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Larval development — *PENAEUS INDICUS* H. MILNE EDWARDS

M. S. Muthu
N. N. Pillai
K. V. George

The larvae ot *Penaeus indicus* reared from eggs spawned in the laboratory are discribed and illustrated and compared with earlier descriptions of the species. At the rearing temperature of 24.4°C to 26.8°C the nauplii hatched out of the eggs 16-17 hours after spawing; the nauplius stage lasted 40-50 hours and the protozoea and mysis stages 4-6½ and 4-7 days respectivley. The larvae passed through 6 nauplius substages, 3 protozoea substages and 3 mysis substages before reaching postlarva I stage.

Based on material from plankton samples, Menon (1937, *Bull. Madras. Govt. Mus. Natural Hist. Sec.* 3 (5): 1-56[1]), Mohamed *et.al.* (1968, *FAO. Fish. Rep.*, 57(2): 487-504[2]), Rao (1973, *J. mar. biol. Ass. India*, 15(1): 95-124[3]); and Subrahmanyam (1965,. *J. mar. biol. Ass. India*. 7 (1) :83-88[4]) described some stages of penaeid larvae, attributing them to *Penaeus indicus* on circumstantial evidence. The present studies based on spawning and rearing of *P. indicus*

at the Narakkal Prawn Culture Laboratory of the Central Marine Fisheries Research Institute during January-March 1976 showed that the larval features of *P. indicus* are different from these early descriptions. A detailed description of the eggs and larvae of this commercially important species is presented here. The temperature and salinity of the water in the rearing basins was 24.4° C-26.8° C and 33.8‰-34.1‰ respectively.

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DESCRIPTION OF DEVELOPMENTAL STAGES

EGGS

Eggs opaque, with a narrow perivitelline space, chorion has a purplish sheen, diameter of eggs varied from 0.25 to 0.27 mm and that of yolk mass 0.22 to 0.24 mm.

The eggs when first observed at 23.45 hours were covered with a gradiating jelly like substance which partly dissolved and became granular while being observed under the microscope, and disappeared after 3 minutes. The egg was then spherical but without perivitelline space and appeared to be still invested with jelly like substance which was transparent. A polar body was seen adhering to the surface of the egg. Within one minute the perivitelline space was formed by the elevation of the fertilization membrane (Fig. 1,a) and the egg assumed the definitive form (Fig.1,b). Immediately after a second polar body was seen coming out of the yolk mass and traversing the perivitelline space just below the first polar body and soon reached the surface of the egg. The first cleavage began at 00.15 hours, about 30 minutes after the extrusion of the eggs (Fig.1,c). The second cleavage (Fig.1,d) took place at 00.30 hours. The cleavage continued (Fig.1,e,) and at 01.30 hours the blastula stage was observed (Fig. 1,f). An embryonic membrane was clearly visible during the blastula stage. Gastrulation (Fig.1,g) started at 02.15 hours and continued up to 02.55 hours. At 04.50 hours the embryonal mass became constricted laterally and the appendages started differentiating (Fig.1, h, i, j,). By 07.45 hours all the 3 naupliar appendages could be seen as lateral thickenings (Fig.1,k) which became tipped with short spine-like setae by 09.45 hours (Fig. 1,l). At 13.00 hours the 3 appendages were fully formed with long setae. The embryo occupied the entire space inside the egg and

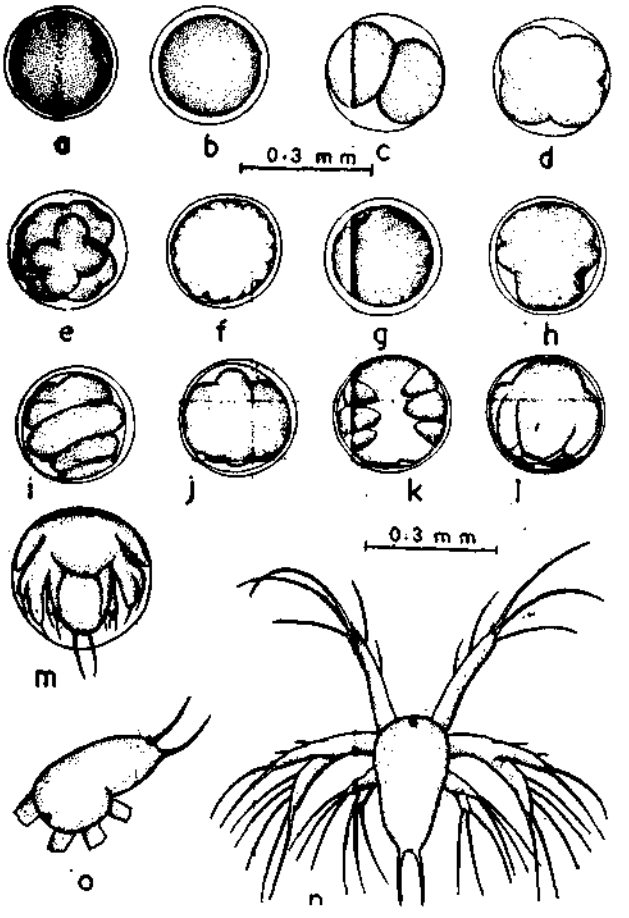

Fig. 1 *Penaeus indicus*: a to l - egg in various stages of development; m - egg with nauplius inside; n - Nauplius I; o - lateral view of Nauplius I.

the movements were restricted to sudden jerks of appendages. The furcal setae first pierced the egg membrane (Fig.1,m) and the nauplius wriggled out of the egg 16 to 17 hours after the eggs were spawned.

NAUPLIUS I

MTL: 0.30 mm (0.28 - 0.31 mm);MW: 0.17 mm (0.15-0.17 mm); MFS: 0.13 mm (0.11-0.14 mm).

An ocellus present at anterior median

region of body, dorsal surface of body bears posteriorly a small median denticle (Fig.1,o) a pair of dorsally curved caudal setae present at posterior end of body, 3 pairs of appendages present (Fig.1,n); A1 uniramous, with 2 long setae of almost same length and a small rudimentary spine-like seta at its apex, 2 short setae on inner distal margin and one long seta on outer distal margin; A2 biramous, endopod shorter than exopod, bearing 2 long setae and one rudimentary seta at apex, and 2 short setae along inner margin, exopod carries 5 long setae along inner margin and tip; Md biramous, shorter than other appendages, bearing 3 long setae on endopod and exopod; setae of appendages nonplumose.Duration of this substage was 4 to 4 hours.

NAUPLIUS II

MTL: 0.31 mm (0.29-0.32 mm); MW: 0.17mm (0.15-0.18 mm); MFS: 0.14 mm (0.13-0.15mm).

Setae on appendages plumose; no change in number of setae on A1, but outer terminal and outer lateral setae distinctly smaller than in Nauplius I, inner distal rudimentary seta of nauplius I transformed into a short seta; exopod of A2 with an additional rudimentary seta on outer distal margin, the 4th seta counting from the proximal end bifurcates (Fig.2,a), this bifurcate condition is retained in later naupliar substages; Md comparatively longer; furcal setae show a faint demarcation at proximal 1/3; duration of this substage is 3 to 4 hours.

NAUPLIUS III

MTL: 0.31 mm(0.29-0,32mm); MW: 0.16 mm (0.14-0.17 mm); MFS: 0.14mm (0.13-0.15 mm).

No appreciable increase in body measurements; furcal lobes each with 3 setae (Fig. 2,b) of which innermost very small and slightly ventrally placed and hence not clearly visible in dorsal view; no increase in number of setae on appendages; among A1 setae inner terminal seta longer and outer terminal seta shorter than in nauplius II; rudimentary setae at tip of A2 exopod and endopod in nauplius II has become longer and plumose. Duration of this substage is 6 to 8 hours.

NAUPLIUS IV

MTL: 0.36 mm (0.34-0.38 mm);MW: 0.17 mm (0.15-0.18 mm);MFS: 0.20 mm (0.19-0.21 mm).

The furcal lobes become more distinct and bear 4 setae (Fig.2,c) each, outermost

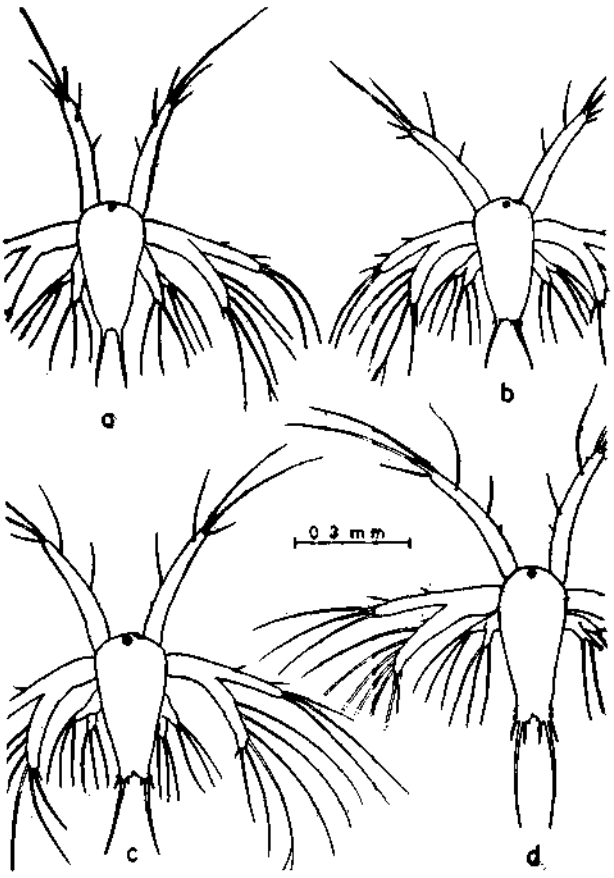

Fig. 2 *Penaeus indicus:* a - Nauplius II; b - Nauplius III; c - Nauplius iv; d - Nauplius v.

seta smallest and being dorsally placed not clearly visible in ventral view; rudiments of developing Mx1, Mx2, Mxp1, Mxp3 seen inside cuticle; A1 outer lateral seta lost and one very small seta added on inner lateral aspect proximally; proximal portion with indistinct segmentation; exopod of A2 with 6 long plumose setae and one rudimentary spine-like seta distally, indistinct segmentation seen in exopod, inner terminal seta on A2 endopod longer. Duration of this substage is 3 to 4 hours.

NAUPLIUS V

MTL: 0.38 mm (0.35-0.41 mm); MW: 0.17 mm (0.15-0.20 mm); MFS: 0.23 mm(0.20-0.28 mm).

Furcal lobes well developed, each carrying 6 setae (Fig. 2,d), minute outermost one being dorsally placed; rudimentary oral appendages become biramous; endopod of A2 with 2 short setae on inner lateral margin and 3 long plumose setae and 1 rudimentary seta terminally, exopod with 9 setae along inner and distal margin, of which distal outer and inner proximal rudimentary and spine like; a prominent rounded swelling appears at base of Md; no change in A1 setation. Duration of this substage was 10 to 12 hours.

NAUPLIUS VI

MTL: 0.48 mm (0.43-0.54 mm); MW: 0.20 mm (0.18-0.21mm); MFS: 0.31 mm (0.29-0.34 mm).

Body more elongated, frontal organ and carapace clearly demarcated (Fig.3,a,b), appendages not clearly segmented, but surface with annular indentations, furcal lobes with 7 setae each (Fig. 3,b); one minute and 2 short setae added to A1 on distolateral aspect, A1 proximally with 5 indistinct segments; endopod of A2 with 3 long setae and 1 short one terminally and with a rudimentary seta added to root of distal seta on inner lateral margin, exopod with 10 setae along inner and distal margin, of which newly added distal outer one rudimentary. Duration of this substage was 15 to 24 hours.

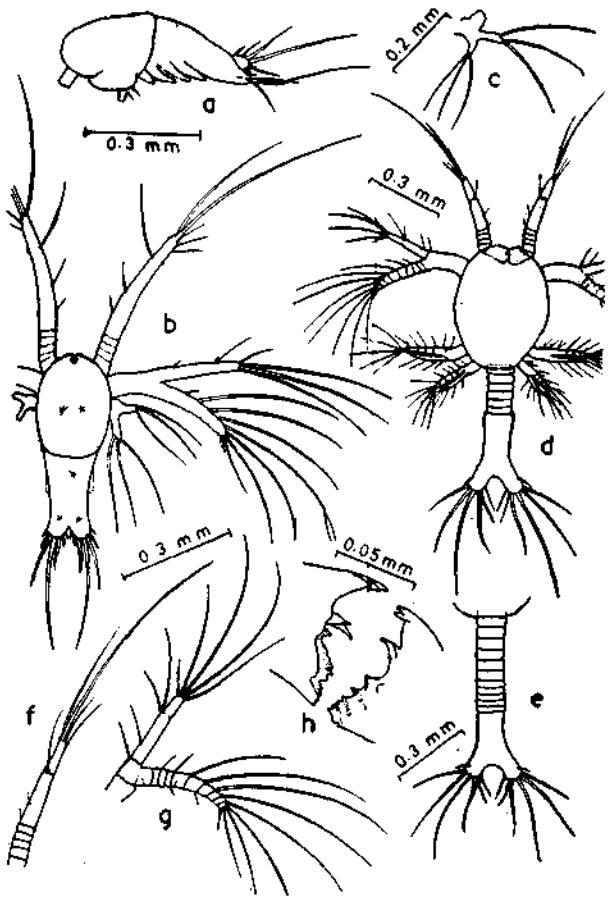

Fig. 3 *Penaeus indicus;* a - Nauplius VI lateral view; b - dorsal view of Naudlius VI; c - Md of Nauplius VI. Protozoea I: d - dorsal view; e - abdomen of advanced stage; f - A 1; g - A2; h - Md.

PROTOZOEA I

MTL: 0.88 mm (0.88-0.91 mm); MCL: 0.42 mm

Carapace anteriorly rounded, with median notch. frontal organs present as rounded protuberances, ocellus of nauplius persists, developing compound eyes covered with carapace, body divisible into 3 parts, carapace covered anterior region, 6 segmented thorax in middle and posterior unsegmented abdomen; newly hatched protozoea with a swelling in anterior part of the abdomen (Fig.3,d) which is replaced in advanced protozoea I by 5 somites resulting in lengthening of abdomen (Fig.3,e); last abdominal somite and telson not separated by a movable joint, each lobe of caudal furca with 7 setae, outermost seta originates from dorsolateral aspect of furca and is dorsally disposed.

A1 (Fig.3,f) 3 segmented, basal segment with 5 subsegments, middle segment with 3 setae and distal segment with 2 setae of which one is long, about twice length of A1 peduncle and 2 aesthaetes, a spike-like setal rudiment present on distal inner margin of terminal segment; A2 (Fig.3,g) biramous, endopod 2 segmented and exopod 10 segmented, 1st segment of endopod with 4 plumose setae of which 2 are placed together near inner distal margin of 1st joint, distal segment with 5 plumose setae of which inner one is smallest, exopod with 11 plumose setae along inner and distal margin and 2 small setae on outer margin; Md (Fig.3,h) flattened, without exopod and endopod, incisor process with 2 or 3 teeth and molar with transverse rows of smaller grinding teeth 1 free standing tooth present between molar and incisor process; Mx1 (Fig.4,a) with unsegmented protopod having 2 lobes, proximal with 7 and distal with

4 setae, some setae stout and distally spinose, exopod small, knob like with 4 long feathery setae, endopod 3 segmented, distal segment carries 5 long plumose setae, basal and middle segments carry 3 and 2plumose setae respectively; Mx2 (Fig.4,b) with protopod having 5 lobes on inner margin, 1st lobe with 7 or 8 setae, 2nd and 3rd with 4 setae and 4th and 5th with 3 setae respectively, exopod knob-like, with 5

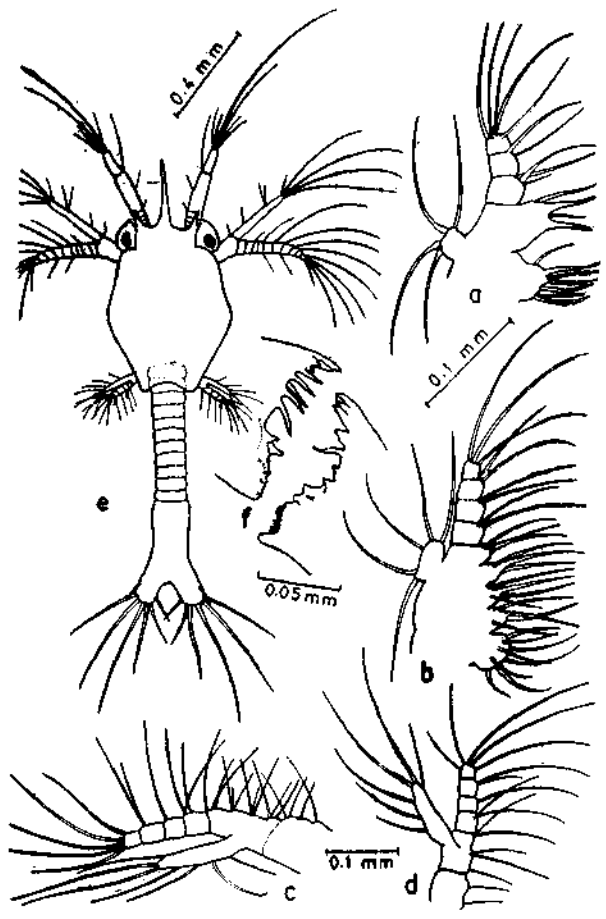

Fig. 4 *Penaeus indicus:* Protozoea I: a - Mx1; b - Mx2; c - Mxp1; d - Mxp2. Protozoea II: e - dorsal view; f - Md.

long feathery setae, endopod 4 segmented, terminal segment with 3 long setae distally, the other 3 segments each with 2 long setae on inner margin; Mxp1 (Fig.4,c) biramous, longer than Mx2, protopod 2 jointed, coxa with 4 to 5 and basis with 12 setae along inner margin, exopod unsegmented, carrying 7 plumose setae, 4 along outer margin, 2 terminal and one subterminal on inner margin, endopod 4 segmented, 1st, 2nd, 3rd and 4th segments carry 3, 1, 2 and 5 long plumose setae respectively; Mxp2 (Fig.4,d) shorter than Mxp1, protopod 2 segmented, coxa with 2 and basis with 5 setae along inner margin, exopod unsegmented, with 6 plumose setae; 3 along outer margin, 2 terminal and one subterminal on inner margin, endopod 4 segmented, carrying 2, 1, 2, and 5 plumose setae on segments 1, 2, 3 and 4 respectively. Duration of this substage was 24 to 48 hours.

PROTOZOEA II

MTL: 1.52 mm (1.40-1.55 mm); MCL: 0.74 mm (0.71-0.76 mm).

Presence of a well developed curved rostrum, bifurcated supraorbital spines (Fig. 4,e), stalked compound eyes and absence of frontal organs distinguish this substage from the previous one.

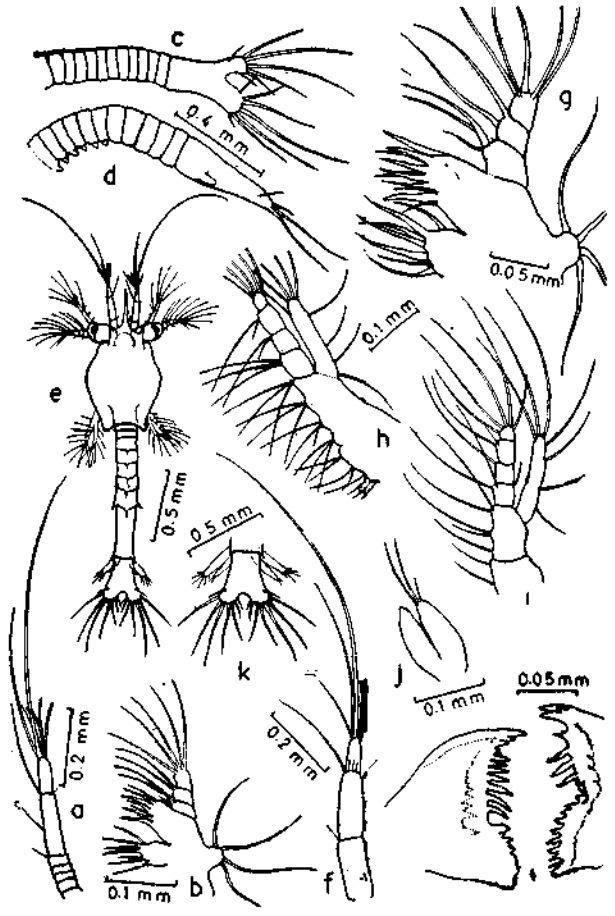

Fig. 5 *Penaeus indicus:* Protozoea II: a - A1; b - Mx1; c - abdomen of early stage; d - abdomen of late stage. Protozoea III: e - dorsal view; f - A1; g - Mx1; h - Mxp1; i - Mxp2; j - Mxp3; k - uropod and telson. Mysis I: l - Md.

A1 (Fig.5,a) with distal segment bearing 4 aesthaetes and 2 long setae; Md (Fig.4,f) asymmetrical, right and left Md with 1 and 5 free standing teeth between incisor and molar processes; Mx1 (Fig.5,b) with 8 setae on distal lobe of protopod; Mxp1 with 2 plumose setae on 2nd segment of endopod.

As in the previous stage, the larvae show increase in length towards end of this stage. There is a definite increase in body length, MTL being 1.88 mm (1.72-1.99 mm) and MCL: 0 83 mm (0.78-0 84 mm). Advanced stage of protozoea II (Fig.5,d) can be easily distinguished from the early stage (Fig.5,c) by the presence of developing buds of five pereopods and Mxp3 and by the increase in length of abdominal segments. Moreover, the developing uropods can be clearly seen inside the lobes of caudal furca. Duration of this substage was 48 to 72 hours.

PROTOZOEA III

MTL: 2.69mm (2.41-2.73 mm); MCL: 1.01 mm (0.98-1.05 mm).

Supraorbital spines not bifurcate, telson demarcated from 6th abdominal segment by an articulating joint, abdominal segment 1 to 5 with dorsomedian spine on posterior border, 5th and 6th abdominal segments have each a pair of posterolateral spines (Fig.5,e), 6th segment devoid of posteromedian dorsal spine, but with a pair of ventrolateral spines, caudal furcae bear 8 setae each, a pair of biramous uropods present, exopod of uropod slightly longer than endopod and bears 6 terminal setae, endopod has 2 terminal setae, buds of pereopod and Mxp3 well developed and biramous, exopod bud of Mxp3 with 3 terminal setae (Fig.5,j); in advanced larvae of this substage, exopod and endopod of uropod are almost of same size and uropod rami reach much beyond middle of telson (Fig. 5,k); an increase in length of biramous buds of thoracic legs is also noticed.

A1 (Fig.5, f) 3 segmented, subsegments of basal segment fused into one, basal segment with one distal seta, 2nd segment with 2 lateral setae and 3 to 4 setules, distal segment with 3 or 4 aesthaetes and 3 setae of which one is long being more than twice length of peduncle, distal segment appears to be the forerunner of outer A1 flagellum; Md asymmetrical, between incisor and molar processes there are 6 free standing teeth in left Md and 2 free standing teeth in right Md; Mx1 (Fig. 5, g) with 10 setae on distal endite of protopod while setation on proximal endite remains unchanged; Mx2 with more setae on protopod endites, exopod and endopod remaining unchanged; Mxp1 (Fig.5,h) with 8 setae on coxa and 12 setae on basis of protopod and 9 setae on exopod; Mxp2 (Fig 5, i) with 7 setae on exopod and one additional seta on outer margin of 1st segment of endopod, protopod with 2 setae on coxa and 5 setae on basis. Duration of this substage was 24 to 36 hours.

MYSIS I

MTL: 3.36 mm (3.07-3.65 mm); MCL: 1.17 mm (1.12-1.26 mm).

Larvae assume more or less a shrimp like

Fig. 6 *Penaeus indicus:* Mysis I: a - lateral view; b - A1; c - A2; d - Mx1; e - Mx2; f - Mxp1; g - Mxp2; h - Mxp3; i - P1; j - P5; k - uropod and telson.

appearance in this stage, rostrum long and curved extending beyond eye, devoid of rostral spines, supraorbital prominent, a small spine present at anteroventral angle of carapace, hepatic spine well developed (Fig. 6,a), carapace covers thoracic region completely and thoracic appendages are well developed; posterolateral spines persist on 5th and 6th abdominal segments, dorsal spines present on posterior margin of 4th, 5th and 6th abdominal segments, in some specimens on 3rd segment also, in rare cases even the 1st and 2nd abdominal segments possess a dorsal spine; minute pleopod buds seen on 1st five abdominal segments; 6th abdominal segment develops a ventromedian curved spine at junction with telson, ventrolateral spines on posterior end retained; telson broader distally with a median notch, each lobe bearing 2 lateral and 6 terminal setae (Fig. 6, k), cleft extends to level half way between origin of outermost and penultimate pair of setae.

A1 (Fig.6, b) with 3 segmented peduncle, 1st segment longest with a ventromedian serrated spine, base of this segment swollen due to developing statocyst and carries 2 short plumose setae, numerous setae occur along appendage, distal segment carries 2 unsegmented rudiments of flagellae, inner one small and knob like carrying 1 very long and another short seta at its apex, outer flagellum carries on distal margin 3 setae and 4 aesthaetes; A2 (Fig 6, c) with endopod unsegmented carrying 3 terminal setae, one proximal seta on inner margin and 2 small setae near a very small knob-like projection on inner side distally, exopod unsegmented, leaf like, with a distolateral seta on outer margin and 11 setae on distal and inner lateral margin; Md (Fig. 5, 1) asymmetrical, with 7 free standing teeth in left Md and 3 in right Md, molar part shows a number of hard ridges bearing small teeth; Mx1 (Fig. 6, d), proximal segment of protopod with 8 setae; Mx2 (Fig.6,e) with exopod enlarged to form scaphognathite carrying 10 plumose setae, proximal one being long and thick; Mxp1 (Fig.6, f) with some setae on inner side of protopod longer and stouter, setae on coxa reduced to 5, exopod with 12 plumose setae, one seta each added to outer margin of 1st and 2nd segments of endopod: Mxp2 (Fig, 6,g) with 7 setae on basis of protopod, exopod as long as endopod carrying only 6 setae, 4 apical and 2 subapical, endopod 4 segmented, first 2 segments carry 1 seta on the outer side, terminal segment with 5 setae; Mxp3 (Fig. 6,h) well developed, protopod with 3 setae on basis, coxa without seta, endopod 5 segmented, terminal segment with 1 short and 5 long setae, 1st, 2nd and 4th segments each with 2 setae, 3rd segment naked, exopod as long as endopod carrying 4 apical and 3-4 subapical plumose setae; P considerably enlarged and their exopods serve as main swimming organs; P1, P2 and P3 almost identical, endopod segmentation indistinct, developing chelae with 5 long slender setae, exopod twice length of endopod with 4 apical and 3-4 subapical plumose setae (Fig.6,i); P4 and P5 almost identical, endopod unsegmented, half size of exopod, and bears 4 long setae apically, exopod with 4 long apical and 2 subapical setae (Fig.6,j); uropods well developed, protopod with a large posteroventral spine, exopod with a prominent posterolateral spine followed by a short nonplumose seta and about 15 plumose setae along distal and inner margin, endopod with 14 plumose setae along inner and distolateral margin. Duration of this substage was 48 to 72 hours.

MYSIS II

MTL: 3.50mm (3.39-3.58mm); MCL:1.20mm (1.15-1.26mm).

Presence of a spine on scaphocerite and appearance of unsegmented pleopod buds (Fig. 7, a) distinguish this substage from mysis I; no change in spination of carapace and abdomen; cleft on telson extends to level of origin of penultimate pair of lateral telsonic setae.

A1 with increased number of setae on peduncle, inner flagellum has increased in length and outer flagellum which is longer than inner with 6 aesthaetes and 1 or 2 setae at distal end; A2 (Fig.7,b) with a small ventral spine on outer distal end of 2nd segment of protopod, endopod nearly half length of exopod bearing a short apical seta, exopod with 19 long plumose setae along inner and distal margin and 1 spine at distal lateral angle; Md (Fig.7,c) with small unsegmented palp, 8 free standing teeth on left and 3 on right Md; Mx1 without exopod, size of endopod reduced; Mx2 with 14 to 15 plumose setae on exopod; Mxp1 with 12 setae on exopod; Mxp2 with 5 segmented endopod, with newly

added segment in middle without setae, terminal segment with 6 setae; Mxp3 (Fig.7,d) with endopod longer than exopod, 3rd segment with 2 setae, a seta added to outer distal margin of 4th segment; P1 P2 and P3 almost identical (Fig.7,e) endopod 5 segmented, distal segment with 2 and penultimate segment with 3 long setae, endopod of P4 and P5 (Fig.7, f) 4 segmented, distal segment with 2 apical

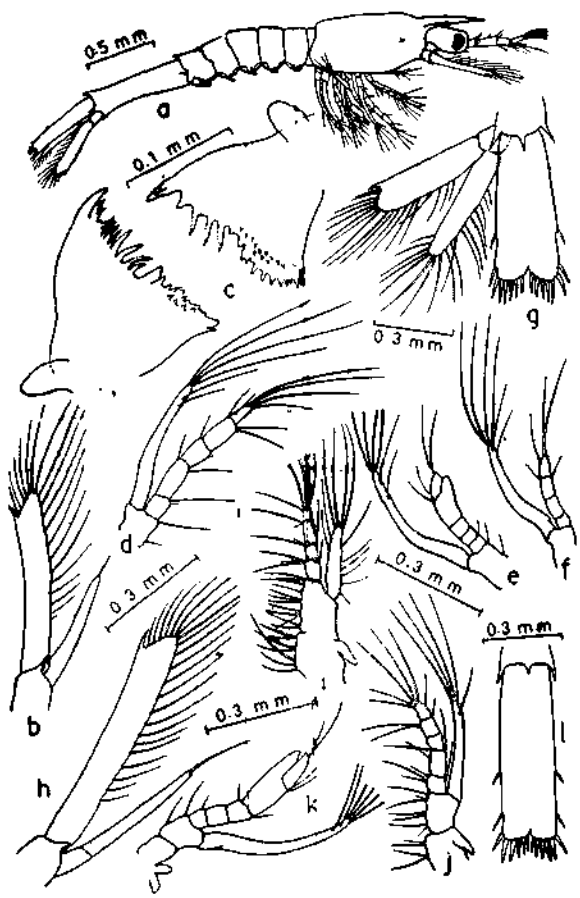

Fig. 7 *Penaeus indicus:* Mysis II: a - lateral view; b - A2; c - Md; d - Mxp3; e - P1; f - P5; g - uropod and telson. Masis III: h - A2; i - Mxp1; j - Mxp2; k - P1; l - telson.

and 1 subapical setae, penultimate segment bears 2 setae; pleopods have a slight constriction in the middle indicating the begining of segmentation; exopod and endopod of uropod with 18 setae. Duration of this substage was 24 to 48 hours.

MYSIS III

MTL: 3.90 mm (3.43-4.17 mm); MCL: 1.26 mm (1.12-1.37 mm).

Development of 2 segmented pleopod bud (Fig. 8, e) distinguishes this substage from mysis II, no change in spination of carapace and abdomen, but a very minute rudiment of rostral tooth may be seen in a few specimens; telson (Fig.7,l) long and rectangular carrying 6 distal and 2 lateral setae on each side, cleft extending to level of origin of 3rd pair of setae.

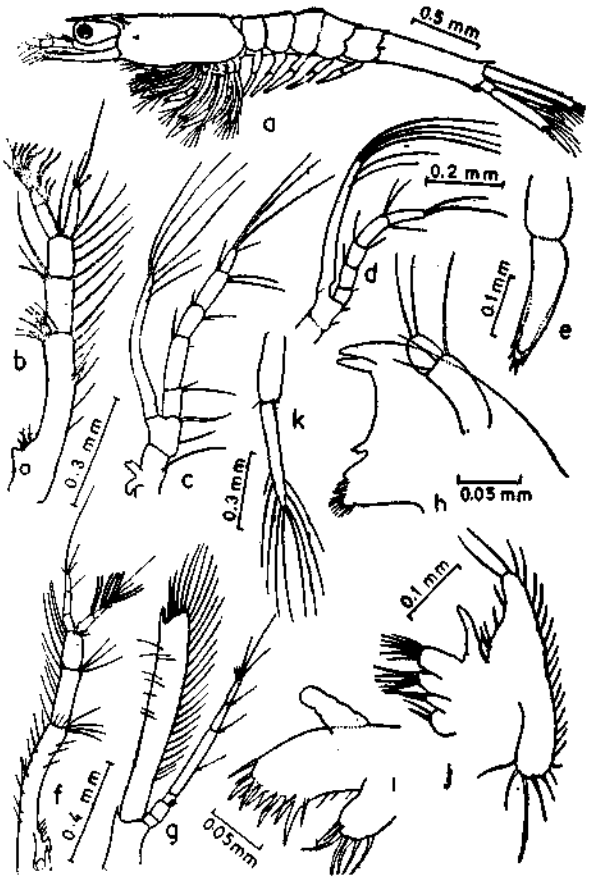

Fig. 8 *Penaeus indicus*: Mysis III: a - lateral view; b - A1; c - Mxp3; d - P5; e - pleopod bud. Postlarva I: f - A1; g - A2; h - Md; i - Mx1; j - Mx2; k; pleopod.

A1 (Fig.8,b) statocyst clearly seen, both flagella are of equal size, inner unsegmented, bearing 4 long slender setae apically, of which one is longer, outer flagellum 2 segmented with 6 to 7 aesthaetes and 2 setae on the distal segment and 2 aesthaetes on the proximal segment; A2 (Fig.7,h) with 2 segmented endopod carrying a long seta apically, exopod with 21 to 22 plumose setae and one anterolateral spine; Md still asymmetrical, palp long, but unsegmented; Mx2 with 19 setae on exopod, rudiments of gills present as protuberance on

bases of protopod of Mxp; Mxp1 (Fig.7,i) with 12 setae on exopod; Mxp2 with an outer distal seta added to 4th segment of endopod; Mxp3 (Fig.8,c) with endopod longer than exopod, distal segment with 1 short and 3 long setae; P1 (Fig.7,k) with rudiment of gill developed at base of protopod, endopod 5 segmented, chela as long as the other 3 segments put together, dactylus apically bearing 2 long setae, propodus with 2 setae at its joint with dactylus; P4 and P5 (Fig.8,d) are identical, exopod as long as endopod, distal segment of endopod with 2 slender setae apically; exopod with 4 apical and 3-4 subapical plumose setae; pleopods 2 segmented and non-setose; distally some pleopods have developing setae (Fig.8,e); uropod with 22 setae on exopod and 21 setae on endopod (Fig.7,l). Duration of this substage was 24 to 48 hours.

POSTLARVA I

MTL: 5.03 mm (4.55 - 5.26 mm); MCL: 1.53 mm (1.44 - 1.61 mm).

Rostrum with 1 or 2 dorsal spines, supraorbital, hepatic and pterygostomial spines present, the latter often very small, median dorsal spines usually present on 4th, 5th and 6th abdominal segments (Fig.9,a), lateral spines present on 5th and 6th abdominal segments, anal spine still present on 6th abdominal segment, exopods of P small and without setae, pleopods well developed and setose, telson (Fig. 9, j) rectangular in shape carrying 3 pairs of lateral and 5 pairs of terminal setae' median notch practically absent.

Al (Fig.8,f) with statocyst at base of 1st segment, well developed ventromedian spine still present on basal segment; inner branch of distal segment 3 segmented, longer than outer and carries 4 setae apically, of which 1 is as long as the branch, outer branch 2 segmented carrying 8 aesthaetes and 3 setae; A2 (Fig.8,g) with endopod 6 segmented, distal segment apically bearing 3 long and 3 short setae; exopod with 27 setae and one anterolateral spine; Md (Fig. 8,h) has become almost symmetrical, free standing teeth lost, palp well developed and 2 segmented, carrying setae; Mx1 (Fig.8.i) with endopod much reduced, unsegmented and without setae; distal lobe of protopod larger than proximal, distal and proximal lobes with 13 to 18 and 7 to 8 setae respectively; Mx2 (Fig.8,j) with much reduced protopod having 4 endites, proximal 2 endites with 2 setae, distal 2 endites carry 5 to 6 bristle like setae, endopod reduced,

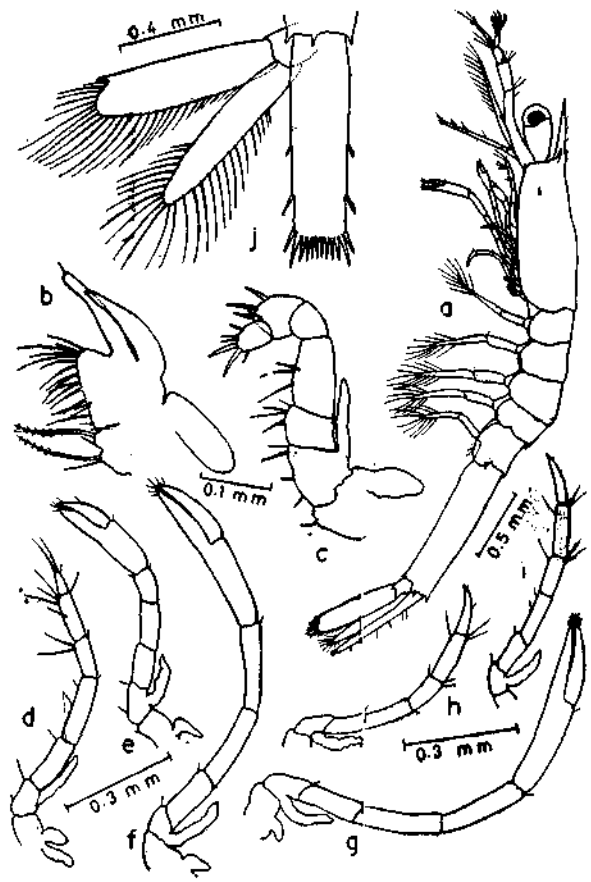

Fig. 9 *Penaeus indicus:* Postlarva 1: a - lateral view; b - Mxp1; c - Mxp2; d - Mxp3; e - P1; f - P2; g - P3; h - P4; i - P5; j - uropod and telson.

unsegmented, without setae, scaphognathite very conspicuous bearing 29 to 30 plumose setae; Mxp1 (Fig.9,b) with endopod and exopod reduced in size without segments and setae, protopod has become wide with numerous setae, epipod well developed; Mxp2 (Fig.9,c) with exopod vestigial, endopod recurved, distal segment with 6 spine-like setae, penultimate segment naked, protopod carries a gill; Mxp3 (Fig.9,d) with gill on protopod, exopod rudimentary without setae, 4th segment of endopod with 5 setae; P1 (Fig.9,e) with rudimentary gill on protopod, exopod much

reduced, without setae, chelae fully developed; P2 and P3 (Fig.9,f.g) progressively longer than P1; P4 and P5 (Fig.9,h,i) almost similar, exopod reduced, endopod 5 segmented, 3rd and 4th segments carry 3 setae each; 26 to 27 setae on margin of exopod and endopod of uropod (Fig.9,j). Duration of this substage was 24 to 30 hours.

DISCUSSION

Earlier authors working with material collected from the plankton have described various larval stages of *Penaeus indicus*. Menon[1] has described protozoea I, II and III and mysis I from plankton of Madras coast. Subrahmanyam[4] described eggs and 3 naupliar stages also from Madras. Rao[3] described mysis I, II and III from Cochin waters It is now clear that, except for some of the stages described by Menon[1], the larvae described by these authors do not belong to the genus *Penaeus*. The large size (0.45-0.47 mm) and wide perivitelline space of the eggs described by Subrahmanyam[4] show that they cannot belong to *P. indicus* which has a smaller egg (0.27 mm) with a very narrow perivitelline space. There is very little difference between the figures of the eggs and nauplii of *M. dobsoni* given by Menon (1951, *Proc. Indo Pacif. Fish Counc. 3rd meeting.* Sec II: 80-93.[5]) and the figures given by Subrahmanyam[4]. The protozoea II and mysis I described by Menon[1] possess the characters typical of the genus *Penaeus* and hence could belong to *P. indicus*, but the protozoea III described by him clearly does not belong to the genus *Penaeus*, as it has only 7 pairs of telsonic setae and has a pair of well formed Mxp3 with setae on both the exopods and endopods; the presence of a small tooth at the base of the rostrum on either side, in addition to the supraorbital spine is also a character that is not found in the genus *Penaeus*. The first protozoea described by Menon[1] closely resembles the present description but differs from it in the possession of 6 terminal setae on A1 and in the presence of 2+2 setae on the lateral aspect of A2 endopod. The mysis substages described by Rao[3] as those of *P. indicus* are different from the present description and do not belong to *P. indicus* for the following reasons: (1) 5th and 6th abdominal segments do not possess posterolateral spines. (2) the supraorbital spine is minute, (3) small antennal spine is present, (4) the hepatic spine is absent in mysis I, (5) a rostral spine is present even in mysis I and II and 2 rostral spines are seen in mysis III, (6) the shape of the telson is clearly different and the median cleft is absent in mysis II and III, (7) the A2 scale of mysis I has an anterolateral spine and (8) the A2 scale of mysis II and III is very broad and the A2 endopod of mysis III is actually longer than the A2 scale. Many of these characters are common to the mysis stage of *Parapenaeopsis stylifera*. The postlarva I of *P. indicus* described by Mohamed *et. al*[2]. differs from the present description in the following respects: (1) the absence of posterolateral spines on 5th and 6th abdominal segments, (2) the absence of pterygostomial spines and (3) the absence of shrunken exopods of Mxp2 and Mxp3 and P1 to P5. It appears to be a later stage postlarva of *P. indicus*.