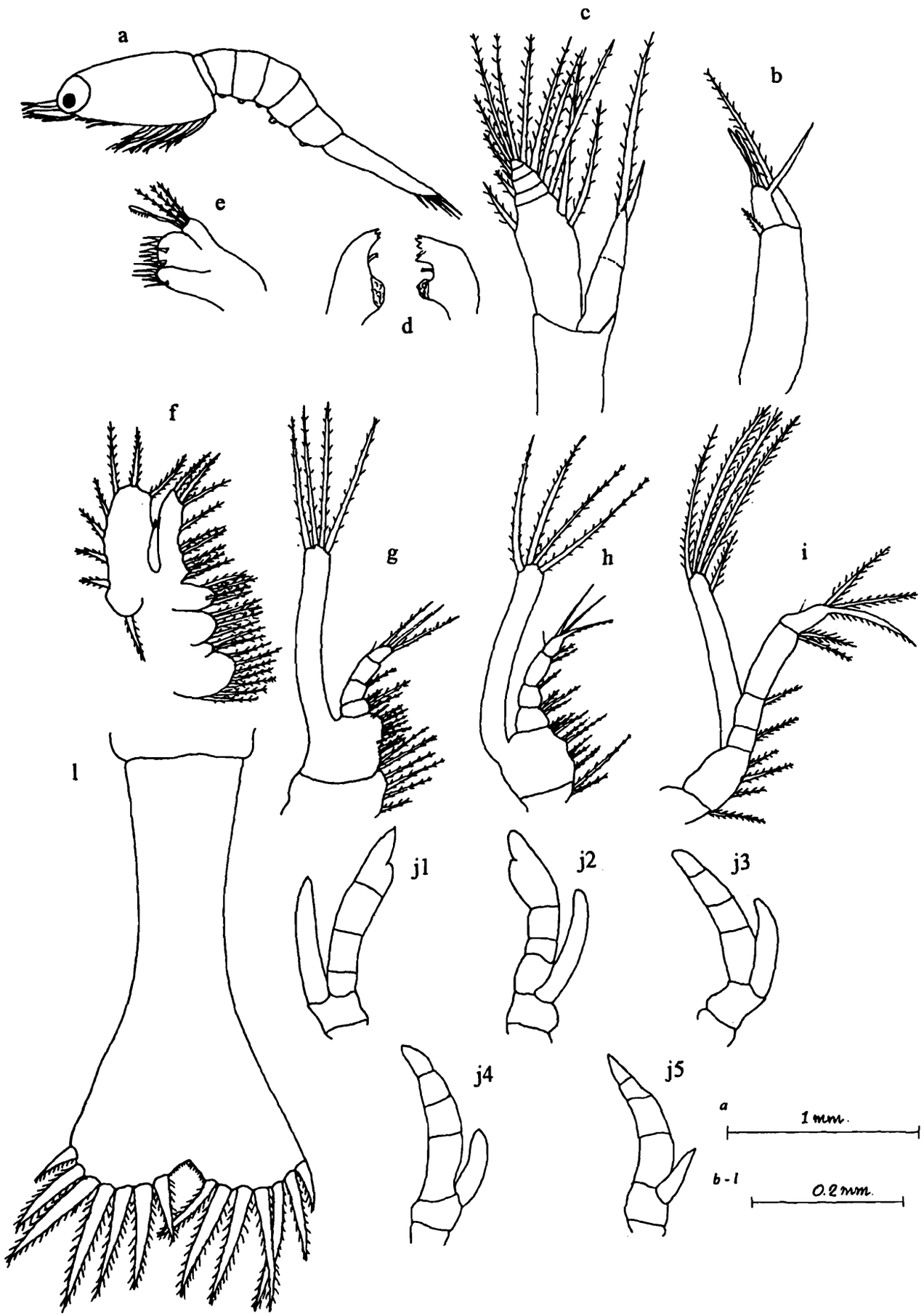

Fig. 32 : *Caridina gurneyi* (I Zoea)

II Zoea
(Fig. 33)

Total length : 2.30 to 2.40 mm. Duration : 1 day

Rostrum (Fig. 33, a) : Straight, extending up to tip of 2nd segment of antennular peduncle. Antennal spine not yet developed; Eyes stalked and free from carapace.

Antennules (Fig. 33, b) : Peduncle 3 segmented with setation as shown in figure. Basal segment showing traces of future stylocerite with 2 small bristles and an anteriorly directed ventral spine well above the level of stylocerite. Both rami well developed, inner unsegmented with 1 plain setae; outer 2 segmented bearing 2 aesthetascs + 1 plain seta terminally.

Antenna (Fig. 33, c) : Scale with 3 distal segments, 2 outer setae and 13 plumose setae on inner margin. Endopod flagellar, distinctly longer than scale and with 7 segments, 3rd segment being longest.

Mandible (Fig. 33, d) : No appreciable change.

First Maxilla (Fig. 33, e) : No change except for increase in number of setae.

Second Maxilla (Fig. 33, f) : Coxal and basal endites with 9+3 and 6+9 setae. Endopod with 3,2,1,1 subterminal + 2 terminal setae. Scaphognathite with about 14 setae. Proximal lobe of scaphognathite well developed.

First Maxilliped (Fig. 33, g) : No appreciable change except for increase in setation of coxa and basis and an additional plumose seta distally on outer margin of 1st segment of endopod.

Second Maxilliped (Fig. 33, h) : Endopod now 5 segmented with 3,2,1,2 + 1 small outer + 3 terminal setae distalwards and additional plumose seta distally on outer margin of basal segment of endopod.

Third Maxilliped (Fig. 33, i) : Endopod now 5 segmented, setation distalwards being 2,2,1,2 inner, 1 small outer + 3 terminal setae and an additional plumose seta distally on outer margin of 3rd segment of endopod.

Pereiopods (Figs. 33, j1 - j5) : All 5 pairs fully functional with setae on endopods and exopods. First 2 pairs showing chelate nature and with 5 natatory setae on their exopods. Exopods of third and fifth pairs with 4, 4 and 2 natatory setae respectively.

Pleopods (Figs. 33, k1, k2, k5) : Biramous and clearly segmented.

Telson (Fig. 33, l) : Process formula now 8+8, with an additional pair (8th) of small setae; 8th spinulose only on the outerside.

Uropods (Fig. 33, l) : Uropod buds seen within telson cuticle.

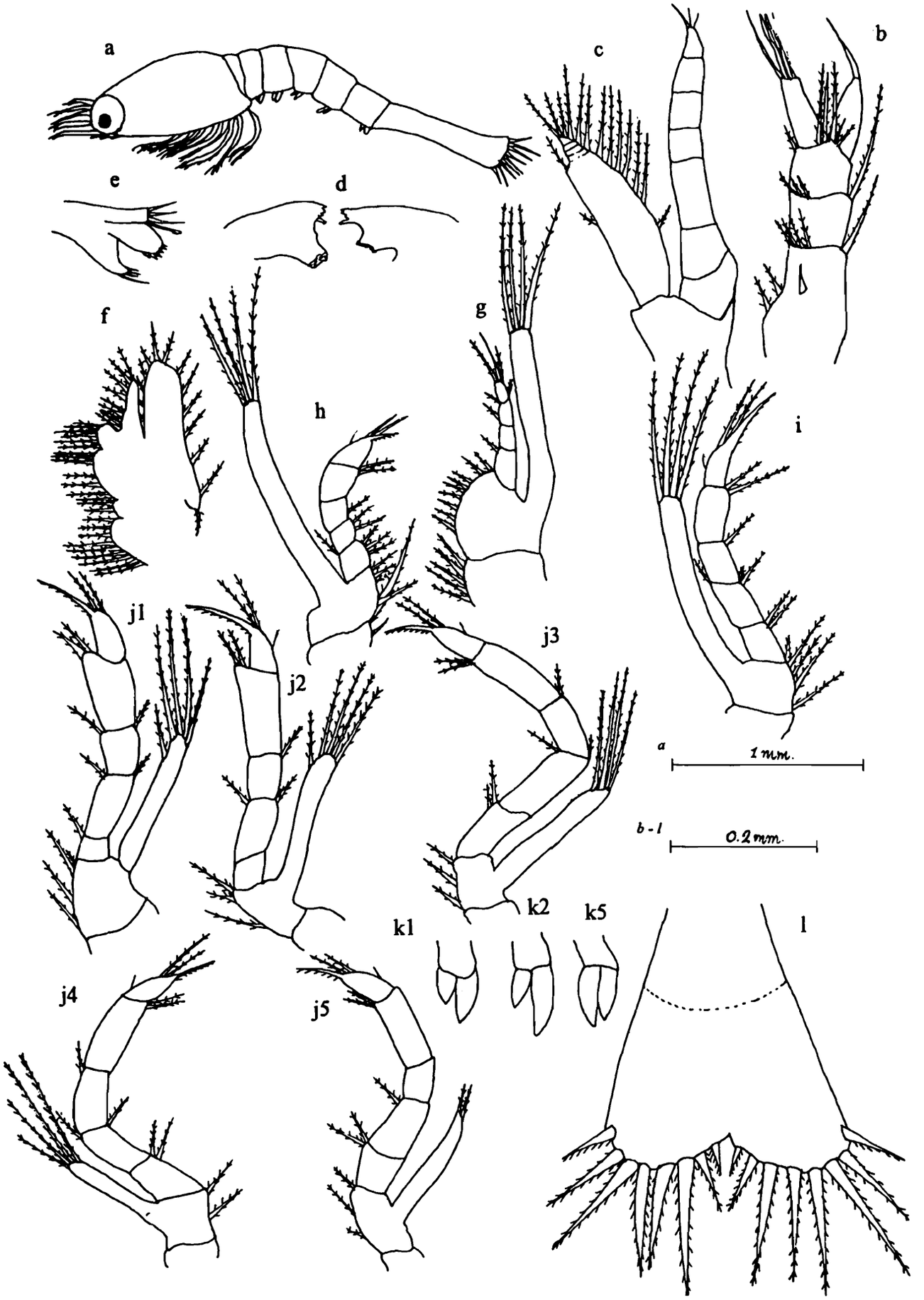

Fig. 33 : *Caridina gurneyi* (II Zoea)

III Zoea
(Fig. 34)

Total length : 2.50 to 2.60 mm. Duration : 2 days

Rostrum (Fig. 34, a) : Still smooth and extending nearly upto tip of 2nd segment of antennular peduncle. Carapace with an acute angle in place of antennal spine.

Antennule (Fig. 34, b) : Basal segment with a future stylocerite with 2 bristles on its inner side and 2 setae on outer margin. Inner rami now 3 segmented, outer still 2 segmented with 2 terminal aesthetascs.

Antenna (Fig. 34, c) : Scale now without any distal segments and with a spine on outer margin; outer setae completely lost; peduncle with a new small spine at base of scale. Endopod flagellar and with 9 segments.

Mandible (Fig. 34, d) : No change except for increase in number of serrated spines on cutting edges.

First & Second Maxilla (Figs. 34, e & f) : No change except for general increase in number of setae.

Maxillipeds (Figs. 34 g, h, & i) : No appreciable change over that of previous stage.

Pereiopods (Figs. 34, j1 - j5) : Chelate nature of first 2 pairs now more prominent but no appreciable change in remaining pereiopods.

Abdomen. : Sixth segment now separated from the telson and with a pair of posterolateral spines.

Pleopods (Figs. 34, k1, k2, k5) : Now elongated and clearly segmented, endopods of second to fifth pairs with buds of appendix interna.

Telson (Fig. 34, l) : Posterior margin narrow with deep median notch. Process formula 8+8, first process being transformed into a spine.

Uropods (Fig. 34, l) : Developed in this stage with functional exopods bearing 7 plumose setae while endopods still as narrow elongated buds.

Post – larva
(Figs. 35 & 36)

Total length : 2.65 to 2.85 mm

Rostrum (Fig. 35, a) : Straight and extending upto middle of 2nd segment of antennular peduncle. Rostral formula $\frac{1 \text{ or } 2}{0}$ no post orbitals, carapace now with a distinct antennal spine in addition to a sharp pterygostomial spine.

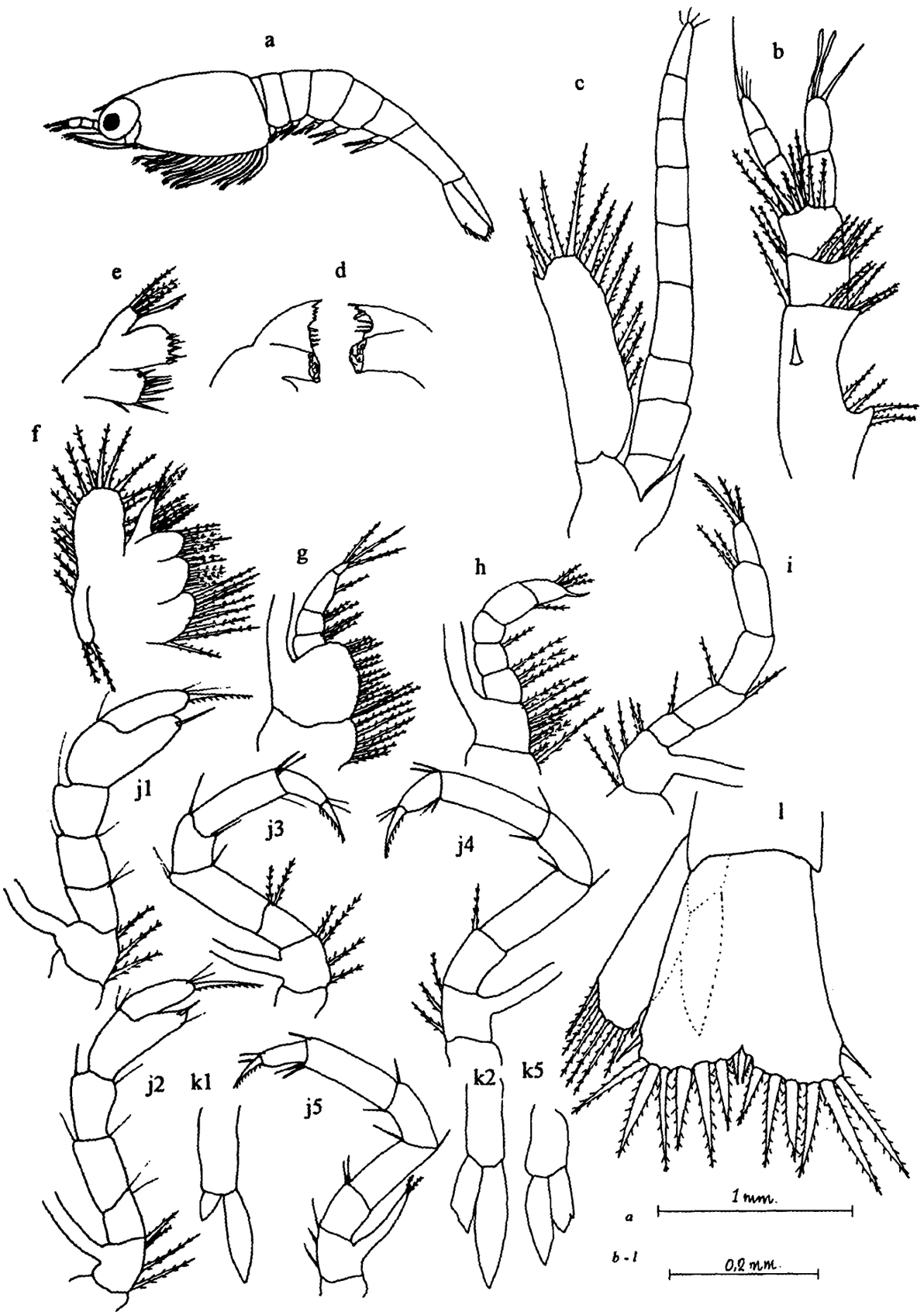

Fig. 34 : *Caridina gurneyi* (III Zoea)

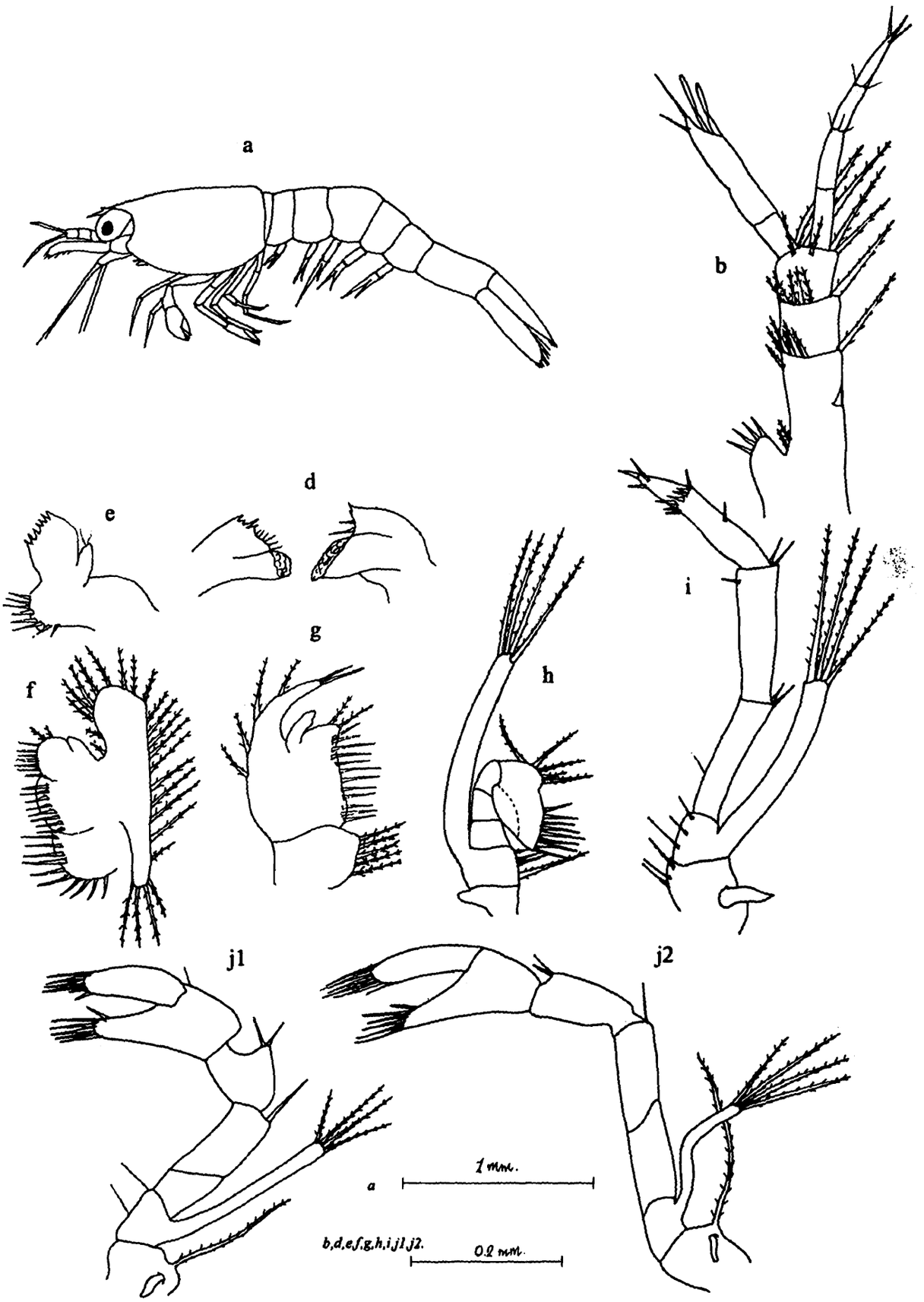

Fig. 35 : *Caridina gurneyi* (Postlarva)

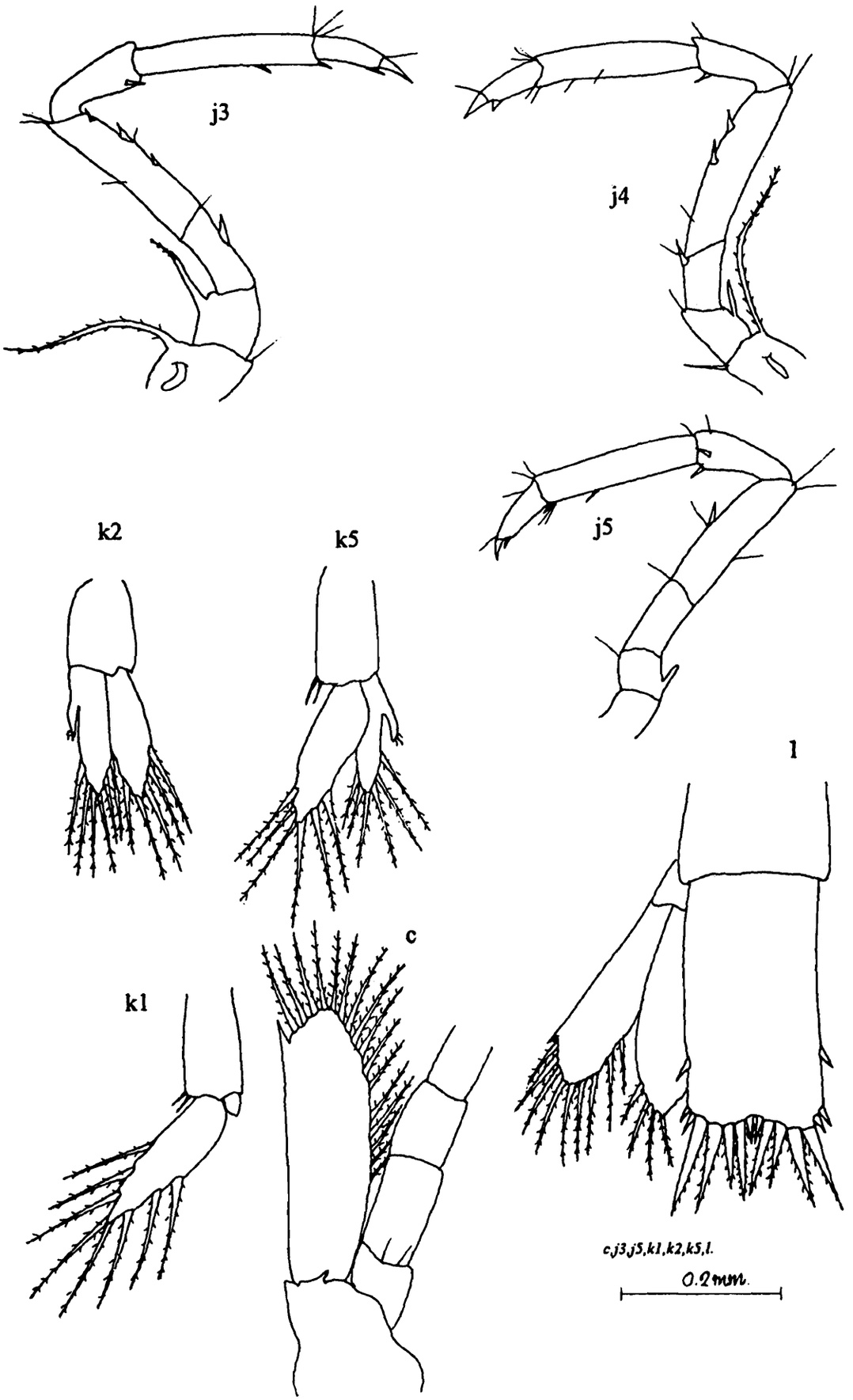

Fig. 36 : *Caridina gurneyi* (Postlarva)

Antennule (Fig. 35, b) : Basal segment with a well developed stylocerite and 2 spines on anterior border. Inner flagellum longer than outer; 4 segmented; outer 2 segmented with 2 aesthetascs arranged subterminally as shown in figure.

Antenna (Fig. 36, c) : Now adult like basal segment of the peduncle with a sharp spine at base of scale. Lamella of scale over reaches outer spine.

Mandible (Fig. 35, d) : Adult like with more incisor teeth and spinuous setae on cutting margin being replaced by hairs.

Maxillae (Figs. 35, e & f) : Palp reduced as in adult but less setose.

Maxillipeds (Figs. 35, g, h & i) : Almost as in adult but less setose; 2nd with podobranch and 3rd with epipod buds.

Pereiopods (Figs. 35, j1, j2, & Figs. 36, j3, j4, j5) : Chelipeds with brushes of hairs as in adult. Carpus of first pair excavated deeply. Dactylus of last 3 pereiopods with subterminal spines respectively on its posterior margin. Exopods of first 2 pairs still long with natatory setae while those of last 3 reduced to elongated buds. Setobranch and an epipod each on first 4 pereiopods.

Pleopods (Figs. 36, k1, k2, k5) : Now fully functional with setose on exo and endopods (except endopod of first which is highly reduced). Appendix interna with 3 hooks.

Telson (Fig. 36, l) : Rectangular in shape with a narrow deeply notched posterior margin. First pair of spines of last stage now shifted anteriorly, 2 more spines distally on lateral margin. Process formula 5+5, outermost is being largest and slightly plumose on its inner margin.

Uropods (Fig. 36, l) : Almost equal to telson. Both rami setose; outer margin of exopod ending in a subapical spine with an accessory subapical spine forming diaeresis.

Description of Larval stages

Caridina jalihali, Mariappan and Richard, 2006
(Figs. 37-41)

Berried females were collected with great efforts by shoveling the net into deeper parts of the pond. Hence, no seasonal abundance could be exactly estimated for these prawns. Eggs brownish in colour, they are much bigger in size measuring 0.60 to 0.67 x 0.88 to 1.07 mm. Fecundity 50 to 100. The berried females of this experiment were collected from Reddipalyam on 6.1.94. Hatching started on 6.30 am on 8.1.94 and continued till 7.15 am. The development is partially abbreviated with 3 zoeal + 1 post larval stages taking 4 to 5 for completion of development. Temperature ranged from 23° to 27° C.

I Zoea

(Fig. 37)

Total length : 2.12 to 2.29 mm. Duration : 1 day.

Rostrum (Fig. 37, a) : Short, smooth, bent downwardly and extending upto margin of orbit. Carapace smooth except for a small pterygostomial spine, antennal spine not yet developed.

Antennule (Fig. 37, b) : Peduncle unsegmented. Inner flagellum represented by a plumose seta; outer with 3 aesthetascs, a plain seta and a small bristle like seta terminally.

Antenna (Fig. 37, c) : Peduncle unsegmented bearing at endopod base a serrated spine. Endopod unsegmented, about 3/4th of scale and terminated by a long plumose seta + a smaller stout spine having a minute basal spine, scale with 4 distal segments, with 2 plumose setae on outer and 1 plain + 10 long plumose setae on inner margin.

Mandible (Fig. 37, d) : Incisors and molar processes clearly differentiated. Incisors with 2 or 3 sharp teeth, molar with grinding projection and remaining as cutting edge with a single spinuous seta.

First Maxilla (Fig. 37, e) : Coxal and basal entites with 4 plain + 2 bristle like setae and 4 spines + 3 plain setae respectively. Palp slightly bifid with 3 plumose setae on terminal + 1 characteristic stout bristle like seta subterminal. Exopod completely absent.

Second Maxilla (Fig. 37, f) : Coxal and basal endites with 7+2 and 3+3 setae respectively. Endopod shorter than scaphognathite bearing 3 terminal setae, its inner lobes 3, 2, and 1 setae distalwards.. Scaphognathite with 9 setae; posterior being stouter than the rest.

First Maxilliped (Fig. 37, g) : Basis broad and bordered along its inner margin by groups of 2 or 3 setae, 3 setae proximally as in the figure. Endopod shorter than exopod, 4 segmented, setation distalwards being 3, 1, 0 & 3long + 1 small outer. Exopod with 4 natatory setae.

Second Maxilliped (Fig. 37, h) : Inner margin of basis lobed carrying 1,2,2 and 3 setae distalwards; proximal lobe carrying a characteristic long + I small setae. The 4 segmented endopod with 3,1,2 and 1 small outer + 3 long bristle like setae distalwards. Exopod with 4 natatory setae.

Third Maxilliped (Fig. 37, i) : Basis comparatively small with 3 plumose setae. Endopod longer than exopod, 4 segmented with 2, 1, 2 and 1 small outer + 3 long bristle like setae distalward. Exopod with 4+1 natatory setae.

Pereiopods (Figs. 37, j1 - j5) : All 5 represented as elongated biramous buds; endopod showing traces of segmentation not yet chelate.

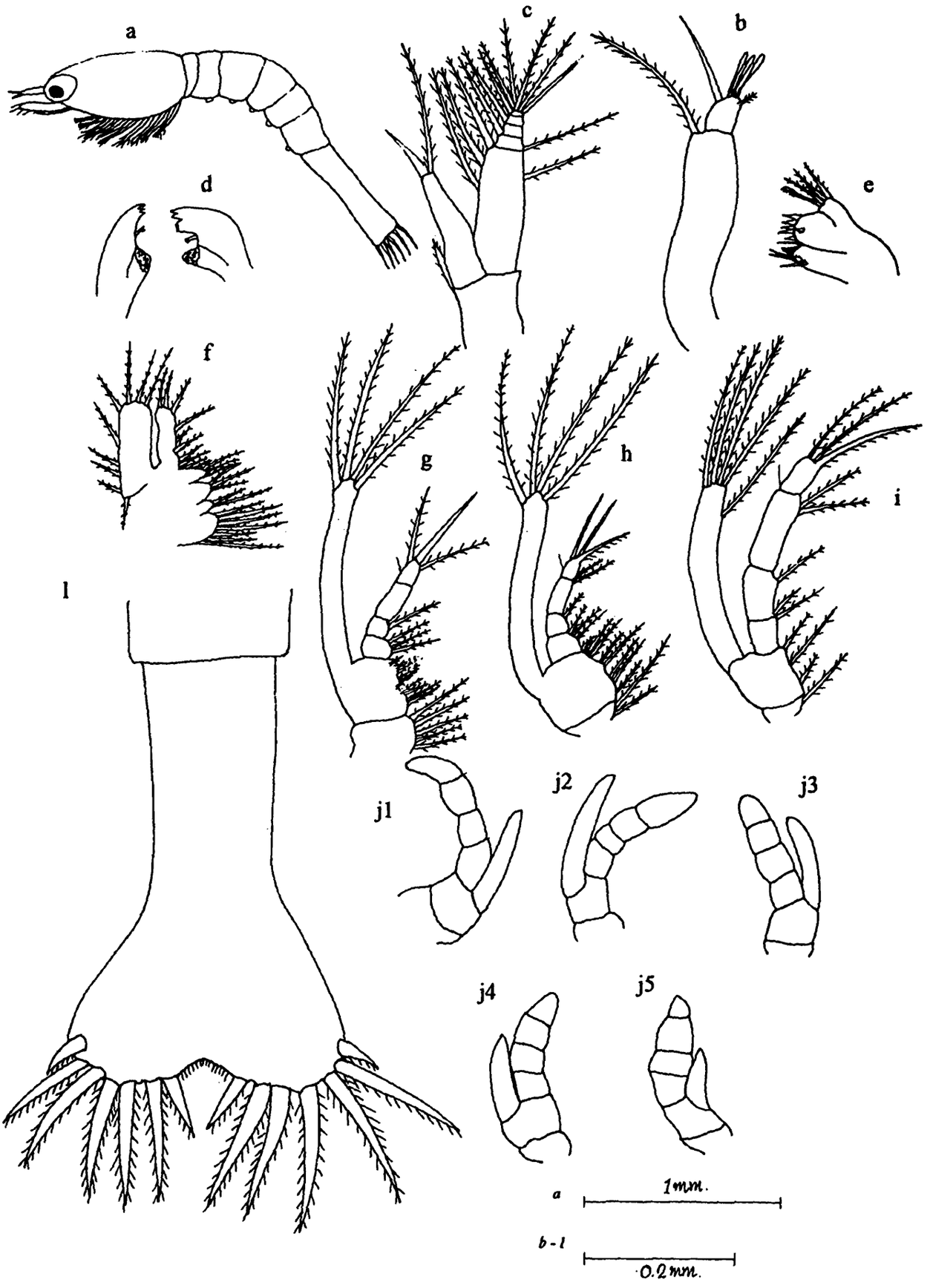

Fig. 37 : *Caridina jalihali* (I Zoea)

Abdomen : 5 segmented, all segment smooth, 6th not yet seperated from telson. Five pairs uniramous pleopod buds on 1st to 5th segments.

Telson (Fig. 37, l) : Broadly triangular with process formula 7+7. All processes plumose, first 2 plumose on the innerside.

II Zoea
(Fig. 38)

Total length : 2.30 to 2.40 mm. Duration : 1 day.

Rostrum (Fig. 38, a) : Straight, extending upto tip of 2nd segment of antenular peduncle. Antennal spine not yet developed; Eyes stalked and free from carapace.

Antennules (Fig. 38, b) : Peduncle 3-segmented with setation as in the figure. Basal segment showing traces of future stylocerite with 2 small bristles and as anteriorly directed ventral spine well above the level of stylocerite. Both rami well developed, inner unsegmented with 1 plain seta; outer 2 segmented bearing 3 aesthetascs 1 plain seta terminally.

Antenna (Fig. 38, c) : Scale now with 3 distal segments, 2 outer setae and 1 plain + 12 plumose setae on inner margin. Endopod flagellar, distinctly longer than scale and with 7 segments, 3rd segment being longest.

Mandible (Fig. 38, d) : No appreciable change.

First Maxilla (Fig. 38, e) : No change except for increase in number of setae.

Second Maxilla (Fig. 38, f) : Coxal and basal endites with 9+2 and 4+4 setae. Endopod with 3,2,1,1 subterminal + 2 terminal setae. Scaphognathite with about 14 setae, posterior most being stoutest, proximal lobe of scaphognathite well developed.

First Maxilliped (Fig. 38, g) : No appreciable change except for increase in setation of coxa and basis and an additional plumose seta distally on outer margin of 2nd segment of endopod.

Second Maxilliped (Fig. 38, h) : Exopod now 5 segment with 3,1,0,2 + 1 small outer + 3 terminal setae distalwards and an additional plumose seta on outer margin of basal segment of exopod.

Third Maxilliped (Fig. 38, i) : Endopod now 5 segmented, setation distalwards being 2,1,0,2 inner, 1 small outer + 3 terminal setae and an additional seta on outer margin of 3rd segment of endopod.

Pereiopods (Figs. 38, j1 - j5) : All 5 pairs fully functional with setae on endopods and exopds. First 2 pairs showing chelate nature and with 5 natatory setae on their exopods. Exopods of third, fourth and fifth pairs with 4, 4 and 2 natatory setae respectively.

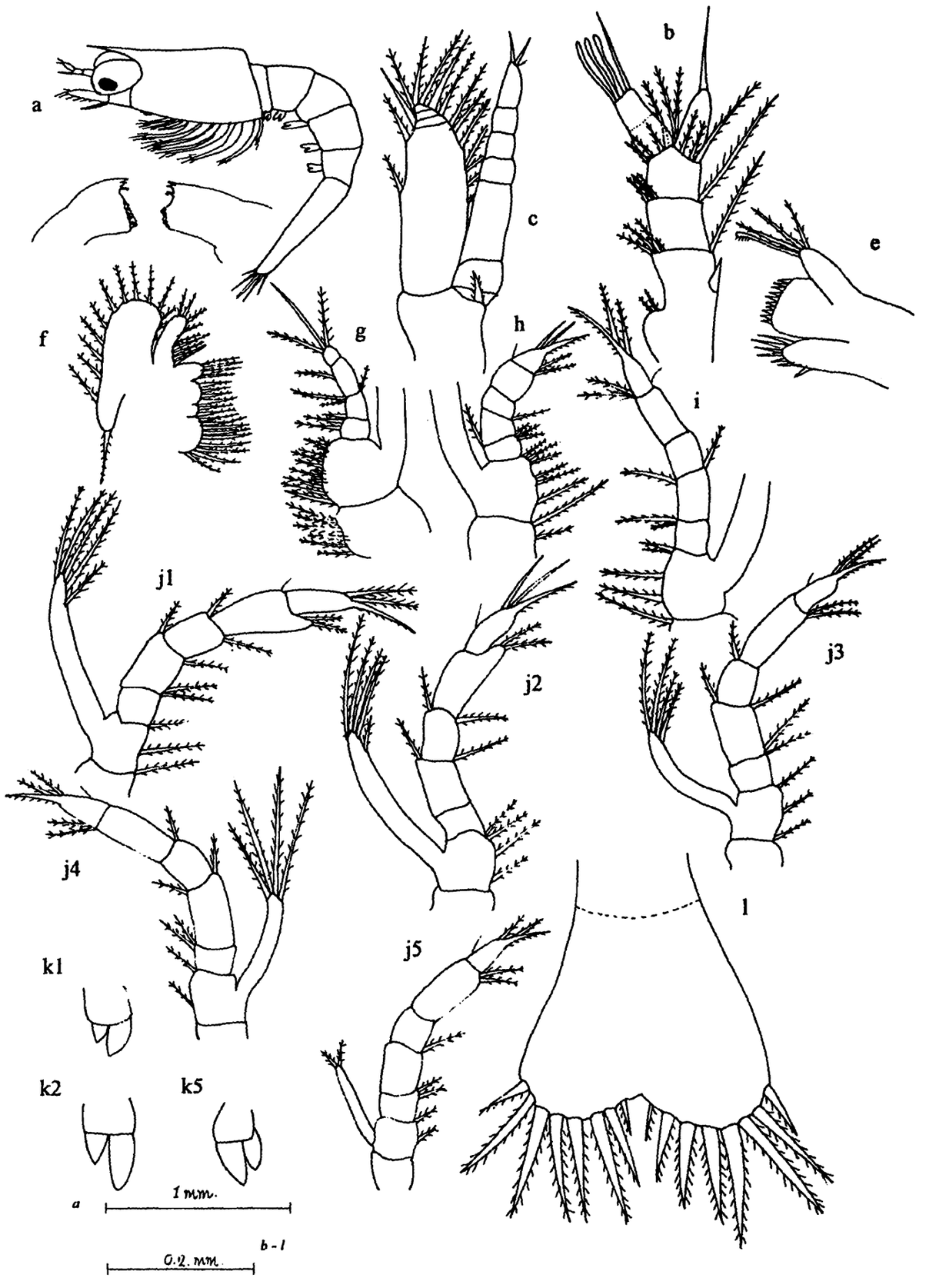

Fig. 38 : *Caridina jalihali* (II Zoea)

Pleopods (Figs. 38, k1, k2, k5) : Biramous and clearly segmented.

Telson (Fig. 38, l) : Process formula now 8+8 with an additional pair (8th) of small setae; 2nd process now plumose on both margins. 7th and 8th spinulose only on the outerside.

Uropods (Fig. 38, l) : Buds seen within telson cuticle.

III Zoea
(Fig. 39)

Total length : 2.7 to 2.85 mm. Duration : 2 days.

Rostrum (Fig. 39, a) : Still smooth and extending upto tip of 2nd segment of antennular peduncle. Carapace with acute angle in place of antennal spine.

Antennule (Fig. 39, b) : Basal segment with a future stylocerite with 2 bristles on its inner side and 2 setae on outer margin. Inner rami 3-segmented, outer still 2-segmented with 3 terminal aesthetascs + 1 plain seta.

Antenna (Fig. 39, c) : Scale without any distal segments and with a spine on outer margin; outer setae completely lost; peduncle with a new small spine at base of scale. Endopod flagellar with 8 segments.

Mandible (Fig. 39, d) : No change except for increase in number of serrated spines on cutting edge.

First & Second Maxilla (Figs. 39, e & f) : No change except for general increase in number of setae.

Maxillipeds (Figs. 39, g, h, & i) : No appreciable change over that of previous stage.

Pereiopods (Figs. 39, j1 - j5) : Chelate nature of first 2 pairs more prominent but no appreciable change in remaining pereiopods.

Abdomen : Sixth segment separated from telson and with a pair of posterolateral spines.

Pleopods (Figs. 39, k1, k2, k5) : Now elongated and clearly segmented; endopods of second to fifth pairs with buds of appendix interna.

Telson (Fig. 39, l) : Posterior margin narrow with deep median notch. Process formula 8+8, first process being transformed into a spine.

Uropods (Fig. 39, l) : Functional exopods bearing 6 plumose setae while endopods still as narrow elongated buds.

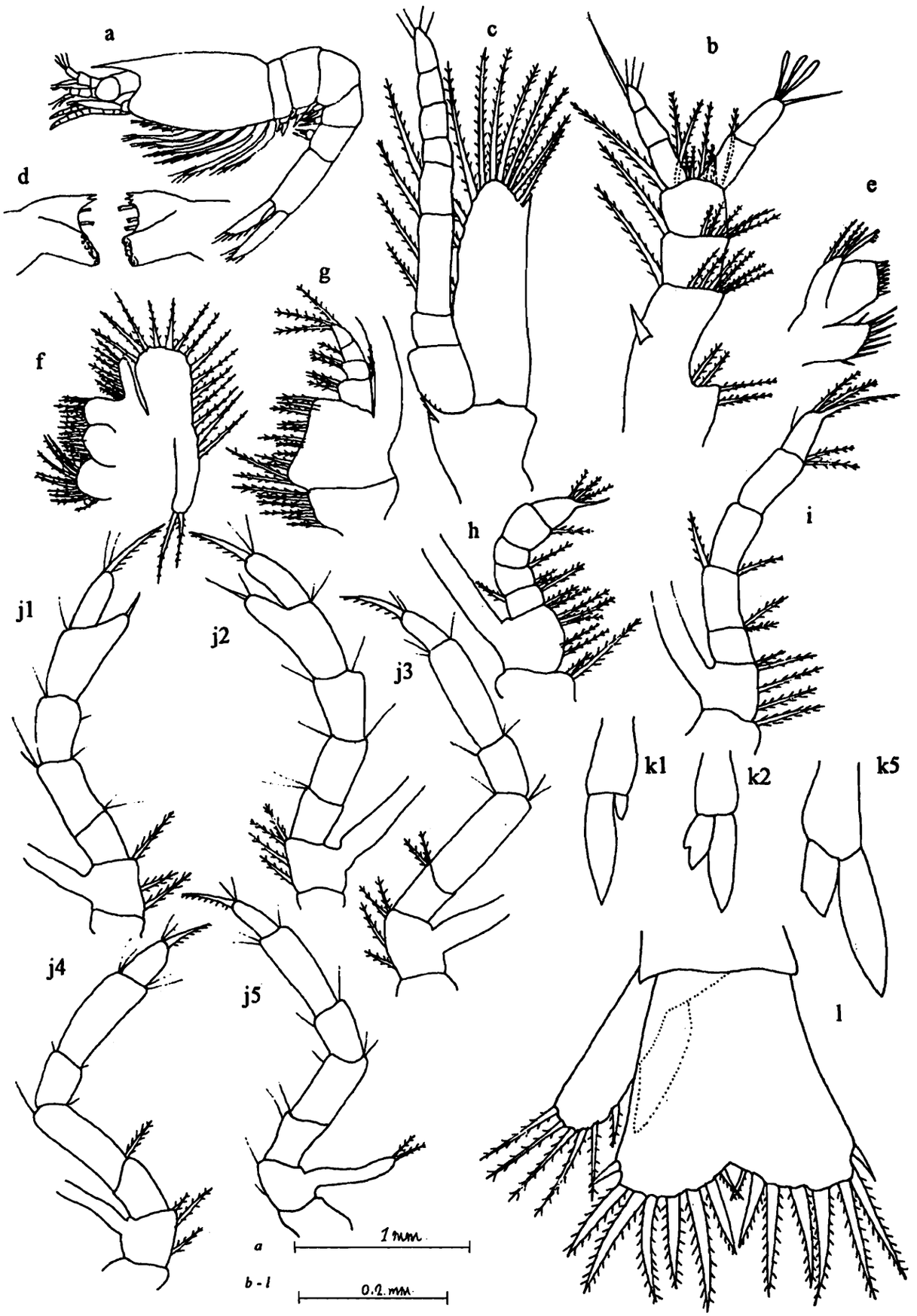

Fig. 39 : *Caridina jalihali* (III Zoea)

Post - larva
(Figs. 40 & 41)

Total length : 2.8 to 2.9 mm. Rostrum: Straight and extending up to middle of 3rd segment of antennular peduncle. Rostral formula $\frac{1 \text{ or } 2}{0}$, no postorbital. Carapace with a distinct antennal spine in addition to a sharp pterygostomial spine.

Antennule (Fig. 40, b) : Basal segment with a well developed stylocerite and 2 spines on anterior border. A single anterior spine on 2nd segment. Inner flagellum 4-segmented; and longer than outer; outer 2 segmented, with 3 aesthetascs + 1 plain seta arranged subterminally on 2nd segment as shown in figure.

Antenna (Fig. 40, c) : Adult like, basal segment of the peduncle with a sharp spine at base of scale. Lamella of scale over-reaches outer spine.

Mandible (Fig. 40, d) : Adult like with more incisor teeth and spinuous setae on cutting margin being replaced by hairs.

Maxillae (Figs. 40, e & f) : Almost as in adult but less setose, second with podobranch and third with epipod buds.

Pereiopods (Figs. 40, j1 & Figs. 41, j2 - j5) : Chelipeds with brushes of hairs as in adult. Carpus of first pair excavated deeply. Dactylus of last 3 pereiopods with subterminal spines each on its posterior margin. Exopods of first 2 pairs with natatory setae while of last 3 reduced to elongated buds. Setobranch and an epipod each on first 4 pereiopods.

Pleopods (Figs. 41, k1, k2, k5) : Functional with setose on exo and endopods (except endopod of first which is highly reduced). Appendix interna with 2 hooks.

Telson (Fig. 41, l) : Rectangular in shape with a narrow deeply notched posterior margin. First pair of spines of last stage now shifted anteriorly, 2 more spines distally on lateral margin. Process formula 5+5, outermost being largest and slightly plumose only on its inner margin.

Uropods (Fig. 41, l) : Almost equal to telson. Both rami setose. Outer margin of exopod ending in a subapical spine with an accessory subapical spine forming diaeresis.

DISCUSSION

Ample information is available on the larval development of atyid genus *Caridina*. (Daday 1907, Gurney 1927, 1942, Holthius, 1980, Shen 1939, Nair 1949, Babu 1963, Shokita 1973, Chinnayya 1971, Lakshmi 1975, Pillai 1960a, 1960b, 1975, Glaister 1976, Jalihal 1983, 2006 Shokita 1976, Benzie 1982, Richard 1983, Benzie and de Silva 1983, Salman 1987, Zhang, Jiansen and Sun, Xiaoyi, 1979). All the described larval development patterns fall into three types: 1. Normal or prolonged type, 2. Partially abbreviated type and 3. Completely abbreviated type.

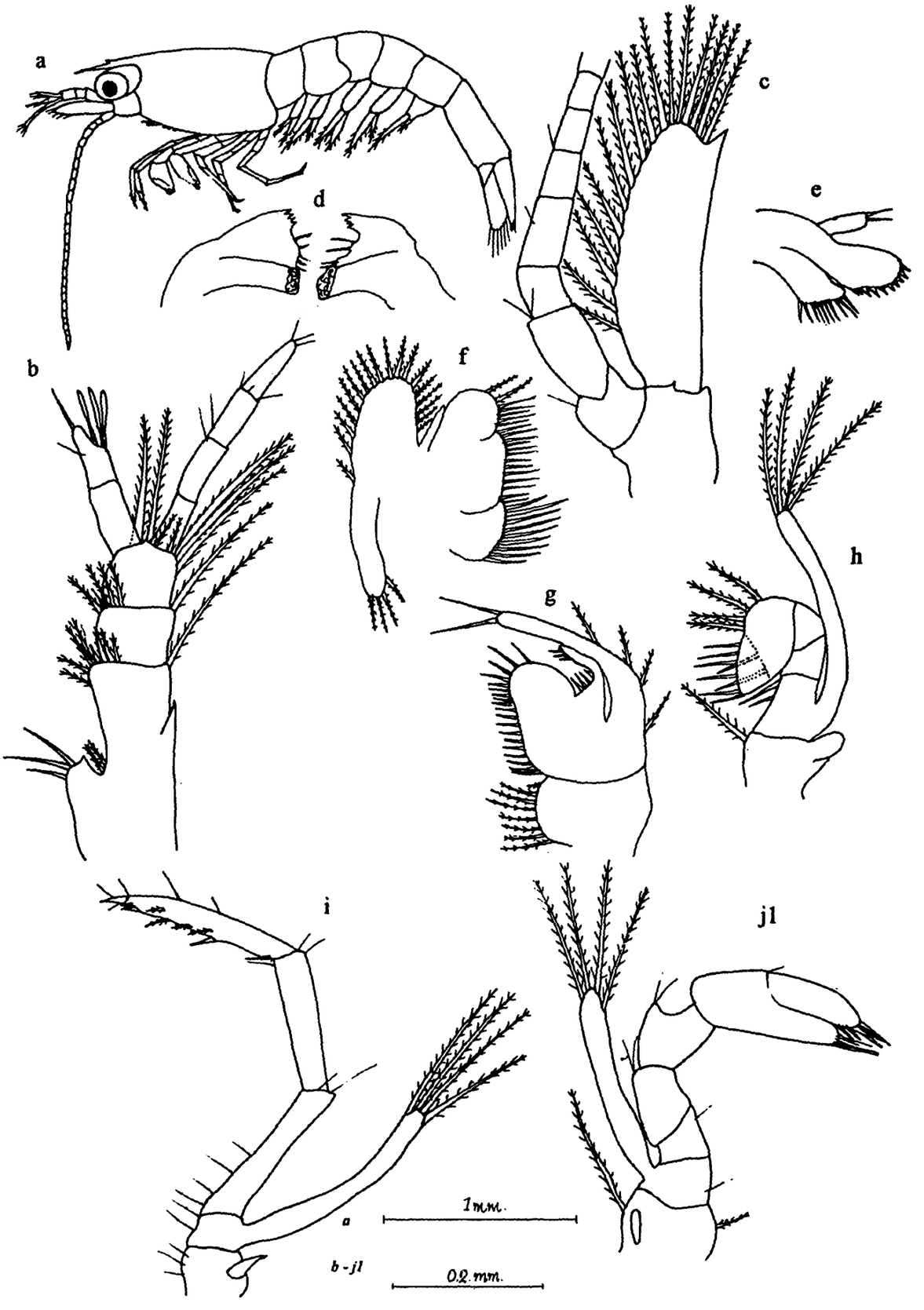

Fig. 40 : *Caridina jalihali* (Post-larva)

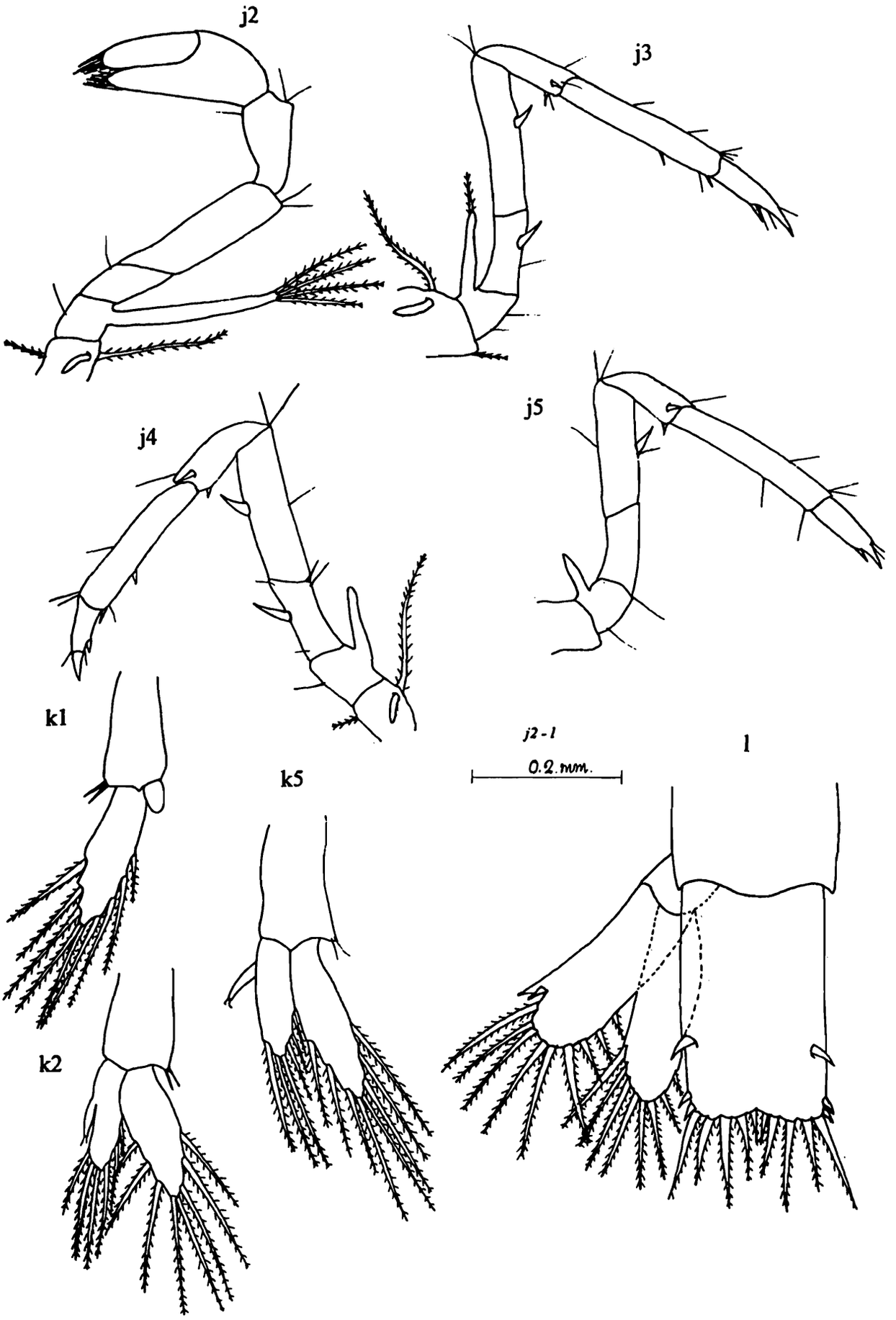

Fig. 41 : *Caridina jalihali* (Post-larva)

The species of *Caridina* with prolonged type of developmental have more number of small-sized numbers of eggs. Zoeal stages ranging from 5 to 9. At hatching larvae possess a few pairs of pereiopod buds, but no pleopods. Telson process formula 7+7. The developmental of *C. gracilirostris, C. gracilipes, C. bengalensis* and *C. williamsoni* of the present investigation falls into this group.

The species that have abbreviated development have less number of larger-sized eggs, and number of zoeal stages are 3 to 4. At hatching larvae possess all 5 pairs of pereiopod buds and pleopods in the form of uniramous or biramous buds. Telson process formula 7+7 or rarely 8+8. The development of *C. kunnathurensis, C. gurneyi* and *C. jalihali* fall into this group. However, 8+8 telson process formula (Nair 1949 and Lakshmi 1985) is not found in any of these three species.

Species with abbreviated development have very few large-sized eggs (1.6x1.05 mm in *Neocaridina denticulata.* Mizue and Iwamoto (1961). Larvae possess eyes which may or may not be stalked, adult-like pereiopods and setose pleopods, elongated and round telson with process formula 8+8 without uropods. None of the present species has this developmental pattern.

Despite the information available larval characters are rarely used to solve problems in systematics. In the present study closely resembling species with over-lapping characters are dealt with. Wherein the larval characters confirm the distinctness of the two species based on adult.

C. bengalensis de Man (1908a) and *C. gracilipes* de Man (1892). were described as two distinct varieties of *C. nilotica* (de Man 1908b). Later these two varieties were considered as full species by Ravindranath 1977, 1981 and Richard 1983. Several authors (Kemp 1915, 1918, Bouvier 1925, Johnson 1963, Ravindranath 1977, Richard 1983, Richard and Chandran 1994) doubted the validity of these two forms as full species. In the present study by adult or larvel characters de Man's (1908b) observation of these two forms as separate varieties (as established by him, and now as species) is confirmed. Further the differences between the zoea of these two species are listed as fallows.

All these differences confirm the conclusions of morphotaxonomy :

1. In first zoea the antenna in *C. gracilipes* the antennular peduncle unsegmented with a serrated spine about 1/5th of the endopod. Where as in *C. bengalensis* it is about ½ of the endopod.
2. In first maxilla palm bears 3 plumose setae in *C. gracilipes* and it is 2 in *C. bengalensis.*
3. In second maxilla scaphogathite with 5 plumose setae in *C. gracilipes* and it is 6 in number in *C. bengalensis.*
4. Periopods in *C. gracilipes* the first pair as small uniramous buds but it is absent in *C. bengalensis.*

5. Telson median notch with 14-16 minute hairs in *C. gracilipes*, it is 16-20 in *C. bengalensis.*

C. kunnathurensis Richard and Chandran 1994, *C. gurneyi* Jalihal *et al.*, 1984 and the *C. jalihali* Mariappan and Richard, 2006 of the present study are all with partially abbreviated development comprising 3+1 stages exhibit following larval differences. The differences between *C. gurneyi* and *C. jalihali* lend larval evidence in distinguishing the two species.

Amongst these, *C. kunnathurensis* larvae in having last two pairs of periopods uniramous and more setose and segmented pleopods are more advanced than those of other two species. Also in postlarva carpus of first cheliped is not deeply excavated and telson median notch is deep in *C. kunnathurensis* but not in *C. gurneyi* and *C. jalihali.*

Larvae of *C. gurneyi* and *C. jalihali* distinctly differ as follows :

1. In rostral extension it is slightly beyond sessile eyes in *C. gurneyi*, whereas in *C. jalihali* it is up to margin of orbit.

2. In antennule, outer flagellum with 2 aesthetascs in *C. gurneyi*. In *C. jalihali*, 3 aesthetascs is present in outer flagellum on antennule.

3. In *C. gurneyi*, peduncle of antenna with smooth spine at the base of endopod. But in *C. jalihali* peduncle with serrated spine at the base of endopod.

4. First 2 pairs of periopods showing traces of chelate nature in *C. gurneyi*, no such chelate nature in *C. jalihali.*

5. Pleopods possess 5 pairs of biramous buds in *C. gurneyi*, where as in *C. jalihali* all 5 pair's plopods shows uniramous buds.

Comparison of first zoeae of the species with prolonged type of development in Table No. 1.

Table No. 1

S. No.	*Characters*	*C. gracilipes*	*C. bengalensis*	*C. williamsoni*
1.	No. of Zoeal stages	7	7	6
2.	Duration	14-15 days	14-15 days	12-14 days
1.	**First Zoea** Size	1.46-1.60 mm	1.50-1.60mm	1.50-1.60 mm
2.	Rostrum	Shorter than the sessile eyes	Not reaching beyond the sessile eyes	Shorter than the sessile eyes

3.	Antennule	Outer ramus unsegmented short with 2 aesthetascs, one plain and a bristle-like seta	Outer ramus unsegmented short with 2 aesthetascs, one plain and a bristle-like seta	Outer ramus unsegmented short with 2 aesthetascs, one plain and a bristle-like seta
4.	Antenna	Scale 3.0 times as long as broad, 2plumose setae on outer margin.	Scale3.10 times as long as broad, 2plumose setae on outer margin.	Scale 2.9 times as long as broad, 2 plumose setae on outer margin.
5.	First Maxilla	Palp bears 3 plumose and one blunt setae. Exopod with 2 plumose setae	Palp bears 2 plumose and one blunt setae. Exopod with 2 plumose setae	Palp bears 3 plumose and one blunt setae. Exopod with 3 plumose setae
6.	Secont Maxilla	Scaphognathite with 5 plumose setae	Scaphognathite with 6 plumose setae	Scaphognathite with 5 plumose setae
7.	Periopods	Only 1st pair as uniramous bud	Absent	Absent
8.	Telson	All process plumose, first 2 on inner margin. Median notch with 14-16 hairs	All process plumose, first 2 on inner margin. Median notch with 16-20 hairs	All process plumose,first on inner margin. Median notch with 13-15 hairs

Key for identification of the first zoea of *Caridina* species of Kanchipuram and Thiruvallur Districts is provided below :

Key to the I Zoea of the *Caridina* of Kanchipuram and Thiruvallur Districts

1. All five pairs of pleopod buds developed 2

– All five pairs of pleopod buds not yet developed 4

2. All five pairs of pleopods as uniramous buds .....

..... *C. jalihali* Mariappan and Richard, 2006

– All five pairs of pleopods as biramous buds 3

3. First 3 periopods biramous buds, last 2 uniramous. .....

..... *C. kunnathurensis* Richard and Chandran, 1994

– All five pereiopods developed as elongated biramous buds; .... *C. gurneyi* Jalihal *et al.*, 1984

4. Only first pair of pereiopods present as small uniramous buds .... *C. gracilipes* de Man.1892

Pereiopod buds absent 5

5. Rostrum overreaching sessile eyes. Outer flagellum of antennule bearing 3 aesthetascs. Endopod of the antenna almost 2/3 of scale. The median notch of the telson smooth. ..... *C. gracilirostris* de Man 1892

– Rostrum not reaching the sessile eyes. Outer flagellum of antennule bearing 2 aesthetascs. Endopod of antenna less than 2/3 of scale. Median notch of telson with hairs 6

6. Antennal scale 3.10 times as long as broad and with 2 outer plumose setae. I Maxilla - Palp with 2 plumose + 1 blunt seta and exopod with 2 plumose setae; II Maxilla - Scaphognathite with 6 plumose setae.Median notch of telson with 16 to 20 hairs ..... *C. bengalensis* de Man 1908

– Antenna 2.9 times as long as broad and with 3 outer plumose setae. I Maxilla palp with 3 plumose + 1 blunt setae and exopod with 3 plumose setae; II Maxilla scaphognathite with 5 plumose setae. Median notch of telson with 13 to 15 hairs. ..... *C. williamsoni* Jalihal *et al.*, 1984

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