III. SYSTEMS
SECTION CARIDEA

Decapod natantians with pleuron of second abdominal segment overlapping those of first and third segments. Third pereiopod never chelate. Gills phyllobranchiate. Females carry eggs on their pleopods.

Life history usually comprising zoeal and postlarval stages but no nauplius stage.

This section is represented in the present work by 3 superfamilies viz. Palaemonoida, Alpheoida and Crangonoida.

Key to the Karwar superfamilies of Caridea

1. First pair of pereiopods subchelate; pleopods (all) with endopods poorly to moderately well developed and with or without appendix interna . . . . CRANGONOIDA
First pair of pereiopods distinctly chelate and not subchelate; second to fifth pleopods usually with well developed endopod and appendix interna . . . 2

2. First pair of pereiopods chelate on both sides and usually more slender than second pair; carpus of second pereiopod not subsegmented . . . . PALAEMONOIDA
First pair of pereiopods sometimes chelate on only one side, but always stouter than second pair, often remarkably so; carpus of second pereiopods subdivided into one or more subsegments . . . . . . . . . . . . . . . . . . . . ALPHEOIDA
SUPERFAMILY PALAEMONOIDA

Caridea with upper antennular flagellum simple or bifid. Mandible with or without incisor process. Third maxilliped with 4 to 5-segmented endopod and may or may not be leaf-like and expanded. Pereiopods without exopods and with or without epipods and arthrobranchs, chelae not terminating in dense brushes of long hairs, fingers of chela not pectinate on opposing margins; first pereiopods not much stouter but usually more slender than second, chela well developed with single movable finger and fingers not dark coloured; second pereiopods (often sexually dimorphic) chelate, fingers not extremely long, carpus entire and not subsegmented. Second to fifth pleopods usually with well developed endopods and appendix interna.

This superfamily is represented by a single family Palaemonidae in the present work.

FAMILY Palaemonidae

Palaemonoida with rostrum compressed, dentate; carapace with antennal, branchiostegal and with or without hepatic spines. Two rami of upper antennular flagellum free throughout their length or fused only in basal part. Mandible usually with an incisor process. Third maxilliped not expanded leaf-like and with or without a pleurobranch at base. Pereiopods without arthrobranchs and epipods. Second pleopod of male with or without appendix masculina; appendix interna mostly present, but sometimes absent on the second pleopod of females.
Of this family, only subfamilies Palaemoainae and Pontoniinae have been so far represented in the present work.

Key to the Karwar subfamilies of Palaemoainae

Posterior margin of telson with 3 pairs of spines and without setae ...................................... Pontoniinae

Posterior margin of telson with 2 pairs of spines and 2 or more setae .................................. Palaemoainae
SUBFAMILY Palaemoninae
SUBFAMILY Palaemoninae

Upper antennular flagellum with both rami fused in basal part. **Appendix masculina** generally present on second pleopod of male and **appendix interna** on second pleopod of female. Pleurobranch present on third maxilliped. Posterior margin of telson with 2 pairs of spines and 1 or more pairs of plumose setae.

This subfamily is represented in Karwar by 3 genera viz. *Leandrites*, *Palaemon* and *Macrobrachium*.

**Key to the Karwar genera of Palaemoninae**

1. Mandible without palp .............. **Leandrites**  
   Mandible with palp ..................... 2

2. Branchiostegal spine present and hepatic spine absent  
   Branchiostegal spine absent and hepatic spine present  
   ........................................... **Macrobrachium**
GENUS LEANDRITES

Body slender, compressed; rostrum with teeth on both margins and with setae. Carapace with well developed antennal and branchiostegal spines (tact spine remote from anterior margin of carapace), branchiostegal groove absent. Cornea hemispherical. Both rami of upper antennular flagellum fused for a short distance; antennal peduncle fails to reach middle of scale. Mandible without palp. First pereiopods slender; second pereiopods slender, fingers very long, with no spines or teeth on any segments; fifth pereiopods smooth with only some scattered hairs on posterior margin. Pleura of first 3 abdominal segments broadly rounded, that of fourth and fifth narrower and that of sixth short, ending in a sharp tooth posterolaterally. First pleopod of male with appendix interna. Telson elongated with two pairs of spines between which a pair of very heavy plumose setae present.

Type species: Leandrites celebensis (de Man).

In Karwar, this genus is represented by only one species L. celebensis (de Man).

1. LEANDRITES CELEBENSIS (DE MAN)
(Figs. 1 & 2)

Synonyms:

Palaemonetes hornelli Kemp, 1925, p. 318: Pillai, 1955, p. 76.
Leandrites celebensis Holthuis, 1950, p. 36.
Diagnostic features:

Rostrum (Fig. 1, b) almost straight, deep, reaching beyond antennal scale; rostral formula $13 - 15 \over 3 - 5$ (2 postorbital), teeth on lower margin in distal half only, this margin with double row of setae. Orbital angle rounded. Antennal and branchiostegal spines strong, latter placed a little posterior to anterior carapace margin with only its tip reaching margin, branchiostegal groove absent.

Basal antennular segment (Fig. 1, c) broad with a short slender stylocerite, upper antennular flagellum with two branches fused for about 5 - 6 segments, free part of shorter branch consisting of 14 - 15 segments and about 3 to 4 times fused portion. Antennal scale (Fig. 1, d) slightly longer than antennular peduncle and more than twice antennal peduncle, distal spine falling short of anterior margin of lamella.

Mandible (Fig. 1, e) without palp. All maxillipeds with exopod, third with an arthrobranch and a small pleurobranch.

First pair of pereiopods (Fig. 2, k) equal, slender, overreaching antennal scale by fingers, fingers unarmed, slightly longer than palm. Second pair of pereiopods (Fig. 2, l) equal, long, slender, overreaching antennal scale by distal half of carpus, fingers long and slender, tips inturned, unarmed. Fifth pereiopods (Fig. 2, o) longer than fourth and third (Fig. 2, m & n) with no transverse rows of setae on propodus, propodus less than twice dactylus.

Telson (Fig. 2, q) with tip acute, 2 pairs of dorsal
spines, 2 pairs of posterior spines and a pair of stout medial plumose setae in between posterior spines. Uropods overreaching telson and with terminal and accessory subapical spines on exopod.

Endopod of first pleopod of male (Fig. 2, p.1) with well developed *appendix interna* and second with strong *appendix masculina* (Fig. 2, p.2).

Previous records:

Off Makassar, S.W. Celebes.

From India: Cochin backwaters, Travancore and Silvathurai Lagoon, Tuticorin.

Variations:

Not much of variations except for:

1. Rostral teeth on upper border varying from 13 - 15 and on lower border from 3 - 5.

2. Fused portion of upper antennular flagellum with 5 to 6 segments and free part of shorter ramus consisting of 14 to 15 segments.

Material examined:

In all, 12 specimens were examined, 4 males ranging from: 18 - 19 mm; 5 ovigerous females 23 - 29 mm and 3 non-ovigerous females 22 - 25 mm.

Colour in live condition:

Translucent, with light brown stellate chromatophores scattered all over carapace, abdomen and on first 2 pairs of pereiopods as shown in figure (Fig. 1, a). Three horizontal stripes of dark blue on branchiostegal surface.
Notes on fecundity:

Eggs borne only on first to fourth pleopods. Immature eggs blackish green, matured ones light green. 5 specimens were studied for counting the number of eggs, the maximum number of eggs being 544 in 29 mm specimen and minimum number being 290 in 23 mm specimen with an average of 351 eggs per female. Eggs oval in shape, maximum and minimum diameters being 0.6 to 0.75 mm and 0.45 to 0.5 mm respectively.

Berried females were observed from September to May.

Ecology:

This species was collected from the Kali estuary, Sadashivgad and Sunkeri, found on muddy bottom in slow running and stagnant waters.

Remarks:

Present material agrees in general with the description of the species by Kemp (1925) (= Palaemonetes hornelli) except for the following:

<table>
<thead>
<tr>
<th></th>
<th>Kemp's description</th>
<th>Karwar material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rostrum teeth on upper border</td>
<td>13 - 17</td>
<td>13 - 15</td>
</tr>
<tr>
<td>First pereiopod fingers</td>
<td>Fingers considerably longer than palm.</td>
<td>Fingers slightly longer than palm.</td>
</tr>
<tr>
<td>Second pereiopod cutting edges</td>
<td>Each at the base with a small tooth.</td>
<td>Unarmed.</td>
</tr>
<tr>
<td>Propodus of third to fifth pereiopods</td>
<td>2 to 2.3-times dactylus.</td>
<td>Less than 2-times dactylus.</td>
</tr>
</tbody>
</table>

The presence of Leandrites celebensis in Karwar forms the first record of the species along the Karnataka coast.
GENUS PALAEMON FABRICIUS

Body slender or robust, compressed; rostrum with teeth on both margins and provided with setae, lower margin with either single row or a double row; carapace with antennal spine situated on anterior margin and a branchiostegal spine which is either on anterior margin or slightly away from it, sharp or distinct branchiostegal groove present. Both rami of upper antennular flagellum fused at base. Antennal scale large, extending beyond antennular peduncle; antennal peduncle reaching beyond less than middle of scale. Mandible with 2 or 3-segmented palp; third maxilliped with an arthrobranch and a pleurobranch. First pereiopods slender and its fingers unarmed but with tufts of setae. Propodus of third to fifth pereiopods with spinules on posterior margin and with transverse rows of setae on fifth pereiopod distally. Pleura of first 3 abdominal segments broadly rounded, those of fourth and fifth narrower, that of fifth sometimes with a minute sharp tooth and that of sixth very short ending in a posterolateral sharp point. First pleopod of male never with well developed appendix interna. Telson elongated, triangular with two pairs of dorsal spines (sometimes one or both pairs absent), posterior margin with two pairs of spines of which inner pair much longer, between which a pair of long plumose setae present.

Type species: Palaemon squilla (Linnaeus).

In Karwar this genus is represented by three subgenera viz. Palaemon, Palaender and Nematopalaemon.
Remarks:

Holthuis (1950) while dealing with the Palaemonidae of Siboga and Snellius Expedition, comments on Kemp's (1925) genera Leander, Palaemon etc. Holthuis divides the species included by Kemp in his genus Leander into 3 separate genera, Leptocarpus, Leander and Palaemon. In this study, the classification proposed by Holthuis (1950) is followed as regards genus Palaemon with Palaemon squilla as the type.

Most of the species of this genus represented in Karwar appear to be potentially culturable.

Key to the Karwar subgenera of Palaemon

<table>
<thead>
<tr>
<th>1. Rostrum with an elevated basal crest of teeth.</th>
<th>2. Mandibular palp 2-segmented</th>
<th>Palaender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandibular palp 3-segmented. Dactylus of last 3 pereiopods enormously long, longer than carpus and propodus together; pleuron of fifth abdominal segment broadly rounded posteriorly</td>
<td>Mandibular palp 3-segmented</td>
<td>Palaemon</td>
</tr>
</tbody>
</table>
| *Holthuis (1950) gives importance to the number of segments of mandibular palp, 2 in the subgenus Palaender and 3 in the subgenus Palaemon. But Fujino and Miyake (1968), while
studying the mandibular palp in shrimps of the genus *Palaemon* from Japan, observe from 1-segmented to 4-segmented palp in 6 species and they remark regarding the nonvalidity of number of segments of the palp as the chief character for separating the subgenus *Palaemon* from subgenus *Palaender*. Similarly, Chace (1972) while studying the Hawaiian material of the subgenus *Palaemon, P. (P) debilis*, observes that this character is taxonomically unreliable since he records mandibular palp from non-segmented to as many as 3-segmented. However in the absence of positive proof of difference in the number of segments other than 2 in *Palaender*, it is considered safe to follow Holthuis (1950) in regarding *Palaemon* and *palaender* as two distinct subgenera in the present work.

**Subgenus *Palaemon* Holthuis**

Lower margin of rostrum with a single or a double row of setae. Branchiostegal groove generally present, visible as a sharp line. Mandibular palp 3-segmented. 2 median spines of posterior margin of telson slender. First pleopod of male with or without a rudimentary appendix interna.

In Karwar, this subgenus is represented by 4 species *belindae* (Kemp), *debilis* Dana, *serrifer* (Stimpson) and *pacificus* (Stimpson).
Key to the Karwar species of subgenus Palaemon

1. Propodus of last 3 pereiopods distally dilated and armed with 5 - 6 strong spines on dilated portion ...................................................... belindae (Kemp)

Propodus of last 3 pereiopods not dilated and without such spines ...................................................... 2

2. Rostrum strongly curved upwards, very long often reaching beyond antennal scale by half of its length, the distal half of dorsal margin without teeth except for a subapical tooth ....................................................... debilis Dana

Rostrum not very long, reaching to or little beyond antennal scale, dorsal margin with evenly placed teeth all along upto tip ...................................................... 3

3. Number of teeth on upper margin of rostrum

8 - 11. Inner margin of shorter ramus of upper antennular flagellum distinctly serrate ...................................................... pacificus (Stimpson)

Number of teeth on upper margin of rostrum

9 - 16. Inner margin of shorter ramus of antennular flagellum not serrate . . . serrifer (Stimpson)

2. Palaemon (Palaemon) belindae (Kemp)

(Figs. 3 & 4)

Synonyms:

Palaemon (Palaemon) belindae Holthuis, 1955, p. 70.

Diagnostic features:

Rostrum (Fig. 3, b) almost straight, extending unto
antennular peduncle, tip mostly bifid with a small subapical
tooth, rostral formula $\frac{5}{2} - \frac{2}{3}$ (postorbitals 3), teeth somewhat
equidistant, rostrum expanded (in lateral view). Carapace with
antennal and branchiostegal spines; branchiostegal groove
present.

Eyes dully pigmented compared to brightly multicoloured
body.

Antennular stylocerite (Fig. 3, c) not reaching middle
of basal peduncular segment, its upper flagellum with two
branches fused for about 9 - 10 segments, free portion of
shorter ramus 2.0 to 2.5-times fused portion. Sharp distal
tooth of antennal scale (Fig. 3, d) not reaching its distal
margin.

Mouth parts typical (Figs. 3, e,j,g,h & Figs. 4, i,j). Mandibular palp 3-segmented, third maxilliped with a
pleurobranch and an arthrobranch.

First pereiopod (Fig. 4, k) overreaching antennal scale
by fingers and second pereiopods by half of chela. Cutting edges
of fingers of both first and second pereiopods (Fig. 4, l)
unarmed but for a blunt tooth on dactylus of second pereiopod.

Third to fifth pereiopods (Fig. 4, m-o) with
characteristically distally dilated propodus armed with 4 - 6
stout movable spines on dilated portion.

A median spine present on sternite of sixth abdominal
segment.

Endopod of first pleopod in both sexes without appendix
interna but that of male (Fig. 4, p) with about 5 delicate
spinules on inner margin as in figure, this margin slightly concave in female, appendix musculina present on the endopod of second pleopod (Fig. 4, p.) of male.

Telson (Fig. 4, q) with pointed apex and with 2 pairs of spines. A pair of plumose setae on posterior margin and 2 pairs of dorsal spines.

Uropods longer than telson.

Previous records:

Kilakarai, Gulf of Mannar and Cape Comorin, all localities being in India. This species is so far not reported from outside the Indian waters.

Variations:

Following variations have been observed in the present material:

1. Teeth on upper margin of rostrum vary from 6 to 8 and when eighth tooth present, it is always found very close to apex giving it a bifid appearance; teeth on lower margin vary from 2 - 3.

2. In Kemp's (1925) material, antennular peduncle reaches to end of antennal scale though in the present material, it is invariably short of antennal scale.

3. Segments of fused portion of upper antennular flagellum vary from 8 to 10 and free part of shorter ramus from 2.3 to 2.7-times fused portion.

Material examined:

Of about 65 specimens collected, only 15 chosen at random were examined in detail, of these 6 were berried females.
ranging from 39 - 42 mm, 4 non-berried females from 38 to 41 mm and 5 males from 30 to 38 mm. Kemp's (1925) largest specimen was about 39.00 mm only.

**Colour in live condition:**

Translucent but brightly coloured with patches of dark blue, brownish red, yellow and green scattered irregularly all over (Fig. 3, a). A very conspicuous, dark brownish red patch on dorsal and lateral sides of hinder end of third abdominal segment. Antennule, antenna and all pereiopods with dark blue bands so also distal part of basipod of pleopods. Uropods brownish red.

**Notes on fecundity:**

Eggs, as also observed by Kemp (1925), are dark grey or olive, being borne only on first to fourth pleopods. Five specimens were studied for counting the number of eggs, maximum number was 892 (in 42 mm specimen) and minimum 312 (in 39 mm specimen) with an average of 774 eggs per female. Eggs oval in shape, maximum and minimum diameters being 0.7 to 0.8 mm and 0.5 to 0.6 mm respectively.

Berried female were observed from November to May.

**Ecology:**

This is a littoral form occurring mainly in sublittoral parts on wave beaten rocks encrusted with seaweeds. They seem to prefer to hold on to weeds with the help of dactylus and spines of dilated propodus of third - fifth pereiopods.

The shrimps were collected with the help of a hand net from the intertidal region of Kinkade and Kamath Bay.
Remarks:

The distalmost spines on propodus of third to fifth pereiopods are always in a pair in present material, a character neither mentioned nor figured by Kemp (1925) in his material. Also, distinct sternal spine present on the sixth abdominal segment has not been mentioned by Kemp, but it was found to be present in his material deposited in the Indian Museum, Calcutta (examined by me). The endopod of first pleopod of female differs from that of male in being a little shorter and without inner marginal spines, this difference also has not been mentioned by Kemp.

Sexual dimorphism as regards the antennule observed by Kemp, however, was not found in the present material.

Occurrence of this species in Karwar forms the first record of the species along the west coast except for Kemp's (1925) and Kurian's (1954) record of the species from Cape Comorin.

3. *Palaemon (Palaemon) debilis* Dana

(Fig. 5)

Synonyms:


*Leander gardineri* Kemp, 1922, p. 208.

*Leander beauforti* Kemp, 1925, p. 295.

*Leander prox debilis* Kemp, 1925, p. 207.

**Diagnostic features:**

Rostrum (Fig. 5, a) very long (longer than carapace) and slender with distinct upward curve, reaching well beyond antennal scale; rostral formula \( \frac{6 - 3}{6 - 3} \) (postorbital 1), distal 1/2 of dorsal margin naked with a single apical tooth. Carapace with antennal spine stronger than branchiostegal, branchiostegal groove distinct.

Stylocerite (Fig. 5, c) long, reaching about 1/2 of basal segment, fused portion of upper flagellum of about 11 segments. Outer margin of scale (Fig. 5, d) almost straight, distally with a strong tooth overreaching lamella, narrowing apically.

Mandible (Fig. 5, e) with only 3-segmented palp, rest of mouth parts typical.

All pereiopods characteristically slender. First pereiopod (Fig. 5, k) not reaching antennal scale, fingers about as long as palm. Second pereiopods (Fig. 5, l) extremely slender, longer, but not stronger than first, overreaching antennal scale by distal end of carpus; fingers shorter than palm, unarmed and without gape when closed. Third to fifth (Fig. 5, o) pereiopods almost similar, third shorter than others, fifth with transverse rows of setae on distal posterior margin of propodus.

Pleopods with sexual dimorphism in addition to appendix masculina; endopod of first pleopod (Fig. 5, p1) of male...
reaching about 1/2 length of exopod with 5 - 8 small marginal spinules while in female, reaching about 1/3 of exopod, inner margin smooth without any spinules, remaining pleopods typical in both sexes.

Telson (Fig. 5, q) longer than sixth abdominal segment, tapering to narrow posterior margin; 2 pairs of dorsal spinules somewhat submarginal in position; 2 pairs of posterior spines, outer rather small, inner much longer and slender, a pair of plumose setae on either side of fairly long median process. Uropods overreaching telson, endopod being only slightly longer than telson.

Previous records:

Widely distributed Indo-Pacific species (for details see Holthuis, 1950).

From India except Kunju's mere mention of its rare occurrence (localities not specified) this species has not been so far reported.

Material examined:

Of about 100 specimens collected, only 20 specimens selected at random were examined in detail, of which 5 were berried (from 34 to 41 mm), 10 non-berried females (from 33 to 34 mm) and 5 males (from 24 to 35 mm).

Colour in live condition:

Body translucent but for a characteristic, prominent, rather crescent-shaped bluish patch (of stellate chromatophores) on either side of third abdominal segment dorsally, with a creamish yellow dot anteriorly. First to
fourth abdominal pleura with a longitudinal patch of blue each along ventral margin. Also, on sixth abdominal segment a blue stellate chromatophore posterolaterally as shown in figure (5, a). A thin longitudinal blue line (of tiny chromatophores) as in figure. Minute dots of blue and pale yellow thinly scattered all over the body.

**Fecundity:**

*Eggs oval in shape, maximum and minimum diameters being 0.6 to 0.7 mm and 0.4 to 0.5 mm respectively (Holthuis gives his range of egg diameter as 0.5 to 0.9 mm) and are borne on first to fourth pleopods only. Immature eggs dark green in colour while the mature ones almost transparent.*

For fecundity studies, 5 specimens (from 33 to 41 mm) were examined and maximum number of eggs was found to be 453 (in 41 mm specimen) and minimum 157 in (in 33 mm specimen) with an average of 309 eggs per female.

**Ecology:**

The present species was found to occur throughout the year (except during monsoon when collections could not be made) mainly on submerged stones or on vegetation in small stagnant pools formed during low tides in mangrove area near the mouth of the Kali estuary (Karwar). It is also reported from anchialine pools (Holthuis, 1973).

The shrimps were collected with a mosquito cloth hand net (30 x 20 cm).

**Remarks:**

As mentioned by the earlier authors, this species is
highly variable and comparison of present material with
descriptive accounts of Holthuis (1950) of the Indo-Pacific
material and of Chace (1972) of Hawaiian material, reveals the
following differences:

<table>
<thead>
<tr>
<th></th>
<th>Indo-Pacific material (Holthuis, 1950)</th>
<th>Karwar material (present study)</th>
<th>Hawaiian material (Chace, 1972)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rostrum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) upper margin</td>
<td>2 - 3 teeth (generally 5), first 3 movable, with single row of setae.</td>
<td>6 - 7 teeth, rest as in Holthuis.</td>
<td>4 - 6 (rarely 2 - 3), no further information.</td>
</tr>
<tr>
<td>b) lower margin</td>
<td>3 - 10 teeth (mostly 6), with double row of setae.</td>
<td>6 - 7 teeth, rest as in Holthuis.</td>
<td>4 - 10, setae not mentioned.</td>
</tr>
<tr>
<td><strong>Antennule</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) distolateral spine of basal segment.</td>
<td>Falls short of convex distal margin of lateral extension.</td>
<td>As in Holthuis.</td>
<td>Overreaches the distal margin.</td>
</tr>
<tr>
<td>b) fused portion of upper flagellum.</td>
<td>7 - 14 segments.</td>
<td>10 - 11 segments.</td>
<td>Not given.</td>
</tr>
<tr>
<td>c) proportion of shorter flagellum to fused portion</td>
<td>About as long as or slightly longer.</td>
<td>A little longer than twice.</td>
<td>Not given.</td>
</tr>
<tr>
<td><strong>Antennal scale</strong></td>
<td>Slightly more than 3-times.</td>
<td>3-times.</td>
<td>3 to 5-times.</td>
</tr>
<tr>
<td><strong>Mandible</strong></td>
<td>With 3-segmented palp as per his key.</td>
<td>With 3-segmented palp.</td>
<td>Hawaiian specimens without palp, Pacific material with 1 - 3 segmented palp or no palp.</td>
</tr>
<tr>
<td>Indopacific material (Holthuis, 1950)</td>
<td>Karwar material (present study)</td>
<td>Hawaiian material (Chace, 1972)</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
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<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Exopod of third maxilliped</strong></td>
<td>Neither described nor figured.</td>
<td>Overreaching the antepenultimate segment of its endopod.</td>
<td>Figured as short of reaching antepenultimate segment.</td>
</tr>
<tr>
<td><strong>Second pereiopods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) cutting edges of fingers</td>
<td>Unarmed.</td>
<td>As in Holthuis.</td>
<td>With a tooth on each cutting edge or more often unarmed.</td>
</tr>
<tr>
<td>b) carpus</td>
<td>A little more than 2-times chela.</td>
<td>As in Holthuis.</td>
<td>Varying in length from slightly shorter to more than 1.5-times as long as chela.</td>
</tr>
<tr>
<td><strong>Fifth pereiopods</strong></td>
<td>Overreaching antennal scale by entire dactylus.</td>
<td>As in Holthuis.</td>
<td>About as far as antennal scale.</td>
</tr>
<tr>
<td><strong>Endopod of first pleopod</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) male</td>
<td>No details, except for ovate shape.</td>
<td>Reaching about 1/2 the length of exopod, without any notch on inner margin, with 5-8 small inner marginal spines.</td>
<td>Reaching slightly beyond midlength of exopod, with notch on mesial (= inner) margin and about 9 spines figured, but not described.</td>
</tr>
<tr>
<td>b) female</td>
<td>No description given.</td>
<td>Just reaching 1/3 length of exopod, inner margin without any spines.</td>
<td>No description of female pleopods.</td>
</tr>
<tr>
<td><strong>Telson</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) tip extension</td>
<td>Reaching less than 1/2 of inner spines.</td>
<td>Reaching about 1/3 (rarely upto 1/2) of inner spines.</td>
<td>Reaching nearly 1/2 of inner spines as per his figure.</td>
</tr>
<tr>
<td>b) plumose setae</td>
<td>Neither described nor figured.</td>
<td>1/2 as long as inner spines.</td>
<td>Just short of inner spines.</td>
</tr>
</tbody>
</table>
As regards the occurrence of this species in India, except for Kunju's (1969) mere mention without giving any localities or any other details, no information is so far available. This, therefore, forms the first proper account of the species from the Indian waters.

4. PALAEMON (PALAEMON) SERRIFIER (STIMPSON)
(Fig. 6)

Synonyms:
Leander serrifer Stimpson, 1860, p. 41; Kemp, 1925, p. 305; Kubo, 1942, p. 32.
Palaemon serrifer Naik, 1972, p. 17.
Palaemon (Palaemon) serrifer Holthuis, 1950, p. 83.

Diagnostic features:
Rostrum (Fig. 6, b) almost straight with a curved and broad distal part, reaching up to or slightly beyond antennal scale; rostral formula $\frac{2 - 15}{4 - 5}$ (postorbitals 3), subapical 1 - 2. Carapace with strong branchiostegal and antennal spines.

Eyes pigmented, dark, ocellus present.

Antennule (Fig. 6, c) with stylocerite 1/2 as long as or less than 1/2 of basal segment of peduncle. Fused portion of upper antennal flagellum of 7 - 9 segments, free part of shorter ramus with 14 - 25 segments and about 2 to 3-times fused portion. Antennal scale (Fig. 6, d) with distolateral tooth not reaching distal margin.

Mandibular palp 3-segmented. Third maxilliped with an arthrobranch and a pleurobranch.
First pereiopods (Fig. 6, k) from short of antennal scale to overreaching it by fingers; fingers shorter than palm and their cutting edges unarmed; carpus twice chela in length.

Second pereiopods (Fig. 6, l) with variable length, overreaching antennal scale by fingers, by entire chela or by part of carpus; palm 1.25 to 2-times fingers; fixed finger with 1 small tooth on proximal part of cutting edge while dactylus without teeth; carpus longer than palm; merus about as long as carpus.

Third to fifth (Fig. 6, o) pereiopods rather slender, overreaching antennal scale by entire dactylus; propodus slightly less than 3 to 4-times dactylus, with 4 - 6 scattered spinules, merus distinctly longer than propodus; fourth and fifth pereiopods similar to third, but propodus of fifth with transverse rows of setae in addition to spinules.

Endopod of first pair of pleopods (Fig. 6, p₁) of male ovate, about 1/2 of exopod and with 4 - 5 inner marginal spines whereas that of female without such spines and only about 1/3 of exopod in length; both sexes without appendix interna on first pleopod. Appendix masculina present on second pleopod of male (Fig. 6, p₂), slightly shorter than appendix interna.

Telson (Fig. 6, q) with tip acute; two pairs of posterior marginal spines, inner being about 6-times outer, and a pair of plumose setae inbetween spines. Two pairs of dorsal spines on surface as in figure.

Previous records:

Indo-Pacific form, known so far from: Africa, Burma,
Mergui Archipelago, Japan, China, Java (After Holthuis, 1950).

From India: Bandra and Danda - Bombay.

Variations:

Following variations have been observed in the present material:

1. Rostral teeth on upper margin vary from 9 - 12 and on lower from 4 - 5 and subapical 1 - 2.

2. Stylocerite \( \frac{1}{2} \) as long as or less than \( \frac{1}{4} \) of basal segment of antennular peduncle.

3. Upper antennular flagellum with segments of fused portion varying from 7 - 9 and free portion of shorter ramus from 14 to 25 segments, being 2 to 3-times fused portion.

4. First pereiopods from falling short of antennal scale to overreaching it by fingers.

5. Length of second pereiopods variable from overreaching antennal scale by fingers, by entire chela and sometimes by entire carpus also; palm varying from 1.25 to 2-times fingers.

6. Propodus of third pereiopods slightly less than 3-times to 4-times dactylus.

Material examined:

Of about 50 specimens collected, only 15 chosen at random were examined in detail. Of these, 9 berried females ranged from 37 - 45 mm; 3 non-berried females from 33 - 37 mm and 3 males from 27 - 35 mm.

Kemp (1925) recorded largest specimen of only 38 mm but
mentioned a 60 mm size in Barnard's South African material.

**Colour in live condition:**

Colour pattern agrees well with that given by Kubo (1942). Light reddish rather narrow (like the young of *P. pacificus*), longitudinal bands on carapace, transverse bands on abdomen and distal ends of joints of appendages (Fig. 6, a).

**Notes on fecundity:**

Eggs light brownish yellow, borne on first to fourth pleopods. Five specimens were studied for counting the number of eggs, maximum number was 1024 (in 43 mm specimen), minimum was 288, with an average of 461 eggs per female.

Eggs oval in shape, maximum and minimum diameters being 0.65 - 0.80 and 0.45 - 0.5 mm respectively. However, these are smaller compared to the Japanese (Kubo, 1942) forms where they are reported to be 0.96 - 1.06 and 0.76 - 0.92 mm in diameter.

**Ecology:**

Though this species is reported to be a marine, littoral form (Holthuis, 1950), the present material was collected only from a localised spot in the estuarine bay of Amdalli just at the junction of a fresh water streamlet joining the sea where the salinity is lesser than normal sea water, the substratum being muddy and gravelly. Collected with the help of a hand net.

**Remarks:**

Certain differences are observed between the present material and description of the species from Bombay by Kemp
(1925) and Holthuis' (1950) account from the Indo-Pacific as listed under:

<table>
<thead>
<tr>
<th></th>
<th>Kemp's account</th>
<th>Holthuis's account</th>
<th>Present material (Karwar)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rostral formula</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 - 13</td>
<td>9 - 16</td>
<td>9 - 12</td>
</tr>
<tr>
<td></td>
<td>3 - 5</td>
<td>3 - 5</td>
<td>4 - 5</td>
</tr>
<tr>
<td><strong>Antennule upper</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) flagellum fused part</td>
<td>6 - 8 segments.</td>
<td>5 - 8 segments.</td>
<td>7 - 9 segments.</td>
</tr>
<tr>
<td>b) free part of shorter ramus</td>
<td>13-20 segments.</td>
<td>18-26 segments.</td>
<td>14-25 segments.</td>
</tr>
<tr>
<td><strong>First pereiopod carpus</strong></td>
<td>1.5 to 1.6-times</td>
<td>1.5-times chela.</td>
<td>2-times chela.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>chela.</td>
<td></td>
</tr>
<tr>
<td><strong>Second pereiopod palm</strong></td>
<td>1.4 to 1.7-times</td>
<td>1.4 to 1.8-times</td>
<td>1.25 to 2-times fingers.</td>
</tr>
<tr>
<td></td>
<td>fingers</td>
<td>fingers</td>
<td></td>
</tr>
<tr>
<td><strong>Third pereiopod merus</strong></td>
<td>- -</td>
<td>As long as carpus.</td>
<td>Distinctly longer than carpus.</td>
</tr>
</tbody>
</table>

The presence of *P. (P.) serrifer* in Karwar forms the first record of the species from the Karnataka Coast, extending the known range further south along the west coast.

5. **Palaemon (Palaemon) pacificus** (Stimpson) (Fig. 7)

**Synonyms:**


*Palaemon* (Palaemon) *pacificus* Holthuis, 1950, p. 27.

*Palaemon pacificus* Naik, 1972, p. 12.
Diagnostic features:

Rostrum (Fig. 7, b) almost straight but slightly upturned at tip, reaching a little beyond antennal scale; rostral formula $\frac{9 - 11}{3 - 4}$ (postorbitals 3), last 1 or 2 teeth of upper margin placed close to tip and smaller than rest. Carapace with strong branchiostegal and antennal spines.

Eyes brightly pigmented, ocellus present.

Stylocerite of antennule (Fig. 7, c) reaching 1/2 of basal segment, fused part comprising 7 to 8 segments, free part of upper flagellum consisting of 20 to 25 segments and 3.5-times fused part. Sharp distal tooth of antennal scale (Fig. 7, d) slightly falling short of its distal margin.

Mandibular palp 3-segmented.

First pereiopods (Fig. 7, k) overreaching antennal scale by fingers, cutting edges unarmed, carpus longer than merus. Second pereiopods (Fig. 7, l) overreaching antennal scale by chela, cutting edges unarmed, fingers shorter than palm.

Last 3 pereiopods short and stout, propodus of third (Fig. 7, m) and fourth with a few fine spinules on its posterior margin and that of fifth with distal transverse rows of setae.

Endopod of first pair of pleopod of male (Fig. 7, p') reaching about $\frac{1}{2}$ of exopod whereas that of female only $\frac{1}{4}$ of exopod. Appendix interna absent on first pleopod in both sexes and appendix masculina present on second pleopod of males (Fig. 7, p').
Telson (Fig. 7, q) tip acute, with 2 pairs of posterior marginal spines, inner pair about 4-times outer; 2 pairs of dorsal spines.

Previous records:
An Indo-Pacific species found in Hongkong, Red Sea, Suez canal, Africa, Pakistan, Japan, New Caledonia, Hawaiian Archipelago etc (for details, see Holthuis 1950).

From India: Bombay, Mormugao Bay and Cape Comorin along the west coast.

Variations:
Following variations are observed in the present material and from accounts of Kemp (1925), Kubo (1942) and Holthuis (1950):

1. Rostral teeth on upper margin vary from 9 to 11, on lower from 3 - 4 and subapical teeth from 1 - 3.

2. Stylocerite $\frac{1}{2}$ as long as basal segment in the present material but less than $\frac{1}{2}$ in the Indo-Pacific (Holthuis, 1950).

3. Fused portion of upper antennular flagellum with 7 to 8 segments, free portion of shorter ramus with 20 to 25 segments.

4. The present material agrees well with the Holthuis' (1950) account of the first pereiopods wherein the carpus is longer than merus unlike Kemp's (1925) and Kubo's (1942) wherein carpus is shorter than merus.

Material examined:

Of about 100 specimens collected, only 20 selected at random were examined in detail of which 8 were berried females.
ranging from 42 - 56 mm, 2 non-berried females from 33 - 47 mm and 10 males from 30 - 43 mm.

**Colour in live condition:**

Colour pattern agrees well with Kubo's (1940) account. Carapace irregularly striped with many narrow longitudinal bands while abdomen has similar but transverse bands, speckled inbetween with dots of light yellow. Joints of appendages with patches of dark reddish brown and saffron distally. Markings are simpler and lighter in young specimens. Also this colouration is less bright in specimens collected from the upper zones of intertidal region than the bright, dense colouration of these collected from the lower zones.

**Notes on fecundity:**

Eggs brownish yellow, borne on first to fourth pleopods. Five specimens were studied for egg count and maximum number of eggs was found to be 1597 (in 56 mm specimens) and minimum 1042 (in 47 mm specimens) with an average of 1223 eggs per female.

Eggs oval in shape, maximum and minimum diameters being 0.46 to 0.6 mm and 0.25 to 0.4 mm respectively. Eggs are however, smaller when compared to the Japanese form (Kubo, 1942) wherein they measured 0.57 to 0.66 and 0.46 to 0.53 mm.

Berried females were collected from October to May.

**Ecology:**

A common littoral, gregarious species, often found on esculpted stones in tidal rockpools. Collected with hand net from Majali, Kinkade, Kamath bay, Binga, Arga, Belikeri and Baburwada.
Remarks:

*P.* (P.) *pacificus* is used as bait for fishing in Japan (Kubo, 1942).

The presence of this species in Karwar forms the first record of the species from the Karnataka Coast.

Subgenus *Palaender* Holthuis

Lower margin of rostrum with only a single row of setae. Branchiostegal groove generally present, visible as a sharp line. Mandibular palp 2-segmented. 2 median spines of posterior margin of telson slender. First pleopod of male with or without a rudimentary appendix interna.

In Karwar, this subgenus is represented by a single species: *P. (Palaender) semmelinkii* (de Man).

6. *PALAEMON (PALAENDER) SEMMELINKII* (DE MAN)

(Fig. 8)

Synonyms:

Leander *semmelinkii* de Man, 1881, p. 137; Kemp, 1918, p. 268; 1925, p. 304; Prasad and Tampi, 1957, p. 20 (larvae).

Leander *modestus* Henderson, 1883, p. 441.

*Palaemon (Palaender) semmelinkii* Holthuis, 1950, p. 57:

Jagadisha and Sankolli, 1976, p. 51 (larvae).

Diagnostic features:

Rostrum (Fig. 8, b) characteristic, almost straight with
an upturned tip, reaching beyond antennal scale by 1/5 of its length; rostral formula $\frac{2}{3}$ (postorbital 1), subapical tooth absent, distal 1/3 of rostrum without teeth on either margins, last 1 - 4 upper teeth immovable, setae on both margins in a single row. Carapace with branchiostegal spine slightly smaller than antennal and placed on anterior margin.

Eyes lightly pigmented, cornea broader than stalk, an ocellus present.

Antennule (Fig. 8, c) with stylocerite sharp, slender and slightly less than 1/2 to as long as 1/2 of first segment of peduncle. Upper antennular flagellum with two rami fused for 7 to 11 segments, free part of shorter ramus consisting of 9 to 18 segments and about as long as to twice fused portion.

Antennal scale (Fig. 8, d) overreaching antennal peduncle by its distal 1/3 length, broad proximally and narrowing distally, distolateral spine of scale not reaching its distal margin.

Mandibular palp 2-segmented (Fig. 8, e). A pleurobranch present on third maxilliped.

First pereiopod (Fig. 8, k) not reaching end of antennal scale; fingers shorter than palm, covered with tufts of setae, cutting edges unarmed.

Second pereiopods (Fig. 8, l) stronger than first, overreaching scale by fingers. Fingers shorter than palm, cutting edges unarmed but sometimes with an inconspicuous tooth proximally on dactylus. Third to fifth pereiopods (Fig. 8, o) similar but fifth with transverse row of setae on distal part of posterior margin of propodus.
Telson tip drawn into a sharp point, 2 pairs of dorsal spines as in figure (Fig. 8, q), inner spines about 7-times outer. Uropods slender, slightly longer than telson.

Endopod of first pleopod of male (Fig. 8, p₁) almost ovate, about 1/2 of exopod, without appendix interna, but with a notch on slightly concave inner margin having 4 spinules; in females, however, this endopod about 1/3 of exopod and its inner margin smooth. Appendix masculina present on second pleopod of male (Fig. 8, p₂).

Previous records:

Indo-Pacific form, recorded so far from Burma, Mergui Archipelago, Nicobar Archipelago, Malay Peninsula, Singapore, Celebes (after Holthuis, 1950).

From India: Bombay and Mormugao on the west coast and Madras on the east coast.

Variations:

The present material shows the following variations:

1. Rostral teeth on upper margin vary from 8 to 9, of these, number of immovable teeth variable from last 1 to last 4 (irrespective of total number of teeth).

2. Stylocerite varies from being less than 1/2 to 1/2 of basal segment of antennular peduncle.

3. Segments of fused portion of antennular flagellum varying from 7 to 11; free part of shorter ramus consisting of 9 to 18 segments and about equal or twice, fused portion.
4. Dactylus of second pereiopod with or without an inconspicuous tooth on cutting edge.

Material examined:

Of the 14 specimens collected, 7 were berried females of 30 to 38 mm, 3 non-berried females of 30 to 36 mm and 4 males of 23 to 36 mm.

Colour in live condition:

The animal is transluscent. Reddish brown chromatophores are scattered all over the body, more densely dorsally than laterally. Some of the chromatophores are thickly concentrated to form transverse lines on carapace as shown in figure (Fig. 8).

Notes on fecundity:

Eggs are borne on only first four pleopods, immature eggs being brownish yellow and mature ones transluscent. 5 specimens were studied for egg count and maximum number was found to be 354 (in 36 mm specimen), minimum 206 (in 32 mm specimens) with an average of 340 per female. Eggs oval in shape, maximum and minimum diameters being 0.75 to 0.6 mm and 0.45 to 0.5 mm respectively.

Berried females were observed from October to June.

Ecology:

Holthuis (1950) mentions this species to be occurring in shallow coastal or brackish waters.

The present material was collected from the Kali estuary on muddy bottom in slow running or stagnant waters.
**Remarks:**

Certain differences are found when present material is compared with Holthuis' (1950) account of the species from the Indo-Pacific material, as listed below:

<table>
<thead>
<tr>
<th></th>
<th>Present (Karwar) material</th>
<th>Holthuis' account</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rostrum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teeth on upper margin</td>
<td>8 - 9</td>
<td>7 - 11</td>
</tr>
<tr>
<td><strong>Immovable teeth</strong></td>
<td>The last 1 - 4 (irrespective of total number).</td>
<td>2 - 3 (more than 3 only when total number is 11).</td>
</tr>
<tr>
<td><strong>Difference in rostral structure in male and female</strong></td>
<td>No sexual differences.</td>
<td>Male rostrum is more slender than in female, teeth more pressed against rostrum proper in males.</td>
</tr>
<tr>
<td><strong>Antennule</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper flagellum</td>
<td>Fused portion of 7 - 11 segments, free portion of shorter ramus: 7 - 18 segments.</td>
<td>Fused portion 7-12 segments, free portion of shorter ramus: 11 - 17 segments.</td>
</tr>
<tr>
<td><strong>Telson</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior inner spines</td>
<td>About 7-times outer spines.</td>
<td>About 4-times outer spines.</td>
</tr>
</tbody>
</table>

This is the first time *P. (P.) semmelinkii* is reported from the Karnataka Coast.

**Subgenus Nematopalaemon Holthuis**

Rostrum considerably long and slender, with distinct, elevated basal crest of teeth; carapace without branchiostegale groove. Stylocerite with a large tooth on upper surface.
Mandibular palp 3-segmented. Dactylus of last 3 pereiopods enormously lengthened, longer than carpus and propodus together.

In Karwar, this subgenus is represented by a single species P. (Nematopalaemon) tenuipes (Henderson).

7. Palaemon (Nematopalaemon) tenuipes (Henderson) (Fig. 9)

**Synonyms:**

Leander tenuipes Henderson, 1893, p. 440; Nobili, 1903, p. 7;
Kemp, 1917, p. 234; 1925, p. 239; Chopra, 1943, p. 5;
Rajyalakshmi, 1962, p. 53.


Palaemon (Nematopalaemon) tenuipes Holthuis, 1950, p. 44;

**Diagnostic features:**

Rostrum rather long, extending well beyond antennal scale, distinctly upturned, with a basal crest, rostral formula $\frac{5}{2}-\frac{7}{6}$ (teeth on upper border confined to basal crest except 1 subapical tooth); antennal and brachiosepal spines strong, almost equal (Fig. 9, a).

Antennular peduncle (Fig. 9, c) short of antennal scale (Fig. 9, d), its upper flagellum with 2 branches fused for 7–10 segments. Antennal scale sharply narrowing anteriorly, its distal tooth not reaching its anterior margin.
Mandibular palp 3-segmented; last but one segment of third maxilliped slightly expanded distally.

First pereiopod (Fig. 9, k) reaching beyond antennal scale, carpus shorter than merus and about 1.5 times chela; second pereiopod (Fig. 9, l) reaching beyond scale by chela, fingers narrow, almost straight with incurved tips; palm swollen, carpus shorter than palm and about 1/2 of merus. Last 3 pereiopods characteristically very long and slender due to extraordinary length of propodus and dactylus, third pereiopod shorter than fourth and fifth (Fig. 9, o) dactylus longer than carpus and propodus together, carpus of normal size; length of these pereiopods exceeding total length of body itself. Due to their enormous length most of the preserved specimens are with these pereiopods damaged.

Pleopods extremely long exceeding even carapace length, first without appendix interna in both sexes; second pleopod of male with appendix masculina.

Telson much shorter than uropods, with 2 pairs of small dorsal spines and 2 pairs of posterior spines (inner being smaller) with a middle pair of plumose setae, sometimes anterior dorsal pair of spines and outer posterior spines are so small that they can easily be overlooked.

Previous records:

Outside India recorded from Pakistan, Burma through Malaysia to New Zealand and in India along both east and west coasts—Bombay, Cannanore, Madras, Vishakapatnam, Puri and many localities in Gangetic delta.
Variations:

Not much variations was observed except in the length of rostrum, rostral teeth and number of jointed segments of fused portion of upper antennular flagellum.

Material examined:

Of about 50 specimens collected, only 20 chosen at random were examined in detail, of these 10 berried females ranged from 45 - 60 mm, 4 non-berred females from 40 - 50 mm and 6 males from 45 - 55 mm.

George (1969) gives the maximum size as 80 mm but in the present material it does not extend beyond 60 mm.

Colour in live condition:

Translusant with light pink chromatophores scattered all over the body, more concentrated dorsally.

Notes on fecundity:

Eggs orange yellow in colour. Five specimens were studied for counting the number of eggs and maximum number was found to be 1655 in 60 mm specimen and minimum number was found to be 978, with an average of 1270 per female. Eggs oval in shape, maximum and minimum diameters being 0.7 to 0.8 mm and 0.4 to 0.5 mm respectively.

Ecology:

This is a coastal species extending upto about 20 m depth (Holthuis, 1950; George, 1969), occurring in both estuarine and brackish waters. In Karwar, available in Trawl
catches in late summer (May) and in "Yendi" (shore seine) catches during early monsoon period along with *Hippolysmata ensirostris*, berried females also available during the same period.

**Remarks:**

This is a commercially important species particularly along the Bombay coast where it is used both fresh and in sundried condition and also in Gangetic delta.

Presence of this species in Karwar form the first record along the Karnataka Coast.
GENUS MACROBRACHIUM BATE

Body compressed, generally robust. Rostrum laterally compressed (sometimes with basal crest), armed with teeth and with hairs between teeth. Carapace mostly with numerous small tubercles in adult, more pronounced in males but smooth in young specimens and hepatic spines present (latter far removed from anterior margin of carapace, occasionally missing—an abnormality); branchiostegal groove present. Antennal scale 2 to 3-times as long as broad, its lamella overreaching the terminal spine. Mandible well developed, with large 3-segmented palp. First pereiopods with fingers as long as palm and without teeth on cutting edges. Second pereiopods robust, usually sexually dimorphic, in adult males often longer than body, proportions of segments varying in different species and often in the same species, covered with tubercles, spines, hairs or smooth, pereiopods of both sides often similar but in some with marked differences. Last 3 pereiopods with dactylus simple, propodus with posterior row of spinules and that of fifth pereiopod (as in Palaemon) with transverse rows of setae or very slender spinules distally on posterior margin; in some species, adult males with numerous spinules on last 3 pereiopods. Abdomen generally smooth, but in some, pleura with numerous small tubercles as those on carapace; pleura of first 3 segments broadly rounded, those of fourth and fifth narrower, tapering posteriorly, that of sixth small, triangular ending in a sharp point. First pleopod of male with no trace of appendix interna while other pleopods with a slender appendix interna, second pleopod of male, however, with a strong appendix masculina longer than appendix
Uropods overreaching telson, its exopod with an apical and longer, movable subapical spines (except in *M. lamarrei*, *M. canarai* and *M. kistensis*). Telson elongated, narrowing posteriorly, 2 pairs of dorsal spines, dorsal surface smooth or with numerous tubercles; 2 pairs of posterior marginal spines of which inner longer and with several plumose setae between two inner spines.

Members of this genus occupy variety of waters from pure fresh waters to brackish waters to marine and show wide range of sizes from small to about 35 - 40 cms.

Lifehistory of 3 types: direct, abbreviated or prolonged.

Remarks:

Holthuis (1950) while commenting on Kemp's (1925) work on Decapoda Caridea of Indian museum, suggests that Kemp's genus *Palaemon* should be divided into 2 genera *Macrobrachium* and *Cryphiops*; and considers *Palaemon carcinus* as the type for the genus *Macrobrachium*. In this study also, Holthuis' is followed as regards genus *Macrobrachium*.

This genus is represented in Karwar by 3 species viz. *M. rosenbergii* (De Man), *M. equidens* (Dana) - striped and non-striped forms and *M. idella* (Hilgendorf).

Key to the Karwar species of the genus *Macrobrachium*

1. Rostrum with a distinct basal crest *... rosenbergii* (De Man)
   Rostrum without basal crest *... ...* 2
2. Second pereiopods with carpus shorter than chela; at least one finger with velvety pubescens. **Equidens** (Dana)

Second pereiopods with carpus longer than chela; fingers without velvety pubescens. **Idella** (Hilgendorf)

**8. MACROBRACHIUM EQUIDENS** (DANA)

(Figs. 10 & 11)

**Synonyms:**

- *Palaemon equidens* Dana, 1852, p. 26; De Man, 1888, p. 283.
- *Palaemon (Supalaemon) sundaicus* De Man, 1897, p. 775; Nobili, 1903, p. 8.

In Karwar this species is represented by 2 forms viz. striped form (Fig. 10) and non-striped (Fig. 11) form which show common diagnostic features and as such common diagnosis is given here, listing the differences between the two forms at the end.

**Diagnostic features:**

- Rostrum slightly upturned without basal crest, about as long as or shorter than antennal scale, rostral formula $\frac{9}{4} - \frac{11}{6}$ (2 postorbital). Antennal and hepatic spines, characteristic of this species, in one line, former being stronger and slightly carinate (Figs. 10 & 11, b).

- Upper flagellum of antennule (Figs. 10 & 11, c) with two branches fused for 10 - 11 segments, peduncle shorter than
antennal scale. Basal segment of antennal peduncle with a
distinct basal spine, scale slightly concave on outer margin,
its distal spine not reaching apex (Figs. 10 & 11, d).

First pereiopods (Figs. 10 & 11, k) overreaching
antennal scale by entire chela. Second pereiopods (Figs. 10 & 11, l)
overreaching by chela + carpus (sometimes + 1/3 of merus) armed
all over with small spinules or tubercle-like spinules; either
both fingers or only movable finger and inner margin of fixed
finger with dense, velvety pubescens, cutting edges with 2
proximal tubercle-like teeth; carpus slightly or much shorter than
chela and distinctly longer than merus. Third to fifth pereiopods
almost similar in structure and length, propodus of fifth (Figs.
10 & 11, l) with transverse rows of setae.

First pleopod in both sexes without an appendix interna;
second pleopod of male (Figs. 10 & 11, p) with a strong appendix
masculina.

Telson (Figs. 10 & 11, q) with 2 pairs of dorsal spines,
tip acute, flanked by 2 pairs to 10 pairs of plumose setae and 2
pairs of posterior spines and uropods extend almost as long as or
a little beyond telson tip.

Previous records:

This species is widely distributed (for details, see
Holthuis, 1950, p. 171) extending from Africa to south west New
Guinea. From India, it has been recorded from Pondicherry,
Travancore and Cochin.

Material examined:

Striped form: 4 males (37 to 72 mm) and 4 berried females
(48 - 66 mm). Non-striped form: 4 males (55 to 76 mm) and 4 berried females (28 to 58 mm).

Colour in live condition:

Non-striped form: Body greenish brown, without any colour pattern (like stripes etc), but with a white spot on the dorsal surface of third abdominal segment, pleura of all the 5 abdominal segments with red, blue and dark brown blotches. (b) Striped form: longitudinal stripes of greenish brown with red and white dots interspersed inbetween along the entire length of body from carapace to telson.

Notes on fecundity:

Egg colour brownish in both forms. 4 specimens from each form were studied for egg counting. In striped form, maximum number: 6564 (in 58 mm specimen), minimum number: 2765, average 5130. In non-striped form, maximum number: 6432 (in 59 mm specimen), minimum number: 2930, average 4978. Eggs oval in shape in both forms and egg size also similar in both forms, maximum diameter being 0.8 to 0.9 mm and minimum diameter being 0.65 to 0.75 mm.

Berried females are available throughout the year except during the monsoon when collections were not made.

Ecology:

Both forms were collected from the Kali estuary from muddy bottom with small, loose boulders. These are generally found together in the same locality. This species is known to occur right from brackish to freshwater.
Remarks:

The astonishing degree of variability in this species has resulted in creation of different varieties or even subspecies and a lengthy synonymy (for details, see Holthuis, 1950). From India, Henderson and Mathai (1910) described this species as *Palaemon sulcatus* n. sp. which name was followed by subsequent authors like Panikkar (1937), Nataraj (1942) and Tiwari (1955).

Apart from the differences in the colour pattern between the two forms i.e. striped and non-striped forms, as observed under colouration they differ mainly as follows:

<table>
<thead>
<tr>
<th>(non-striped form)</th>
<th>(striped form)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rostrum about as long as antennal scale, distal 2 teeth widely spaced. Dorsal teeth 9 - 11 and ventral teeth 5 - 6 (2 postorbital).</td>
<td>Rostrum slightly shorter than antennal scale, all teeth evenly spaced. Dorsal teeth not less than 11 in any, ventral teeth 4 - 5 (2 postorbital).</td>
</tr>
<tr>
<td>2. a) Second pereiopods overreaching antennal scale by chela + carpus + distal 1/3 of merus. Both fingers densely velvety (in adult males only and not in adult females).</td>
<td>a) Second pereiopods overreaching antennal scale by chela + carpus only. Movable finger and only inner margin of fixed finger velvety in adults of both sexes.</td>
</tr>
<tr>
<td>b) Carpus slightly shorter than chela.</td>
<td>b) Carpus much shorter than chela, 7/10 length of latter.</td>
</tr>
</tbody>
</table>

The above morphological differences between the two forms, however, appear to be of minor importance, to separate the two as distinct species. Also, the laboratory reared early larval stages of both the forms show similarity even in their chromatophore.
pattern (which is supposed to be specific) thus clearly in indicating that both the forms belong to one and same species. Dr. Holthuis was, therefore, consulted in this regard and he too opines that both the forms are of same species (personal communication). It is, however, interesting to observe that the differences given above were constant and also the size range is similar in both the forms.

For further confirmation, however, a more detailed studies of wider series of material of different size groups is required, supplemented by study of laboratory reared juvenile morphology so as to find out whether at some stage of lifehistory, the differentiation into striped and non-striped forms start either separately in the two forms or within the same lot of one form.

Regarding the distribution of this species in India, George (1969) mentions that it is found only in Kerala area. This species however, has been recorded from Pondicherry by Nobili (1903) under the name *Palaemon* (*Supalaemon*) *sundaicus*.

The presence of this species in Karwar forms the first record of the species along the Karnatak coast and extends its distribution to further north along the west coast.

This species incidentally appears quite promising for culture.
9. MACROBRACHIUM IDELLA (HILGENDORF)
(Fig. 12)

Synonyms:

Palaemon (Eupalaemon) idae idella Hilgendorf, 1838, p. 29.
Palaemon (Eupalaemon) multidens Coutiere, 1900, p. 1266; Nobili, 1903, p. 9.
Macrobrachium idella Holthuis, 1950, p. 146; Pillai and Mohamed, 1973, p. 359 (larvae).

Diagnostic features:

Rostrum (Fig. 12, b) almost straight, about as long as antennal scale and without basal crest, rostral formula \( \frac{11 - 13}{4 - 5} \) (2 postorbital), distal 2 teeth widely spaced. Both antennal and hepatic spines present, former being stronger.

Anterior part of carapace, abdominal pleura, sixth abdominal segment and dorsal surface of telson and uropods covered with numerous fine tubercles, in large males.

Upper flagellum of antennule (Fig. 12, c) with fused basal portion of 10 - 12 segments, peduncle shorter than antennal scale. Basal segment of antenna (Fig. 12, d) with a distinct spine, distal spine of scale falling short of anterior margin of lamella.

First pair of pereiopods (Fig. 12, k) overreaching antennal scale by chela and distal 1/4 of carpus. Second pair of pereiopods (Fig. 12, l) overreaching antennal scale by chela + carpus + distal 1/3 of merus, covered with small spinule all over,
chela slender, fingers not velvety, carpus slightly shorter than chela and distinctly longer than merus. Third to fifth pereiopods almost similar in structure and length, distal portion of pronodus of fifth with transverse rows of setae.

Pleuren of 6th abdominal segment pointed, and about $\frac{2}{3}$ times fifth segment and about 1/2 of telson.

Telson (Fig. 12, q) with 2 pairs of dorsal spines situated as in figure; tip acute with 2 pairs of posterior spines, middle pair being about 4-times as long as lateral pair, about 20 plumose setae between middle pair of spines. Uropods almost reaching up to telson tip.

Appendix interna absent on first pleopod in both sexes; a strong appendix masculina present on second pleopod of male.

Previous records:

This species is so far recorded from Africa & India. Pillai & Mohamed (1973) refer to this species as 'endemic of Kerala backwaters' but M. idella is found to occur both along the east & west coasts of India: Pondicherry, Calicut, Palghat, Kottayam, Travancore, Cochin (Kerala) and Mangalore.

Variations:

Not much variations are observed in the present material except for:

1. Rostral teeth on upper margin varying from 11 to 13 (not 12 - 17 as given by Holthuis, 1950) and on lower from 4 to 5.
2. Fused portion of upper antennular flagellum varying from 10 to 12 segments.

Material examined:

In all, 10 specimens were examined, 4 males ranging from 82 to 95 mm, 5 ovigerous females from 55 - 70 mm and 1 non-ovigerous female of 65 mm.

Colour in live condition:

The general colouration is light greenish-brown, with black patches on pleura of first to third abdominal segments.

Eggs:

Eggs dark brownish in colour. 5 specimens were studied for counting the number of eggs, the maximum number of eggs being 8840 in 65 mm specimens and minimum number of eggs being 4980 in 55 mm specimen, with an average of 6872 per female. Eggs oval in shape, maximum and minimum diameters being: 0.85 to 0.9 mm and 0.7 to 0.75 mm.

Berried females were observed from August to October.

Ecology:

These prawns are generally found on muddy bottoms and were collected from the cast net catches along the Kali estuary from the eastern side of Sunkeri (Karwar).

Remarks:

The occurrence of *Macrobrachium idella* in Karwar forms the first record of the species from the North Kamara coast,
thereby extending its distribution further north along the west coast and not "endemic to Kerala" as observed by Pillai and Mohamed (1973).

A promising, cultivable species.

10. MACROBRACHIUM ROEBERGII (DE MAN)
(Fig. 13)

This famous giant freshwater prawn is widely distributed in the Indo-Pacific and has been called by different names by many authors in the past.

Synonymy and Previous records:

Since the synonymy and previous records of this most popular and well known species have been exclusively dealt with by Holthuis (1950), to avoid repetition, please see Holthuis (1950, pp. 111 - 113) and also George (1969, p. 38).

Diagnostic features:

Very large, growing up to about 350 mm. Rostrum (Fig. 13, b) long, variously curved but tip upcurved, basal crest distinct, rostral formula 11 - 12. Both antennal and hepatic spines strong.

Antennal scale (Fig. 13, d) with distal margin triangularly narrowing, distal spine falling much shorter than reaching apex.
First pereiopod (Fig. 13, k) reaching beyond antennal scale by entire chela and a part of carpus. Second pereiopods (Fig. 13, l) unequal, sexually dimorphic, one much larger than other in full grown males (even longer than body), beautifully metallic blue, covered all over with spine-like tubercles, carpus more than twice chela and longer than merus, fingers about as long as palm (in larger cheliped) and movable finger stouter and with dense velvety pubescens, in females, these chelipeds slightly unequal/subequal and slender. Third to fifth pereiopods (Fig. 13, o) slender, with movable spinules on posterior margin of propodus, fifth with transverse rows of setae on propodus. All pereiopods armed with scattered tubercles/spines and hairs, more so in older specimens.

Telson with very small dorsal spinules, median spine of telson (apex) long, characteristically overreaching its posterior spines and with 4 pairs of plumose setae between inner posterior spines.

Pleopods normal, first pair in both sexes without appendix interna, second of male with appendix masculina.

Material examined:

Only 5 specimens were collected from fishermen's catches in the estuarine part of the river Kali during July - September, (1972 - 1974), 3 males ranging from 190 - 220 mm and 2 berried females from 170 - 180 mm.

Remarks:

Though this species is commercially the most important,
there is no regular fishery in and around Karwar of this species but occasionally a few specimens are caught perhaps when they migrate towards the estuarine waters during breeding season at the onset of monsoon when the normal fishing is suspended. Though this species has been reported along the coastal regions almost all over India, this forms the first record of the species on the Karnataka Coast.

Culture of this species is already being practised in some parts of the world and it is in experimental stage with good results in India too.
SUBFAMILY PONTONIINAE

Upper antennular flagellum with both rami fused in basal part. Antennal scale usually well developed but occasionally absent. Pleurobranch absent from third maxilliped. Appendix masculina generally present on second pleopod of male and so also appendix interna on second pleopod of female. Posterior margin of telson with three pairs of spines.

Only one genus of this subfamily, *Periclimenes*, is so far represented in Karwar.

GENUS *PERICLIMENES* COSTA

Pontoniinae with body slender, rostrum armed with conspicuous teeth and with immovable hepatic spine. Antennal scale well developed. Mandibular palp absent; all maxillipeds with exopods. Dactylus of last 3 pereiopods without basal protuberance, simple or biunguiculate; pleura of first 5 abdominal segments broadly rounded or bluntly pointed, never produced into a sharp point.

Free living or epizoic on Porifera, Coelenterata or Echinodermata.

In Karwar this genus is represented by 2 subgenera, *Periclimenes* and *Harpilius*, the former by 2 species - *elegans* (Paulson) and *andamanensis* Kemp and latter by a single species *obscurus* Kemp.
Key to the Karwar subgenera of *Periclimenes*

1. Dactylus of last 3 pereiopods
   biunguiculate ............ *Periclimenes*

2. Dactylus of last 3 pereiopods simple .. *Harpilius*

Remarks:

The subgenera represented in the present study show very much overlapping characters; can be separated by only a single feature viz. dactylus of third to fifth pereiopods simple or biunguiculate. Therefore, no separate definitions for the subgenera have been given here.

11. *PERICLIMENES* (PERICLIMENES) OBSCURUS KEMP

(Figs. 14 & 15)

Synonyms:

*Periclimenes* (Periclimenes) obscurus Kemp, 1922, p. 144:

Diagnostic features:

Rostrum (Fig. 14, b) slightly ventrally bent, almost as long as antennular peduncle, shorter than antennal scale, rostral formula $\frac{8}{0}-\frac{9}{2}$ (postorbital 2), hindmost dorsal tooth separated from rest by wider gap. Only antennal and hepatic spines present latter being unmovable; supraorbital spine absent, orbital angle produced forwards into a triangular lobe.

Eyes well pigmented with cornea broader than stalk.
Antennular peduncle (Fig. 14, c) shorter than antennal scale, upper flagellum with two rami fused for 6-7 segments. Lateral margin of antennal scale (Fig. 14, d) almost straight, distal tooth sharp but not reaching tip of lamella.

Mandible without palp, both incisor and molar parts slender. Remaining mouthparts as in figure (Fig. 14, e-g).

First pereiopods (Fig. 15, k) reaching upto antennal scale; fingers unarmed. Second pereiopods (Fig. 15, l) overreaching antennal scale by distal half of chela, fingers half of palm and with one small tooth each basally; carpus half of palm. Third to fifth pereiopods (Fig. 15, o) with dactylus, about 4 to 4.5 times as long as its basal breadth, biunguiculate, gently narrowed distally, accessory claw nearly half as long as principal claw.

Endopod of first pair of pleopods (Fig. 15, p₁) of females 1/3 of exopod, without appendix interna.

Telson (Fig. 15, q) with two pairs of dorsal spines as shown in figure, tip acute with 2 pairs of posterior marginal spines, with a pair of plumose setae inbetween longer, inner pair of spines.

A median sternal spine present between coxae of first pereiopods.

Previous records:

This species is so far recorded only from the Indian waters: Springhaven, Madras Harbour; Ennur backwaters near Madras and Trivandrum.
Variations:

Following variations were observed in the present material:

1. Rostral teeth on upper border vary from 8 to 9 and lower border from 0 to 2.
2. Segments of the fused portion of the upper antennular flagellum vary from 6 to 7.

Material examined:

4 non-ovigerous females (10 - 13 mm) and a single berried female (13 mm), no males however, represented in the present collection.

Colour in live condition:

Almost transparent except for the light red colour like that of its host gorgonid on the ventral surface of the abdomen.

Notes on fecundity:

Eggs slightly reddish-yellow in colour. A single berried female (of 13 mm) had 177 eggs. Egg shape oval, maximum diameter: 0.4 to 0.45 mm and minimum diameter: 0.3 to 0.35 mm.

Ecology:

The present material was collected from the intertidal region at Amdalli, Karwar and was found on the red gorgonids. Kurien (1954), however, collected his specimens from a depth of 15 fathoms off Trivandrum. While Kemp's material is reported to be found swimming around buoys and pillers encrusted with sponges,
hydroides and other marine organisms from harbour area. So far no information is available regarding its association with gorgonids.

Remarks:

The following differences are observed when the present material is compared with Kemp's (1922) account of the species:

<table>
<thead>
<tr>
<th></th>
<th>Kemp's account</th>
<th>Karwar material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rostral teeth on lower border</td>
<td>1 - 2</td>
<td>0 - 2</td>
</tr>
<tr>
<td>Number of segments of fused portion of upper antennular flagellum</td>
<td>4 - 5</td>
<td>6 - 7</td>
</tr>
<tr>
<td>Second pereiopod - carpus</td>
<td>Slightly shorter, 1/2 of palm. than, as long as, or rather longer than, palm.</td>
<td></td>
</tr>
</tbody>
</table>

In Kurian's (1954) account of the species, the tooth on cutting edge of fingers of second pair of pereiopods is absent, and carpus is slightly longer than palm unlike in the present material.

The presence of this species in Karwar forms the first record of the species along the Karnstak coast.

Key to the Karwar species of the subgenus Harpilius

1. Carpus of second pereiopod with 2 distal spines, fingers about half the length of palm; third to fifth pereiopods stout . . . . . . . elegans (Paulson)
2. Carpus of second pereiopod with only one distal spine, fingers equal to palm in length; third to fifth pereiopods slender. *Andamanensis* Kemp

12. *Periclimenes (Harpilius) Andamanensis* Kemp

(Fig. 16)

Synonyms:

Periclimenes (Ancylacaris) *Andamanensis* Kemp, 1922, p. 204.


DESCRIPTION

Rostrum straight proximally, slightly upturned distally, reaching up to antennal scale; rostral formula $\frac{2}{3\frac{2}{1}}$ (1 postorbital). Carapace with supraorbital, antennal and unmovable hepatic spines.

Eyes dully pigmented, cornea slightly broader than stalk.

Antennule (Fig. 16, c): Stylettni trite sharp and slender, reaching almost to middle of basal segment, distalateral spine of basal segment reaching $\frac{1}{2}$ of middle segment, distal margin almost straight. Second and third segments slender, subequal in length and width. Upper flagellum with fused portion of 12 - 15 segments, free part of longer branch consisting of 7 - 8 segments, total length of stouter ramus a little longer than peduncle.

Antenna (Fig. 16, d): Scale longer than peduncle, outer margin slightly concave, distal tooth sharp and overreaching lamella.
Mouth parts: Mandible (Fig. 16, e) without palp. All maxillipeds with exopods.

First pereiopods (Fig. 16, k): Merocarpal articulation falls short of basal segment of antennule. Fingers unarmed, almost as long as palm. Carpus about 1.1-times breadth and from 1.4 to 1.7-times chela.

Second pereiopods (Fig. 16, l): Overreaching antennal scale by chela, carpus and a portion of merus; chela about 1.25-times carpus. Fingers with two tubercles each at proximal half of cutting edges, with or without slight excavation and without any series of small teeth in their proximal two-thirds unlike as mentioned by Kemp (1922). Palm slightly shorter than or upto 1.25-times fingers. Carpus with conspicuous spine on its inner distal margin and in males in addition a small acute projection or tubercle. Merus shorter than carpus with a spine on anterodistal end.

Pereiopods third to fifth: Long and slender, fifth pair (Fig. 16, o) reaching to or little beyond, end of antennal scale. Propodus with about 5 pairs of spinules on its posterior margin and 2 to 2.5 times dactylus. Dactylus simple, curved, with a few setae on middle of its anterior margin.

Abdomen: sixth segment about 1.6-times fifth. A median sternal spine between coxae of first pereiopods present.

Pleopods: Appendix interna absent on first pleopod. In males, endopod of first pleopod (Fig. 16, p₁) slightly less than 1/2 of exopod, with 5 - 6 inner mesial hooked spinules. Appendix masculina present on second pleopod (Fig. 16, p₂).
Telson (Fig. 16, q) : With two pairs of dorsal spines arranged as in figure, tip of telson acute with 3 pairs of posterior marginal spines, of which median ones twice length of innermost. Uropods overreaching posterior margin of telson.

Previous records:

Port Blair, Andaman Islands, Verlaten Island in the Sunda strait between Java and Sumatra and Madagascar.

Variations:

1. Teeth on upper border of rostrum vary from 7 - 9 and these on lower from 1 - 3.
2. Number of segments of fused portion of upper antennular flagellum vary from 12 to 15.
3. Carpus of first pereiopods varying from 1.4 to 1.7-times chela.
4. Cutting edges of chela of second pair of pereiopods with or without excavation, teeth varying from 3 - 5 in number.

Material examined:

Of the nine specimens collected, 2 berried females ranged from 15 - 16 mm, 4 non-berried females from 12 - 14 mm and 3 males from 14 - 16 mm.

Colour in live condition:

Body translucent with light yellow chromatophores all over the carapace and abdomen as shown in figure. Eyestalks, basis and coxa of first pereiopod are with dark red and blue patches. A small horizontal streak of bluish red on antero-lateral surface of carapace. A prominent brownish yellow band on the distal end of palm of second chela.
Notes on fecundity:

Egg colour dark green. Of the 2 berried females collected, a 15 mm specimen had 188 eggs while a 16 mm specimen had 204. Egg shape oval, maximum diameter: 0.4 to 0.45 mm, minimum diameter: 0.25 to 0.30 mm.

Ecology:

Estuarine, found on muddy bottom. Collected from the Kali estuary, Karwar by using a hand net.

Remarks:

The present material when compared with Kemp's (1922) account of the species from Andamans, reveals the following differences:

<table>
<thead>
<tr>
<th></th>
<th>Present material (Karwar)</th>
<th>Kemp's account of Andaman material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rostral teeth on lower margin</td>
<td>1 - 3</td>
<td>2 - 3</td>
</tr>
<tr>
<td>Antennule - distolateral spine</td>
<td>Longer, reaching 1/2 of second segment.</td>
<td>Very short, extends a little beyond.</td>
</tr>
<tr>
<td>Number of segments of fused part of upper antennular flagellum</td>
<td>12 - 15</td>
<td>8 - 11</td>
</tr>
<tr>
<td>Antennal scale length</td>
<td>3.5 times the width.</td>
<td>5 to 5.5 times the width.</td>
</tr>
<tr>
<td>First pereiopods</td>
<td>Falls short of basal segment of antennular peduncle.</td>
<td>Reaches nearly to the end of basal segment of antennular peduncle.</td>
</tr>
<tr>
<td>Present material (Karwar)</td>
<td>Kemp's account of Andaman material</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>Second pereiopods - merus Shorter than carpus.</td>
<td>Longer than carpus (only in small males shorter than carpus).</td>
<td></td>
</tr>
<tr>
<td>Chela</td>
<td>1.25-times the carpus.</td>
<td>1.8 to 2.2-times in adults.</td>
</tr>
<tr>
<td>Palm</td>
<td>Shorter than or atmost 1.25-times the fingers.</td>
<td>1.8 to 2.1-times the fingers but not shorter.</td>
</tr>
<tr>
<td>Cutting edges of fingers With only two small teeth on each but no series of small teeth in the proximal two-thirds.</td>
<td>With a series of small teeth on the proximal two-thirds.</td>
<td></td>
</tr>
</tbody>
</table>

This is the first record of the species from the peninsular coast of India. Also, colour in live condition of this species has been described for the first time.

13. **PERICLIMENES (HARPILIUS) ELEGANS (PAULSON)** (Fig. 17)

**Synonyms:**

Anchistia elegans Paulson, 1857, p. 113.


Periclimenes (Harpilius) elegans Holthuis, 1952, p. 81.

**Diagnostic features:**

Rostrum (Fig. 17, a) distally curving upwards, as long.
as or a little longer than antennal scale; rostral formula $\frac{7}{3} - \frac{8}{4}$ (postorbital 1), upper distal 2 teeth separated from rest by a wide gap, tip of rostrum bifid. Carapace with supraorbital, antennal and hepatic (unmovable) spines.

Eyes dully pigmented, cornea broader than stalk.

Stylocerite of antennule (Fig. 17, c) reaching 1/3 of basal segment; fused part of upper flagellum comprising 10 - 15 segments, stouter ramus shorter than peduncle. Antennal scale (Fig. 17, d) about 3 to 4-times as long as wide, narrowing distally, outer margin more strongly concave and its distolateral tooth strong, overreaching lamella.

Mouth parts typical, mandibular palp absent; all maxillipeds with exopods.

First pereiopods (Fig. 17, a) overreaching scale by half to entire length of chela; carpus less than 7-times its distal breadth, fingers as long as palm, their cutting edges unarmed. Second pereiopods (Fig. 17, a) equal, extending beyond antennal scale by entire length of carpus; merus in males 5-times (in females, 6-times) as long as its distal breadth, with a spine on distal end of lower margin; carpus 3 to 4-times as long as its distal breadth (in both sexes) with 2 stout distal spines, chela twice carpus in length, fingers about 1/2 of palm, sparsely rugose, cutting edges sometimes excavate, proximal 2/3 with 2 to 5 unequal teeth as in figure. Last 3 pairs of pereiopods (Fig. 17, a) stout; fifth when extended falling short of antennal scale; merus of third pereiopod 6.5-times as long as broad, propodus with a series of spinules, dactylus slightly curved, length 4-times its
breadth, with a few setae on its anterior margin.

Endopod of first pair of pleopod (Fig. 17, p₁) of male reaching about half of exopod (of female, only 1/3), inner margin with a notch, appendix interna absent on first pleopods. Appendix masculina present on second pleopod (Fig. 17, p₂) of male.

Telson (Fig. 17, q) with 2 pairs of dorsal spines so arranged as to divide its length into 3 equal parts; tip of telson acute with 3 pairs of marginal spines, second pair longest. Uropods longer than telson.

A median sternal spine present between coxae of first pereiopods.

Previous records:

Red Sea, Persian Gulf, Malay Archipelago. India: Andaman and Nicobar Islands, Madras Harbour and Trivandrum.

Variations:

1. Rostral length varying from as long as to slightly longer than antennal scale; teeth on upper margin varying from 7 - 8 and on lower from 3 - 4.

2. Segments of fused portion of upper antennular flagellum vary from 10 - 15 in number.

3. Cutting edges of fingers of second pereiopods with or without excavation, teeth small to large.

4. The present material ranged from 17 - 25 mm in size while Kurien (1954) reports his largest specimen as a 14 mm berried female; Holthuis (1950) has reported his Siboga material upto 28 mm.
Material examined:

Of the 40 specimens collected, 25 were chosen at random for examination in detail of which 10 males, ranged from 17 - 23 mm, 5 berried females from 20 - 24 mm and 10 non-berried females from 16 - 20 mm.

Notes on fecundity:

Eggs brownish yellow, brone on first to fourth pleopods. 5 specimens were studied for counting the number of eggs, maximum number was 506 (in 23 mm specimen) and minimum was 370 (in 20 mm specimen), with an average of 465 eggs per female. Eggs oval in shape, maximum and minimum diameters being 0.50 to 0.60 mm and 0.4 to 0.5 mm respectively.

Berried females were observed from October to May.

Ecology:

Marine littoral form, found on rocks with crevices especially where sea anemones & Zoanthus colonies are abundant. The material was collected from Kinkade, Kamath Bay, Binya Bay and Baburwada with the help of a hand net. Kemp (1922) recorded this species at low water in pools on coral beach at Fort Blair, while Kurian (1954) described it from material obtained from 15 fathoms off Trivandrum from sandy, silty bottom with shell fragments.

Remarks:

Following differences were observed, when the present material was compared with Kemp's (1922) account of the species.
from Madras:

<table>
<thead>
<tr>
<th></th>
<th>Kemp's description</th>
<th>Karwar material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antennal scale</td>
<td>4.5 to 5.5-times as long as wide.</td>
<td>3 to 3.8-times.</td>
</tr>
<tr>
<td>First pereiopods</td>
<td>7.5-times as long as its distal breadth.</td>
<td>Less than 7-times.</td>
</tr>
<tr>
<td>Carpus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second pereiopods</td>
<td>In male 6 to 7-times as long as its distal breadth, in females 7 to 7.5-times.</td>
<td>5-times in males, 6-times in females.</td>
</tr>
<tr>
<td>Merus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carpus</td>
<td>4 to 4.5-times distal breadth.</td>
<td>3 to 4-times.</td>
</tr>
<tr>
<td>Fingers</td>
<td>Non-rugose.</td>
<td>Sparsely rugose.</td>
</tr>
</tbody>
</table>

The occurrence of *P. (H.) elegans* in Karwar forms the first record of the species from the Karnatak Coast.
SUPERFAMILY ALPHEOIDA

Caridea with eyes exposed (eyestalks normal as in Processidae and Hippolytidae, extremely elongated as in Ogyrididae) or partly or wholly covered by orbital hoods of carapace (Alpheidae). First pair of pereiopods comparatively stouter than second (remarkably so in Alpheidae), chelate, (on one side only in some Processidae in which the other ending in simple claw-like dactylus); fingers may or may not be dark coloured. Carpus of second pair of pereiopods usually subdivided into 2 or more subsegments.

All the 4 families viz. Processidae, Hippolytidae, Ogyrididae and Alpheidae of this superfamily are represented in Karwar but the thesis deals with only the first 2 families. A key to all the families, however, has been included in this work.

Key to the Karwar families of Alpheoida

1. Both pereiopods of first pair chelate ........ 2

2. Only one pereiopod of the first pair chelate, (usually right), the other ending in a simple claw-like dactylus (except in the Atlantic genus Ambidexter) ............... Processidae

3. Ends of fingers of first pair of pereiopods usually dark coloured. Eyes free, never extremely elongate .................. Hippolytidae

4. Ends of fingers of first pair of pereiopods not dark coloured. Eyes either extremely long or partly or wholly covered by carapace  .... 3
3. Eyes extremely elongate, reaching to end of antennular peduncle; cornea small. First pair of pereiopods shorter than and about as robust as, second .......................... Ogyrididae

Eyes never very elongate, usually partly or wholly covered by carapace. First pair of pereiopods distinctly stronger than second, often unequal and swollen .......................... Alpheidae
FAMILY HIPPOLYTIDAE
FAMILY HIPPOLYTIDAE

Alpheoida with eyes free (never extremely elongate). First pair of pereiopods both chelate, short and rather heavy but never swollen; finger tips usually dark coloured. Carpus of second pereiopods usually subdivided into 2 or more subsegments.

In Karwar this family is represented by 2 genera viz. Hippolyssmata and Hippolyte.

Key to the Karwar genera of the family Hippolytidae:


2. Mandible with incisor process, carpus of second pereiopod 3-subsegmented . . . . Hippolyte
GENUS HIPPOLYSMATA STIMPSON
GENUS HIPPOLYSMATA STIMPSON

Rostrum long. Supraorbital spine absent. Upper antennular flagellum uniramous. Mandible without incisor process or palp. All maxillipeds with exopod. First four pereiopods with or without epipods. Carpus of second pereiopod multi-subsegmented.

In Karwar, this genus contains 2 subgenera viz. Exhippolysemblata and Hippolysmata, represented by a single species each.

Key to the Karwar subgenera of Hippolysmata

1. Rostrum longer than carapace and with a basal crest of teeth which are closely packed . . Exhippolysemblata
2. Rostrum shorter than carapace, teeth distributed regularly over its dorsal margin, never forming a basal crest . . . . . . Hippolysmata

Subgenus Exhippolysemblata Stebbing

Hippolysmata with rostrum larger than carapace, and a distinct dorsal basal crest of teeth which are closely packed together; epipods present on first four pereiopods.

A single species ensirostris Kemp represents this subgenus in Karwar.
14. **Hippolysmata** (*Exhippolysmata*) *ensirostris* Kemp *(Fig. 18)*

**Synonyms:**


*Exhippolysmata ensirostris* Balss, 1933, p. 85.


**Diagnostic features:**

Rostrum (Fig. 18, a) long (longer than carapace), narrow, characteristically upturned, reaching much beyond antennal scale; rostral formula $\frac{11}{7} - \frac{12}{11}$, of which 7 – 9 closely set dorsal teeth being on basal crest. Antennal and pterygostomial spines strong.

Antennular peduncle (Fig. 18, c) reaching 2/3 of scale, upper flagellum with basal portion consisting of 20 – 28 large segments. Distal tooth of antennal scale (Fig. 18, d) falling short of apex of lamella, basal segment of peduncle with a strong spine.

Mandible without incisor process and palp. Third maxilliped slightly short of or reaching up to antennal scale.

First pair of pereiopods (Fig. 18, k) chelate, robust, shorter than rest, carpus shorter than chela, fingers shorter than palm, all segments smooth. Second pereiopods (Fig. 18, l) slender, carpus 16 to 20-subsegmented, merus 6 to 9-subsegmented. Third (Fig. 18, m) and fourth pereiopods with 11 spines ventrally
on inner lower margin of merus, that of fifth (Fig. 18, o) with 5 to 7 spines and its propodus with serrate hairs in somewhat transverse rows distally.

Pereiopods 1 - 4 with short, rudimentary epipods characteristic of the species.

Telson (Fig. 18, q) twice sixth abdominal segment in length, tip acute with 1 pair of very minute posterior spines (discernible only under high magnification) and 2 pairs of dorsal spines, lateral margin fringed with hairs along its distal 3/4.

Tip of endopod of first pleopod (Fig. 18, p₁) blunt, ending in appendix interna-like hooks in both sexes, appendix masculina shorter than appendix interna in second pleopod (Fig. 18, p₂) of male.

Previous records:

Ceylon, Burma, Sumatra, Tandjoeng Krawang, Bay of Batavia.

From India: Puri, Godavari estuary, Madras, Pondicherry, Trivandrum, Bombay.

Variations:

1. Rostral teeth on upper margin varying from 11 to 12 (7 - 9 on basal crest) and on lower margin from 7 to 11.

2. Antennule with basal portion of upper flagellum comprising 20 to 28 large segments.

3. Third maxilliped failing to reach or as long as, scale.
4. Second pair of pereiopods with carpus of 16 to 20 subsegments and merus with 6 to 9.

Material examined:

Out of many specimens collected, 15 specimens, chosen at random, were examined, 4 males ranging from 45 to 55 mm; 6 ovigerous females from 60 to 70 mm and 5 non-ovigerous females from 60 to 65 mm.

Colour in live condition:

This species is not as brilliantly coloured as its allied species Hippolysmata (Hippolysmata) vittata. Body brownish red, paler on dorsal side and darker on rostrum, appendages and telson.

Notes on fecundity:

Eggs are borne on first to fourth pleopods. Eggs yellowish in colour. 5 specimens were studied for counting the number of eggs, the maximum number being 2,670 in 70 mm specimen and minimum number being 2,590 in 56 mm specimen, with an average of 5,875 eggs per female. Eggs small, oval in shape, maximum and minimum diameters being 0.45 to 0.55 mm and 0.35 to 0.40 mm respectively.

Ecology:

In Karwar, these are available quite in plenty in commercial trawl (10 - 18 fathoms) (May) and "Yendi" (shore seine) catches (2 - 5 fathoms) in late summer generally along with Palaemon (Nematopalaemon) tenuipes, as also observed in Bombay.
Berried females so far seen in summer (April to June).

**Remarks:**

The present material though agrees with the earlier accounts of the species (Kemp, 1914 & Holthuis, 1947), shows the following differences:

1. The distal 3/4 of lateral margin of telson provided with hairs unlike distal 1/4 of Kemps's and distal 2/3 of Holthuis' material.

2. There is a pair of very minute posterior spines on the telson, mentioned to be absent by Kemp and Holthuis in their material. These spines can be observed only under high magnification and as such might have been overlooked by the earlier workers.

This is the first record of the species from the Karnataka Coast.

**Subgenus Hippolysmata Stimpson**

Rostrum shorter than carapace, teeth on dorsal margin more or less regularly distributed never forming a basal crest; small epipods present on pereiopods first to fourth.

Of this subgenus only one species *vittata* Stimpson occurs in Karwar.
15. **HIPPOLYSMATA** (**HIPPOLYSMATA**) **VITTATA** **STIMPSON**
(Fig. 19)

**Synonyms:**


*Hippolysmata vittata* var. Kemp, 1914, p. 115, Pillai (larvae), 1966, 158.


**Diagnostic features:**

Rostrum (Fig. 19, b) almost straight, rather short, reaching beyond second segment of antennular peduncle, rostral formula $\frac{6}{3} - \frac{3}{4}$ (2 - 3 postorbitals). Antennal spine strong, separated from produced suborbital angle; pterygostomial angle drawn into a small spine.

Antennular stylocerite (Fig. 19, c) short, reaching proximal 1/3 of basal segment of peduncle; all segments with marginal spinules, dorsally basal portion of upper flagellum consisting of 25 to 32 rather large segments bearing short ventral hairs. Antennal scale (Fig. 19, d) as long as antennular peduncle, long and narrow, 4-times as long as broad, distal spine almost as long as anterior margin of lamella.

Mandible (Fig. 19, e) without palp or incisor process. Third maxillipede overreaching rostral tip by distal segment, a well-developed exopod present.

First pair of pereiopods (Fig. 19, k) chelate, stout,
short of reaching antennular peduncle or almost over-reaching it by fingers. Fingers more than 1/2 of palm; carpus shorter than chela and merus longer than chela. Second pair of pereiopods (Fig. 19, l) longer and more slender than first; chela small; carpus 17 to 19-subsegmented; merus 6 to 7-subsegmented; ischium 3 to 4-subsegmented. Third pereiopods (Fig. 19, m) extending beyond tip of rostrum by distal 2 segments; dactylus biunguiculate, terminal claw being longer with 2 – 3 spines on posterior margin; merus also with 4 - 6 outer spines. Fourth and fifth pereiopods also similar to third in general form but propodus of fifth (Fig. 19, o) with transverse rows of setae on outer distal margin; epipods present on first to fourth pereiopods.

Telson (Fig. 19, q) with 2 pairs of dorsal spines and 2 pairs of posterior spines, lateral margin armed with a row of hairs in its distal 2/3.

Posterior angles of fifth and sixth abdominal pleura are acutely pointed.

Endopod of first pleopod (Fig. 19, p₁) in both sexes ending in a blunt tip bearing minute hooks like those of appendix interna and second pleopod of male (Fig. 19, p₂) with appendix masculina shorter than appendix interna, remaining pleopods normal.

Previous records:

A widely distributed species of the Indo-West Pacific
region, in India known from the following localities:

Cannanore, Kilakarai, Apa Islands and Pamban, Port Blair, Andaman Islands.

Variations:

1. Rostral teeth on upper border varying from 6 to 9 and on lower border from 3 - 4 (postorbital 2 to 3).

2. The number of large segments in basal portion of antennular upper flagellum varying from 27 to 32.

3. First pair of pereiopods short of reaching or reaching beyond antennular peduncle.

4. Second pair of pereiopods with subsegments of carpus varying from 17 to 20, of merus 6 to 7 and of ischium 3 to 4.

Material examined:

In all, 15 specimens were examined: 4 males ranging from 24 to 27 mm, 6 non-ovigerous females from 25 - 30 mm and 5 ovigerous females from 28 - 32 mm.

Colour in live condition:

Body transluscent, with brilliant red coloured narrow longitudinal stripes as in figure, giving a very colourful appearance.

Eggs:

Eggs are borne on first to fourth pleopods. Immature eggs greenish and mature ones yellowish green. Berried females were observed from October to May. 5 specimens were studied for
fecundity observations, the maximum number of eggs being 849 in 32 mm specimen and minimum number 630 in 30 mm with an average of 763 per female. Eggs oval in shape, maximum and minimum diameters being 0.60 - 0.65 mm and 0.45 - 0.50 mm.

Ecology:

This littoral species was collected from Shankarbag in Karwar. They were found underneath small loose boulders in lower levels of intertidal zone.

Remarks:

The present material almost agrees with the earlier accounts of the species (Holthuis, 1947; Hayashi, 1968), but the hairs on lateral margin of telson in the present material are distributed in its distal 2/3 unlike in Hayashi's (1968) account wherein it is in its distal 1/2. Also, the presence of transverse rows of setae distally on propodus of fifth pereiopods is not mentioned in the earlier accounts.

The occurrence of *H. vittata* in Karwar forms the first record of the species from the Karnatak Coast.
GENUS HIPPOLYTE LEACH
GENUS **HIPPOLYTE** LEACH

Rostrum long. Supraorbital and antennal spines present. Mandible with both incisor and molar processes but palp absent. Third maxilliped with exopod but no epipod. Pereiopods without epipods. Carpus of second pereiopod divided into 3 subsegments.

**Hippolyte ventricosa** (H. Milne Edwards) is the only species representing this genus in Karwar.

16. **HIPPOLYTE VENTRICOSA** (H. MILNE EDWARDS)

(Figs. 20 & 21)

**Synonyms**:


**Hippolyte australiensis** Kemp, 1914, p. 98.


**Diagnostic features**:

Rostrum (Fig. 20, b) little short of reaching antennal scale, rostral formula $\frac{1}{2} - \frac{2}{4}$ (no postorbital teeth). Carapace with sharp supraorbital spine; antennal spine short, narrowly separated from long, produced, orbital angle; branchiostegal spine sharp, strong, reaching beyond anterior margin of carapace.
Eyes large and cylindrical, not reaching to middle of rostrum.

Antennular peduncle (Fig. 20, c) reaching nearly 1/2 of antennal scale, styllocerite reaching beyond 3/4 length of basal segment of peduncle, distolateral angle of basal segment produced into strong spine reaching beyond middle of second segment, outer flagellum of 7 - 8 segments, broad. Antennal scale (Fig. 20, d) about 3-times as long as broad with distal part of lamella overreaching much beyond outer tooth.

Mandible with a slender incisor process but without palpi; rest of the mouth parts as in figure (Fig. 20, f-j).

First pair of pereiopods (Fig. 21, k) robust, not reaching to tip of third maxilliped, fingers broad, armed distally with 3 marginal teeth and 2 dorsal teeth on each finger. Second pereiopod (Fig. 21, l) with fingers almost as long as palm, with 2 - 3 blunt teeth each distally; carpus a little shorter than twice chela, 3-subsegmented, middle joint shorter, merus shorter than carpus; ischium 2-subsegmented.

Third pereiopod (Fig. 21, m) with dactylus somewhat broad with a sharp terminal spine and 11 accessory spines on posterior margin; propodus with 7 pairs of spines on posterior margin, each pair with 1 small + 1 longer spines; carpus armed with single strong dorsal spine situated as shown in figure; merus with 5 dorsal spines similar to one found on carpus. Fourth and fifth pereiopods (Fig. 21, n,o) similar to third in structure but dactylus with only 9 accessory spines on its posterior margin.

Telson (Fig. 21, q) with 2 pairs of strong dorsal spines
arranged as in figure, posterior margin very slightly concave and not produced into pointed tip, armed with 4 pairs of blunt spines, the median pair being the longest. Uropods almost reaching to telson tip, exopod with a terminal and a subapical spine.

Abdominal second segment typically rounded and produced, pleuron of fifth segment bluntly produced.

Endopod of first pleopod of female without appendix interna (Fig. 21, p1).

Previous records:

Widely distributed in the Indo-Pacific region, being recorded so far from the following:

Asiatic Seas; Bitter Lakes; Suez canal; Red Sea; Zambesi; Madagaskar; Indian Ocean, W. Australia; St. Vincent Gulf, S Australia, New S. Wales, Port Jackson, New S. Wales and Marouba, near Sydney and around Japan (for details see Holthuis, 1947; Hayashi, 1968).

Variations:

Variation in the present material was observed only in regard of number of rostral teeth, varying from 1 - 2 on upper border and from 2 - 4 on lower.

Material examined:

In all 30 females, 10 ovigerous, ranging from 12 - 16 mm, 20 non-ovigerous ranging from 10 - 15 mm, no males being represented in the collection.
Colour in live condition:

The colour pattern of this species agrees with Kemp's (1914) description in having a uniform brilliant green body colour. Also, as observed by Hayashi (1968), colour changes according to its habitat. However, it is observed in the laboratory that in dark, the colour is light green and when lights are on within a few minutes it changes to dark green or brownish green, whether the specimens were provided with or without substratum like small stones or sea weeds etc.

Eggs:

Colour of eggs yellowish green. Of the 5 specimens studied for counting the number of eggs, maximum number 414 in 14 mm specimen and minimum 320 in 12 mm specimen, average being 363. Eggs oval, maximum diameter 0.50 to 0.55 mm and minimum 0.40 to 0.45 mm. The berried females were observed from October to May.

Ecology:

Marine, found among the seaweeds, mainly Sargassum collected from the intertidal regions from Kinkade, Kamat bay, Binge, Amadalli.

Remarks:

Present material agree with in respect of rostral teeth with the account of the species from Malaya Archipelago (Holthuis, 1947) and as regards to size forms a medium size (10 - 16 mm) group between the specimens of High Sea Sargassum (16 - 27 mm) and specimens from sea grass (8 - 10 mm). Present material form the same size group as that of "short generation"
(12 - 16 mm) in Zostrea belt as reported for the Japanese species by Hayashi, 1968. Following differences are observed when the present material is compared with the account of Japanese species by Hayashi (1968):

<table>
<thead>
<tr>
<th>Present material (Karwar)</th>
<th>Hayashi's account (Japanese water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rostrum</td>
<td>Falling short of antennal scale.</td>
</tr>
<tr>
<td>Carapace</td>
<td>Strong, reaching beyond anterior margin of carapace.</td>
</tr>
<tr>
<td>Eyes</td>
<td>Not reaching middle of rostrum.</td>
</tr>
<tr>
<td>Antennule</td>
<td>Stylocerite reaching beyond 3/4 of basal segment.</td>
</tr>
<tr>
<td></td>
<td>No tufts of hairs on body.</td>
</tr>
</tbody>
</table>

The 2-subsegmented nature of ischium of the second pereiopods in the present material is not reported in any of the earlier accounts of the species.

From India, this species has been so far known from the east coast, Kilakarai, Apa Islands, Pamban Port Blair, Andaman Islands. So its occurrence is Karwar forms the first record of the species along the west coast of India.
FAMILY PROCESS ID: 2
FAMILY PROCESSIDAE

Body smooth; rostrum short, apex bifid or simple, unarmed; carapace armed at most with antennal spine, with or without postorbital groove. Eyes large. Stylocerite well developed; antennular flagellum simple, upper shorter, with thickened setigerous proximal portion. Mandible without incisor process and palp. First maxilla with only 1 endite and palp; second with reduced endites. Third maxilliped with well developed exopod and rarely without it. All pereiopods with pleurobranches; first pereiopod with or without arthrobranch on its base, mostly without exopod but exopod present in one genus Nikoides. Both pereiopods of first pair chelate (ambidextor) or with only 1 pereiopod of front pair chelate (Nikodes, Processa), usually right, left with unopposed simple dactylus. Second pair of pereiopod chelate, more slender than first; carpus always, merus usually, and ischium occasionally subsegmented; right second pereiopod usually stronger than left, sometimes equal. Pereiopods third to fifth slender, with simple dactylus. Fifth abdominal segment occasionally with posterolateral spine or spines. In male, first pair of pleopod with foliaceous endopod, second with both appendix interna and masculina on endopod. Telson with 2 pairs of dorsal and 2 pairs of posterior spines and with stout plumose setae between inner pair of posterior spines. Uropods elongate, exopods with transverse suture extending from lateral spine.

Of the 3 genera of the family, only one genus Processa is represented in Karwar.
GENUS PROCESSA LEACH

Processid shrimps with only 1 (mostly right) of first pereiopods chelate, the other (usually left) with simple dactylus and without exopod. Telson simple or sulcate.

*Processa barnardi* Hayashi is the only representative of the genus and the family in Karwar.

**17. PROCESSA BARNARDI HAYASHI**
(Figs. 22 & 23)

**Synonyms:**


*Processa barnardi* Hayashi, 1975, p. 92 : Jagadisha and Sankolli, 1976, p. 57 (larvae).

**Diagnosis:**

Rostrum with bifid tip. Stylocerite rather blunt, unarmed. Antennal spine present. First pair of pereiopods with right chelate, left having simple dactylus, no exopods on this pair. Second pereiopod asymmetrical, right longer with 27 carpal and 13 meral subsegments while left with 17 carpal and 5 meral subsegments. Fifth and sixth abdominal segments with a sharp posterolateral spine each. Telson dorsally sulcate.

**Description:**

Rostrum (Fig. 22, a) : Almost straight, narrow, not reaching beyond eyes, extending upto proximal half of basal
antennular segment; tip bifid with lower tooth longer, small setae present between upper and lower teeth. Carapace with a sharp antennal spine, pterygostomial angle broadly rounded. Eyes fairly large.

Antennule (Fig. 22, c): Basal segment of peduncle longer than distal two segments together, and with a small ventral spine at midlength. Stylocerite unarmed, blunt anteriorly and rounded laterally.

Antenna (Fig. 22, d): Scale almost reaching antennular peduncle in length, distal spine not reaching its apex. No ventrolateral spine on basal segment, instead a small lobe-like structure bearing a tuft of setae.

Mouth parts typical, mandibles (Fig. 22, e) almost similar, only molar process present armed with a number of spine-like teeth. First maxilla (Fig. 22, f) with palp bilobed, without any setae. Second maxilla (Fig. 22, g) with setose endites, palp with a single seta, scaphognathite narrow, fringed with setae, posterior setae very long.

Maxillipeds (Fig. 22, h - j): Typical, with exopods present on all, epipods present on first and second only. Third maxilliped overreaching antennal scale by last 2 distal segments.

Pereiopods without exopods on any.

First pereiopods (Fig. 22, k, k↓): Almost equal in length. Only right side chelate, while left ending in simple dactylus; both overreaching antennal scale by dactylus. Right pereiopod with palm about 1.5 times fingers but that of left propodus about twice as long as dactylus.
Second pereiopods (Fig. 23, 1,1') : Unequal, right longer, reaching antennal scale by merocarpal articulation, ischium merus and carpus with 3, 13 and 29 subsegments respectively; left overreaching antennal scale by only chela and about 4/5 of carpus; ischium entire, merus and carpus with 5 and 17 subsegments respectively.

Third to fifth pereiopods (Fig. 23, m - o) : Structurally similar, fourth longest; merus and ischium of third and fourth with 4 and 3 movable spinules each, propodus nearly 5-times as long as dactylus, only that of fifth with 8 serrulated spines on its posterior margin.

Abdomen (Fig. 22, a) : First four segments posteriorly rounded and smooth, pleura of fifth and sixth acutely pointed posteriorly; sixth also with a lobe above articulation of uropods.

Pleopods : In both sexes, first endopod reduced, and appendix interna absent, but that of male (Fig. 23, p1) slightly notched on distal margin, with a distinct reticula. Second pleopod of male (Fig. 23, p2) with well developed appendix masculina. In remaining pleopods both rami almost equal in both sexes.

Telson (Fig. 23, q) : About 1.5-times as long as sixth abdominal segment, length nearly 2.5-times its greatest width; dorsal surface strongly sulcate with 2 pairs of spines and hair-like setae distributed all over as in figure, posterior margin produced into a sharp median point flanked by 2 pairs of spines and a median pair of plumose setae.

Uropods (Fig. 23, q) : Overreaching telson, exopod with
a small terminal and a larger subterminal accessory spine, distinct transverse suture present.

Previous records:

It is an Indo-Pacific species, so far recorded from South Africa, Karachi and South Australia.

Material examined:

In all 9 specimens were collected, of which 2 were males (15 - 16 mm), 5 non-ovigerous females (18 to 25 mm) and 2 ovigerous females (19 - 25 mm).

Colour in live condition:

Body almost transparent, with bright orange-red chromatophores on maxillipeds, abdomen; basally on pleopods and uropods. Eyes light bluish-green. General appearance of shrimp rusty orange-red.

Notes on fecundity:

Eggs borne on first to fourth pleopods, oval in shape with minimum and maximum diameters being 0.3 to 0.35 and 0.4 to 0.45 mm respectively. Eggs light yellowish orange in colour. Ovigerous females were collected during the months of September and December.

Ecology:

This species was found amongst the green seaweeds encrusting the boulders in about 1 metre depth of water in the intertidal rocky shores of Karwar at Kinkade, Amadalli and Anjadiv Islands.
Remarks:

So far only 4 specimens (2 males and 2 females) of this species have been reported in literature (Hayashi, 1975). The present material is represented by as many as 9 species collected around Karwar.

The present material does not show any variation but when compared with Hayashi's account, reveals the following differences:

<table>
<thead>
<tr>
<th></th>
<th>Karwar material (present work)</th>
<th>Hayashi's account</th>
</tr>
</thead>
<tbody>
<tr>
<td>First pereiopod,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>left propodus</td>
<td>2-times the dactylus.</td>
<td>Less than 3-times the dactylus.</td>
</tr>
<tr>
<td>Second pereiopod</td>
<td></td>
<td></td>
</tr>
<tr>
<td>right,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ischium</td>
<td>3 subsegments.</td>
<td>3-4 subsegments.</td>
</tr>
<tr>
<td>merus</td>
<td>10-13 subsegments.</td>
<td>10-12 subsegments.</td>
</tr>
<tr>
<td>left,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>carpus</td>
<td>16-19 subsegments.</td>
<td>15-17 subsegments.</td>
</tr>
<tr>
<td>merus</td>
<td>4-6 subsegments.</td>
<td>5-6 subsegments.</td>
</tr>
<tr>
<td>ischium</td>
<td>Undivided.</td>
<td>1-3 subsegments.</td>
</tr>
<tr>
<td>Third pereiopod,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>merus</td>
<td>3-4 outer spines.</td>
<td>3-5 outer spines.</td>
</tr>
<tr>
<td>ischium</td>
<td>1-3 outer spines.</td>
<td>Neither described nor figured.</td>
</tr>
<tr>
<td>Fifth pereiopod,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>extension</td>
<td>Overreaching the antennal scale only by dactylus.</td>
<td>Overreaching the antennal scale by dactylus and propodus.</td>
</tr>
<tr>
<td>propodus</td>
<td>With 7-8 serrated spines on posterior margin (fifth spine from distal accompanied by a small spine).</td>
<td>With 7-8 spines on posterior margin (nature of spines and accompanying small spine with fifth not mentioned).</td>
</tr>
</tbody>
</table>

The information on colour in live condition,
fecundity notes and ecology are given for the first time.

The occurrence of *P. barnardi* Hayashi in Karwar forms the first record of the species and family Processidae based on collection of adult material, except for a single postlarval specimen from Travancore plankton tentatively ascribed by Pillai (1955) to *P. australiensis* (= *P. sulcata* Hayashi).
SUPERFAMILY CRANGONOIDA

Caridea with subchelate first pair of pereiopods, carpus of second pair of pereiopods entire or subsegmented; pleopods with endopods poorly or moderately developed, with or without appendix interna.

In Karwar, this superfamily is represented by a single family Crangonidae.

FAMILY CRANGONIDAE

Rostrum usually dorsally flattened, small, not toothed; first pair of pereiopods subchelate, stouter than second; second pair of pereiopods equal, slender, minutely chelate or simple, carpus entire.

Genus Pontophilus is the only genus representing this family in Karwar.

GENUS PONTOPHILUS LEACH

Crangonidae with rostrum rather reduced and depressed. Carapace with or without dentate carinae. Eyes well developed. Stylocerite distally truncate, rounded or acute. Third maxillipede with or without epipod. First pereiopod with or without exopod; second pereiopod shorter than first, fingers longer or shorter than palm; dactylus of fourth and fifth pereiopods not dilated. Pleopods with or without appendix interna. Gills pleurobranch, present or absent on third
maxilliped and present on all pereiopods, its ventral apices directed posteriorly. Arthrobrach present or absent on third maxilliped.

**Pontophilus parvirostris** Kemp is the only species representing this genus in Karwar.

18. **PONTOPHILUS PARVIROSTRIS KEMP**

(Figs. 24 & 25)

**Synonyms:**


**Diagnostic features:**

Rostrum minute, triangular, rather flat, reaching little beyond posterior margin of eyestalk (Fig. 24, a). Carapace with antennal (suborbital in position), hepatic and branchiostegal spines. Oblique carina posterior to branchiostegal spine extending up to 1/3 to 1/4 of carapace length; a faint transverse depression posterior to carapace front.

Eyes fairly long, contiguous along the inner margin.

Antennule (Fig. 24, c, c₁) shows sexual dimorphism. Stylocerite in male reaching a little beyond basal segment, whereas in females reaching well beyond middle of second segment, also upper flagellum in male broader than in female. Basal segment of peduncle in both sexes with 2 sharp distal spines, 1 ventral (not seen in dorsal view) and other dorsal but internal besides a distinct spine on midventral surface (not mentioned
by Kemp. Antennal scale (Fig. 24, d) reaching slightly less than 1/2. of last segment of third maxilliped.

Mouth parts as in figures (Fig. 24, e - j). Maxillipeds with exopods characteristic nonflagellar basal part and an inwardly bent flagellar distal part. Endopod of first maxilliped peculiarly rod-shaped. Epipods present on all maxillipeds, but that of third reduced.

Pereiopods: Exopod and epipod absent on all.

First pereiopods (Fig. 25, k) equal, subchelate, extending up to third maxilliped. Dactylus slightly less than half propodus, fixed finger rather short, stumpy. Carpus very short with 2 distinct tooth like spines on ventral surface one larger and on inner distal angle (perhaps by Kemp as outer inferior) and other smaller somewhat medially placed on distal margin.

Second pereiopods (Fig. 25, l) chelate, reaching to about end of first pereiopods. Dactylus slender, slightly shorter and less than in width of fixed finger, without any cutting edges, both fingers ending in simple claw-like stout spine (mentioned to be absent by Kemp).

Third to fifth pereiopods (Fig. 25, m - o) structurally similar, fourth and fifth stouter than third, fourth more setose than others; dactylus short, simple.

All abdominal segments smooth, ventral margin of pleura of first to fourth segments slightly concave and not rounded as mentioned by Kemp.
All pleopods without **appendix interna** in both sexes but first of male (Fig. 25, p₁) with endopod much reduced and second with endopod 1/3 of exopod and with a well developed **appendix masculina**. Third to fifth with endopods about 1/2 to 2/3 of exopods and not much reduced as mentioned by Kemp. Exopod in both sexes born at an angle projecting freely outwards from peduncle.

Telson (Fig. 24, q) having dorsal spinules shifted almost marginally; distal 2/3 of lateral margin fringed with fine setae; posterior margin with short median spine and 2 pairs of spines with 2 pairs of plumose setae inbetween.

Uropods overreaching telson, exopods with small terminal tooth on outer margin.

**Previous records**:

This species so far known only from India - Kilakereal and Waltair on east coast (Kemp, 1916 & 1925) and from Travancore on west coast (Kurian, 1952 & 1954).

**Material examined**:

In all 21 specimens were collected, 4 males ranging from 10.3 to 11.5 mm, 4 non-ovigerous females from 11 to 16 mm and 13 ovigerous females from 11 to 16 mm.

**Colour in live condition**:

The colour in live condition is so well camouflaged with the substratum i.e. sand, that it is difficult to notice these shrimps at once while collecting. Almost the entire body has a mosaic pattern, blotched with black, reddish brown, brown and light red chromatophores, with lateral surface of carapace...
and dorsolateral portion of abdomen having scattered white patches. There is a prominent dark patch on lateral portion of second abdominal segment. Also the basal portion of pleopods, palm of first pereiopod, and distal portion of carpus of fourth and fifth pereiopods are reddish brown.

Notes on fecundity:

The number of eggs counted on a single female of 15 mm was found to be 250. Eggs were of ivory colour, rather oval and their maximum and minimum diameters (in preserved condition) ranged from 0.50 to 0.55 mm and 0.40 to 0.45 mm respectively.

It is interesting to observe that the eggs in this shrimp, forming a single mass, are attached to the ovigerous setae of basipods only of pleopods, both rami being free. Eggs are held in a single mass by what appears to be a mucilagenous substance or sheath (?) which remains intact even on preservation. Also, abdomen ventrally between the pleural projections of either side is grooved forming a kind of brood pouch wherein the eggmass is safely lodged, both rami of the pleopods projecting freely (but exopod more laterally) from the brood pouch.

As explained in the 'Ecology' part, pleopods here are mainly used for the purpose of burying in the sand and the attachment of eggs only onto basipod leaving both the rami free is perhaps an adaptation for burying as well as for protecting the eggs from getting damaged while burying.

Ecology:

The specimens were collected from the sandy bay at
Baburwada, Ankola. This locality is quite interesting in as much as though it is a sandy shore with pronounced wave action etc, there are high up on the beach in the intertidal zone, wide patches of loose boulders and stones with admixture of mud and sand on either side in the bay. But lower down in water, the bay is fringed with several outcroppings of discontinuous barrier-like rocky patches. The characteristic of these rocks is that both the tops and seaward sides were fully covered with colonies of sand-binding tube worms. The shrimps in the present work, were found buried in the sand in small puddle-like depressions on the leeward sides of such rocky patches. Most of these puddles had about 25 - 50 cms of water even during minus low tides. The leeward side, while thus offering perhaps adequate shelter and protection to these delicate shrimps, ensured by the barrier-like position of rocky patch, continuous churning up of bottom sand caused by striking waves, perhaps so essential for the feeding activities of these shrimps which appear to be particulate feeders.

Ovigerous females were collected between 11th Dec. 1973 to 24th Jan. 1974, after which no collections were made.

Behaviour:

For observations on behaviour, the live shrimps on collection were transhipped to the Marine Station at Korwar, where they were kept alive in aquarium tanks for further experimentation.

Feigning: The shrimps when disturbed exhibited feigning behaviour and peculiar dorsal flexure of abdomen as observed by
Sankolli and Shenoy (1971) in another Crangonid, Aegon (= Pontocaris) pennata Bate.

Burying: Also, they preferred to bury themselves than to crawl or swim in the sandy substratum provided in the experimental tanks. They did not bury deeper than about 2 cms even when provided with deeper columns of sand. The burying method is interesting in that the pleopods are used mainly for the purpose, which by their vigorous beating action, set up a current disturbing the sand and creating a depression in sand, aided by chelipeds and probably the third maxillipeds in loosening the sand in front. Thus in a few seconds, the entire body is covered underneath the sand except for eyes, antennular and antennal flagella which remain exposed.

Their preference to sandy bottom as evidenced from field observations, was studied in the laboratory by providing two types of substrata. In each of the experimental tanks (45 x 45 x 30 cm) one half of the bottom was covered by fine sand and the other half by mud. They invariably showed preference to the sandy part of the substratum. This natural preference to sandy substratum is further supported by the fact that these shrimps are rather small with smooth exoskeleton and much setose but rather delicate appendages.

As explained above, they very occasionally swam in the tanks and when they did, they exhibited rather a vertical swimming pattern, using the pleopods but holding their thoracic appendages straight up in line with the body. Also while descending, they followed the same vertical pattern (with head
up and tail down) but this process was more of a 'passive' sinking than an active process of swimming down, this time palm of the chelipeds and the third maxillipeds being held at right angles to the axis of the body.

The seawater and the substratum in the experimental tanks were renewed every day. For this purpose, the sand was collected freshly from waist-deep water from the sandy shore opposite the Marine Station. The shrimps on transfer, quickly buried themselves. On renewal, the sand and other particles would remain in suspended state for sometimes till these particles settle. During this period, the beating action of the exposed anterior appendages of the shrimp, viz. antennular and antennal flagellae were seen to be very much increased. Conversely, when after sometime, the suspended particles in the tank would settle down, the beating of these appendages would be reduced. If, however, in such an undisturbed tank some part of the bottom was agitated physically either by jetting in of water with a vacuum bulb or stirring with a glass rod, again the bottom particles would be set in suspended condition followed immediately by vigorous beating action of the appendages.

Though direct observations on actual feeding behaviour and study of gut contents could not be made during this study, it is inferred by studying the ecology of the animal and functional morphology of various concerned appendages, that these shrimps are most probably particulate feeders.

Remarks:

This species was so far known based on only 4 females + 1
very young male (Kemp, 1916 & 1925) and a single female (Kurian, 1952). The present material thus offers a good series of mature adult specimens of both sexes. The information is added here for the first time on the male pleopods and also sexually diamorphic features (wherever possible).

The differences from Kemp's (1916) account have been mentioned in the text (based also on examination on Kemp's syntype of about 13 mm ovigerous females).

This is the first record of the species along the Karnatak Coast.