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Larvae of *Stilbognathus cervicornis* (Herbst, 1803) (Decapoda, Epialtidae, Tychinae) reared in the laboratory, from Gulf of Mannar, India

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Abstract
The complete larval development of *Stilbognathus cervicornis* (Herbst, 1803) from hatching to the megalopa stage was obtained by culture in the laboratory. Two zoeal and one megalopa stages are described and figured. Morphological characters of zoea larvae of *Stilbognathus cervicornis* of the subfamily Tychinae are compared with those of Epialtinae and Pisinae.

Keywords: *Stilbognathus cervicornis*, megalopa stage, laboratory, Epialtinae and Pisinae

Introduction
The Indian side of the Gulf of Mannar which is stretches along the southeast coast of India, is a coral dominated environment, extending from the Adams bridge to the Cape of Comorin. This area is well known for its richness and variety of fauna. The inshore sea bottom of this Gulf forms an ideal habitat for the growth of shell fishes that sustain a good fishery. Impressed by the array of organisms, Henderson (1893) aptly remarked that "No collection ground in the Indian seas can show greater profusion of animal life than the Gulf of Mannar" (Jeybhaskaran *et al*, 2000) [15]. The Indian part of the Gulf of Mannar covers approximately an area of 10,500 square kilometres along latitude 8°35'N-9°25'N and longitude 78° 08'E-79"30'E. There are about 21 islands spread over a distance of 140 kms and an area of 625 hectares and these coral reefs of fringing and patchy types are not more than 6 metres depth, extend from Rameshwaram to Tuticorin (lat. 8°50'-9°10'N and long. 78°10'-79°10'E). (Jeybhaskaran *et al*., 2000) [15]. Jayabaskaran *et al*. (2000) while studying the *Brachyuran crabs of Gulf of Mannar reported the occurrence of Stilbognathus cervicornis* (Herbst, 1803) under the name *Ophthalmias cervicornis* (Herbst, 1803) (Subfamily Ophthalmiinae Balss, 1929, Genus *Ophthalmias* Rathbun, 1897) as per the classification available then. The brachyuran crabs occurring in the Gulf of Mannar are generally caught by the gear locally known as 'Nandu valai' or crab net. It resembles the small gill net or the wall net.
In the present acount we report the occurrence of a berried female of *Stilbognathus cervicornis* from Vedalai, a fishing village very near to Mandapam in the Gulf of Mannar and have described the zoea stages and a megalopa stage as reared in the laboratory. With the help of photographs of the mother crab, we have described the account to avoid futuristic confusion on the identification authenticity of the mother crab species.
Many studies of larval development in the Epialtidae subfamily Pisinae have been made from different parts of the world (Gurney, 1924; Aikawa, 1937; Kurata, 1963; Yang, 1967; Boschi and Scelzo, 1968; Fagetti, 1969a, b; Ingle, 1979; Ingle and Clark, 1980; Hong, 1988) [10, 3, 40, 4, 8, 9, 13, 14, 12]. In Japan, the larval development of six species of Pisinae was described by Kurata (1969) [22] and Terada (1983) [36]. From Indian waters, larval accounts of Majoid crabs are available for *Achaeus lacertosus* (Kakati & Sankolli, 1979), *Acanthonyx limbatus* (former *Dehaanius limbatus*) (Kakati & Sankolli, 1975) [16], *Schizophrys aspera* (Kakati & Nayak, 1980), *Doclea hybrida* (Snakolli & Shenoy, 1975), *Doclea muricata* (Krishnan, T., & Kannupandi, T., 1987) and *Doclea gracilipes* (Krishnan, T., & Kannupandi, T., 1987) [20]. Though many larval accounts of the spider crab family Epialtidae are thus available, no

description of zoeae and megalopa in the subfamily Tychinae are available as far as the knowledge of the present authors. The subfamily Tychinae of the family Epialtidae is represented by five genera (WoRMs): namely Genus Criocarcinus H. Milne Edwards, 1834*;* Genus Picrocerus A. Milne Edwards, 1865*;* Genus Stilbognathusvon Martens, 1866*;* Genus Stilbomastax A.B. Williams, Shaw & Hopkins, 1977; and genus Tyche Bell, 1836.

The genus Pitho Bell, 1836 which had been placed in Tychinae and accepted as a subfamily of Epialtidae has been transferred to Mithracidae. Recently William Santana *et al* (2016) based on the larval development study, suggested to place another species *P.aculeata*, in light of recent molecular findings (Windsor & Felder 2014) in the family Mithracidae. Thus, there is no information available on the larvae of the subfamily Tychinae of the family Epialtidae.

Materials and Methods

The first author came across a berried female of *Stilbognathus cervicornis* during the crab survey of the Gulf of Mannar waters from a fishing village Vedalai (Lat. 90^0 16'0" Long. 79^0 7'0") near Mandapam in Ramanathapuram district of Tamil Nadu, during October 2010. The crab was collected from gill net spread over the coral reef at 15-20 feet depth. The specimen was bright reddish in colour. Measurements of adult mother crab were noted with the help of digital vernier caliper. The berried specimen measured 37.67 mm in carapace length excluding rostral spine length. The widest width of the specimen was 24.87 mm.

The mother crab was held in an aquarium until larval hatching at ambient room temperature (28^0- 30^0 C). The hatching occurred at night. After hatching, the active, positively phototactic larvae were separated into 50 ml poly carbonate plastic jars containing 45 ml of filtered seawater, (5 no. per jar). Some larvae were preserved in 5% formalin solution for further morphological descriptions. Newly hatched larvae were fed with Artemia nauplii. Seawater was changed, and specimens were inspected and fed daily. All rearing jars were washed with fresh seawater and air-dried before re-use on the following day. During rearing the salinity was between 29-31 ppt. Larvae were reared in natural day-night light regime. A minimum of five specimens of each stage were dissected for morphological description for first and second zoea stages, whereas only one megalopa was used for megalopa dissection and description is based on only a single megalopa specimen. As far as possible we have tried to follow the suggestions of Clark *et al*, (1998) [6].

Results

Systematics

Order: Decapoda
Suborder: Pleocyemata
Infraorder: Brachyura
Section: Eubrachyura
Subsection: Heterotremata
Superfamily: Majoidea
Family: Epialtidae
Subfamily: Tychinae
Genus: *Stilbognathus*
Species*: Stilbognathus cervicornis*

Synonymized names (ref.WoRMs)

Cancer cervicornis Herbst, 1803 [in Herbst, 1799-1804] *(basionym)*
Ophthalmias cervicornis (Herbst, 1803 [in Herbst, 1799-1804]) *(superseded combination)*
Ophthalmus cervicornis (Herbst, 1803 [in Herbst, 1799-1804]) (incorrect spelling)
(From Marine Species Identificztion Portal)
Cancer Cervicornis Herbst, 1803: 49, pl. 58, fig. 2.
Stenocionops cervicornisMilne Edwards H., 1834: 338. -- Milne Edwards H., 1836-1844 (1839): pl. 31, figs 1, 1a-d. -- Milne Edwards A., 1865a: 135. -- Henderson, 1893: 343. -- Alcock, 1895a: 248 [1]. -- Michel, 1964: 7.
Ophthalmias cervicornisRathbun, 1906: 882. -- Sakai, 1938a: 249, figs 25a-b. -- Guinot, 1962c: 46, fig. 33. -- Griffin, 1974: 22, figs 5, 7a-c. -- Sakai, 1976a: 190, pl. 66, fig. 1. -- Tirmizi & Kazmi, 1991: 150, fig. 46.
Stilbognathus cervicornis Griffin & Tranter, 1986a [11]: 64. -- Muraoka, 1998: 24. -- Sakai K., 1999: 23, pl. 10D.
Stilbognathus? Curvicornis Kazmi & Tirmizi, 1999: 381, fig. 5 (erroneous spelling).

The genus *Stilbognathus* von Martens, 1866 is characterised by orbit without a postorbital lobe (a broad lobe on posterior part of eave in *Stilbognathus tycheformis*); branchial margin with one moderate length spine anteriorly and; posterior carapace margin with a broad based medial lobe or spine with apex blunt, rounded. (Davie 1996) The species *Stilbognathus cervicornis* (Herbst, 1803) is characterised by its posterior angle of eave not produced; rostrum half as long as postrostral carapace length or longer; rostral spines subparallel or incurved; ischium of third maxilliped with anterior margin flat; anterior marginal branchial spine.

Type locality: East Indies. Stilbognathus

Distribution Range: *S. Cervicornis* is widespread throughout the Indo-West Pacific from eastern Africa through Sri Lanka, southeast India, Indonesia and Japan to Hawaii. It was found in Mozambique Channel (Griffin, 1974); Mauritius (A. Milne Edwards, 1865); Pakistan (Tirmizi & Kazmi, 1991, Kazmi & Tirmizi, 1999); India -Tuticorin; Vedalai in Gulf of Mannar (present one), Sri Lanka; Japan - coast of Wakayama (Sakai, 1938a), coast of Wakayama, Kii Minabe and Sakaihama (Sakai, 1976a); Indonesia - Seram (Griffin & Tranter, 1986a) [11]; Hawaiian Islands - Honolulu (Rathbun, 1906); 10-30 m. (Ref: Marine Species Identification Portal))

The carapace is sub oval and uneven behind the orbits. The carapace is tuberculate and has tufts of hairs on the tubercles and on the horns. The superio-posterior margin of carapace forms a prominent, blunt intestinal lobe. Rostral spines slender and as long as rest of carapace, sub-parallel with exterior convexity (but broken in our specimen). Supra-ocular spine is long and run as long as or slightly beyond the eye stalk. Subhepatic region tuberculous. Extremities of epistome dilated, over hanging the buccal cavity which is strongly widened anteriorly; exognath longitudinally grooved; first four segments of endognath deeply hollowed ; condyle at distal end of ischium a smooth oval lobe, inner margin of ischium denticulate ; merus strongly produced at the outer angle, inner margin deeply incised ; palpus lamellate. Legs decreasing posteriorly in length, furnished with tufts of curled hair. The present female has eggs still attached to pleopods, though some hatched in the laboratory. (Fig. 3)

Remarks:-The present mother specimen agrees with the description of *S.cervicornis*. The supraorbital spines are longer than the eyestalks; the medial lobe on the posterior carapace margin is blunt; on the third maxilliped the surface of the ischium is flat, not grooved, and the medial margin of the merus is bilobed. Branchial spine of moderate length; medial lobe on posterior carapace margin with apex blunt, rounded. (Davie 1996).

Fig 1: *Stilbognathus cervicornis*, Berried female mother crab, Denuded carapace dorsal view

Fig 2: *S.cervicornis* Berried female,mother crab,ventral view

Fig 3: Lateral view of berried female, mother crab of ***S.cervicornis***

Fig 4: ***S.cervicorni*** buccal cavity showing third maxilliped (mother crab)

Larval description

Larval development of *Stilbognathus cervicornis* consists of two zoeal stages and one megalopa. The duration of each larval stage was 3-5 days; the megalopa appeared 10 days after hatching. Only morphological changes are described for the second zoea.

Stilbognathus cervicornis

First zoea (figure 5)

Carapace (figure 5a). With short curved dorsal and straight rostral spines, latter not extending beyond antennae, and no lateral spines on carapace; ventral margin with densely plumose 'anterior seta', followed by five sparsely plumose setae. Eyes sessile. Frontal area between dorsal and rostral spine possesses a small protuberance. No setae present between eyes and dorsal spine, and also no posterior seta to dorsal spine. The contour of dorsal and posterior margins of carapace appears as rounded right angled corner. The lateral portion of carapace is punctate.

Antennule (figure 5b). Unsegmented, smooth, conical. Terminally bearing four long aesthetascs and one short seta.

Antenna (figure 5c). Biramous, protopod pointed, almost equal to exopod, about double the length of rostral spine, bearing two rows of sharp spinules; endopod bud present; one-segmented exopod with pair of serrulate setae about one-fourths from tip, spinulations as shown in fig.

Mandible (figure 5d). Asymmetrical, with irregular medial toothed molar process and enlarged lateral incisor process bearing marginal teeth. Palp absent.

Maxillule (figure 5e). Coxal endite bearing six setae, all are plumodenticulate. Basial endite with three terminal plumodenticulate setae and four subterminal setae (three plumodenticulate and one plumose). Two-segmented endopod with proximal segment bearing smooth seta, distal segment bearing two subterminally and three plumodenticulate setae apically. Exopod seta absent.

Maxilla (figure 5f). Coxal endite bilobed, 6+4 setae. Basial endite bilobed, proximal lobe with 5 plumodenticulate setae and microtrichia on proximal margin, distal lobe bearing three plumodenticulate setae. Unsegmented endopod distally with two plus three terminal plumodenticulate setae; Scaphognathite marginally with 13 densely plumose setae, including distal process.

Maxilliped1 (figure 5g). Coxa simple. Basis with nine plumo-denticulate setae arranged 2, 2, 2, 3. Endopod five-segmented with 3, 2, 1, 2 and 3+1 plumodenticulate setae. exopod two segmented and with four terminal plumose natatory setae.

Maxilliped 2 (figure 5 h). Coxa naked. Basis with three plumodenticulate setae. Endopod three-segmented; first segment and second with plumodenticulate seta, distal segment with three plumodenticulate setae. Two segmented exopod with four terminal plumose natatory setae.

Maxilliped 3 Present as small endo-, exo- and epipod buds.Pereiopods present as small buds, chela enlarged.

Abdomen (figure 5a and 5m). Five somites. Somite 1 with pair of dorsal plumodenticulate setae, somites 2-5 each with two-minute setae placed on posterior edge. Posterolateral spines on somites 2-4 increasing in length distally; only somites 2 with a pair of dorsolateral processes. Pleopods absent.

Telson (figure 5m). Bifurcated, distinct median notch with microtrichia, three pairs of plumodenticulate setae on inner margin; each furcal shaft proximally bearing only one lateral spine, naked; furcal shafts almost looks smooth.

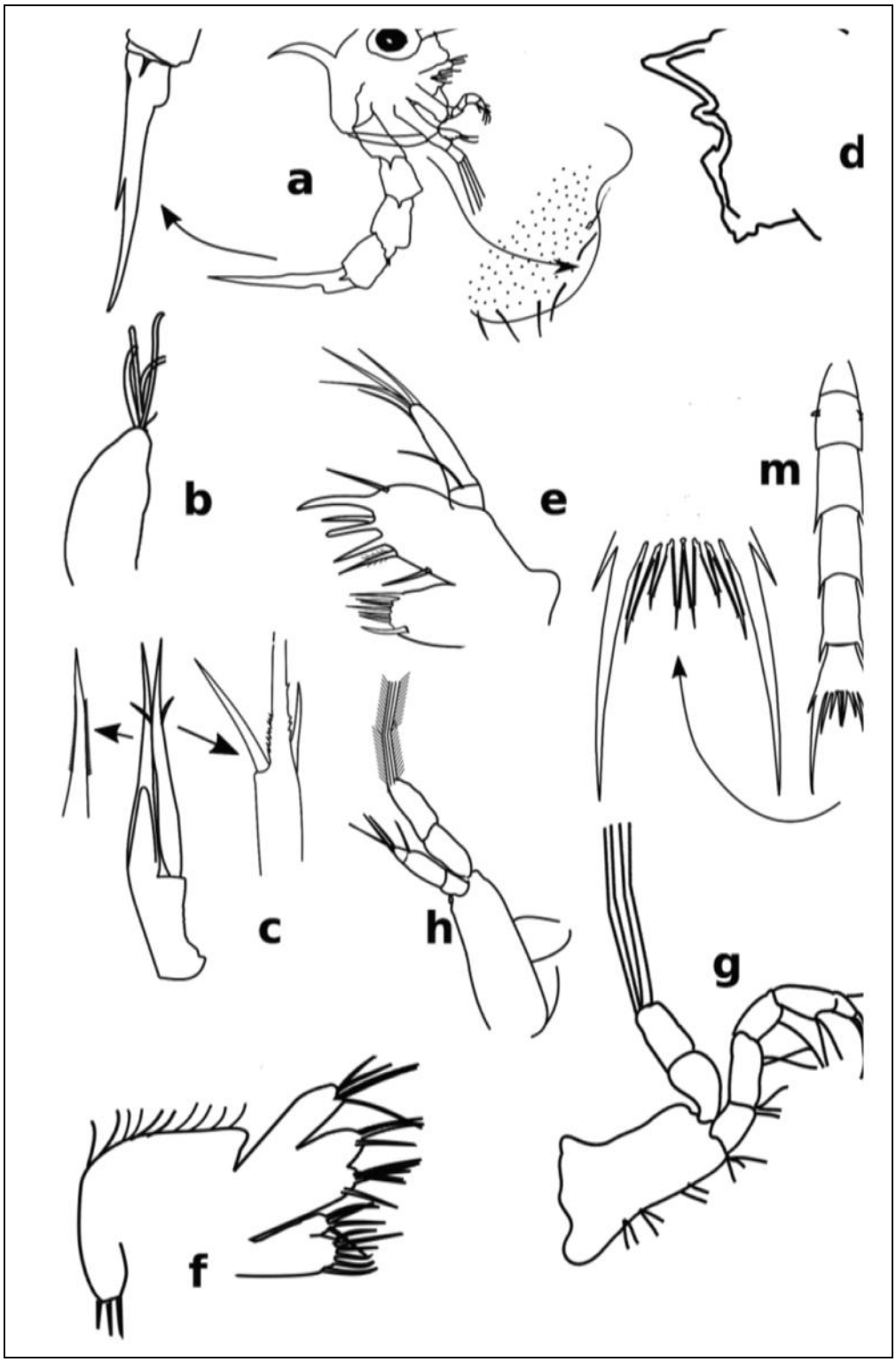

Fig 5: Zoea I of ***Stilbognathus cervicornis*** (Herbst, 1803) a. Zoea I, side view, b. Antennule, c. Antenna, d. Mandible, e. Maxillule, f. Maxilla, g. First Maxilliped, h. Second Maxilliped, m. Abdomen and Telson (magnification by 4x and 10x objectives)

Second zoea (figure 6)

Carapace (figure 6a). Eyes mobile. Lateral margin with additional plumose seta, thus now 6 nos.Antennule (figure 6b). With nine long aesthetascs and one fine simple setae, endopod bud present.Antenna (figure 6c). Endopod bud increased in length to middle nearing half of the enlarged of protopodite.Mandible (figure 6d). With palp bud.Maxillule (figure 6e). Coxal endite no change; basial endite with eight terminal plumo denticulate cuspidate setae and one subterminal plumose seta; endopod with two segmented, proximal with one plumo denticulate seta and the distal with 4+1 plumo denticulate seate, exopod plumose seta present. Maxilla (figure 6f): Proximal coxal lobe with five (2+3) plumo denticulate setae, distal basial lobe bearing 3+5 plumo denticulate seta, endopod with 2+3 plumo denticulate setae. Scaphognathite with 22 (common) and upto 25 marginal plumosetae.

Maxilliped 1 (figure 6g). Exopod with six plumose natatory setae.

Maxilliped 2 (figure 6h). Exopod with six plumose natatory setae.

Maxilliped 3: Endo-, exo- and epipod buds enlarged.

Pereiopods (figure 6j). Longer, segmentation not apparent but chela distinct.
Abdomen (figure 6m). Additional non-distinct sixth somite. Somite 1 now with three dorsal setae. Somites 2–5 with posterior pair of very minute setae and with pair of unsegmented biramous pleopods.

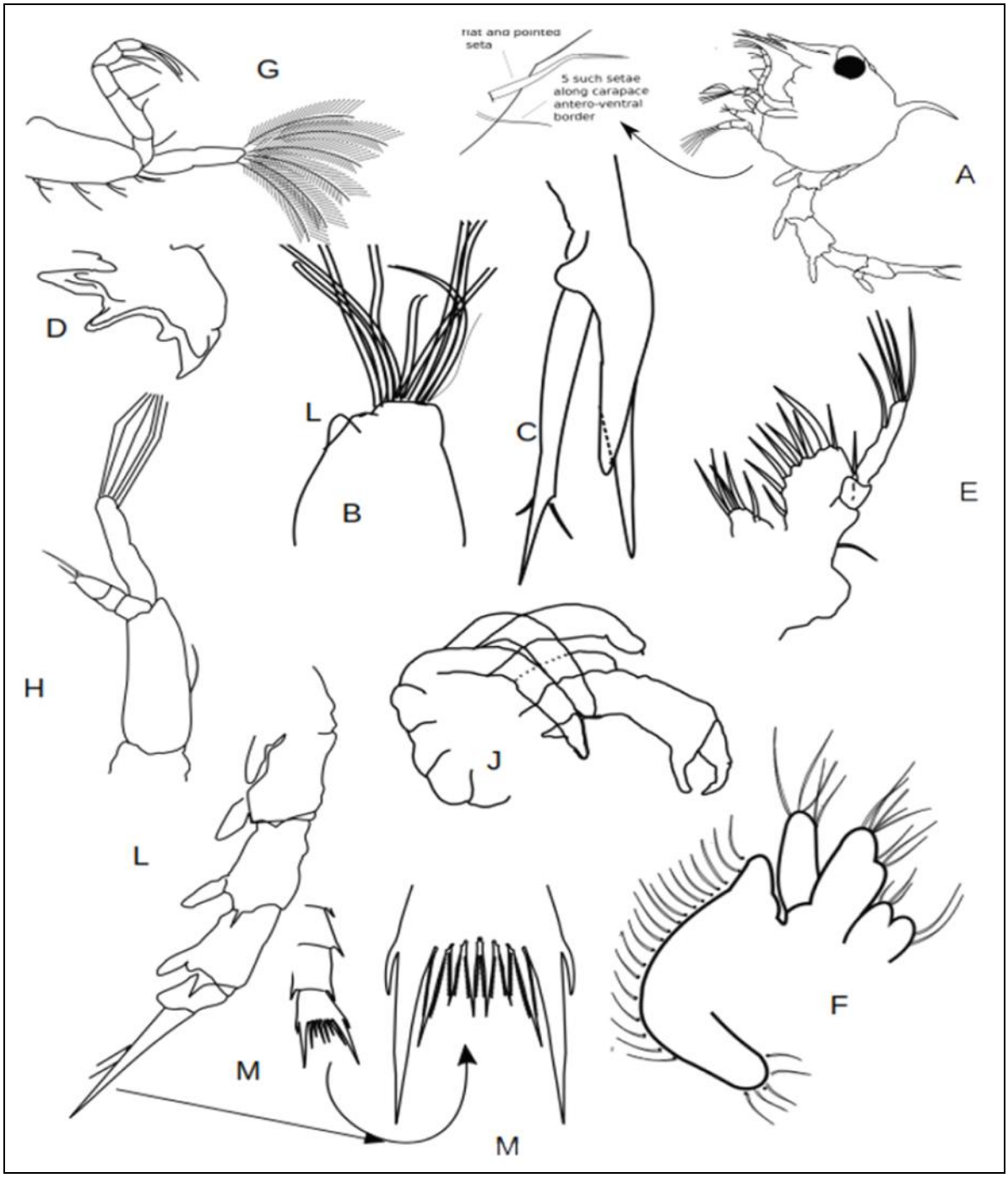

Fig 6: Zoea II of*Stilbognathus cervicornis* (Herbst, 1803)a. Zoea II lateral view; b. Antennule; c. Antenna,; d. Mandible ; e. Maxillule; f. Maxilla; g. First maxilliped; h. Second maxilliped; i. Abdomen side view; j. Pereopod bus; m.Telson (magnification by 4x and 10x objectives)

Megalop (figures 7& 8) (description based on a single damaged specimen)
Carapace (figure 7 a & a1). Sub-rectangular, with straight rostral spine bent downward, lateral spines absent; dorsal surface of carapace contour as shown in fig and photograph. Surface not covered with setae but mildly punctate.
Antennule (figure 7c). Three-segmented peduncle without any setae; unsegmented endopod with one subterminal simple setae and one terminal spine like setae; three-segmented exopod with naked proximal segment, simple setae and 10 aesthetascs on middle segment, and distal segment without any setae. Antenna (figure 7d). Segments 1-5, progressing proximally to distally, each with 2, 2, 0, 2, 1 simple setae, respectively; terminal setae long. Mandible: Scoop-shaped process with cutting edge.
Maxilliped 1 (figure 8h) Coxa with 4 plumodenticulate setae, basis bearing 10 plumodenticulate setae; endopod unsegmented without setae; exopod with 4 plumose setae on distal segment; epipod with 5 setae.
Maxilliped 2 (figure 8i). Coxa and basis not clearly differentiated; three
endopod segments proximally to distally with 0, 0, 2 setae, respectively; exopod with naked proximal segment and three plumose setae on distal segment; epipod not present on the

examined specimen.

Maxilliped 3 (figure 8j). endopod 5-segmented, proximally to distally with 7, 4-5, 2, 4 and 3 plumodenticulate setae; two segmented exopod with naked proximal segment and four to five short plumose setae apically on distal segment; epipod with one plumodenticulate setae proximally, sixdistally.

Pereiopods (figure 8, k1-k5). Covered with simple setae; dactyl of pereiopods 2–3 with spinules as shown and pereopods 4 and 5 with serrate setae; propodus of pereiopods 2–4 with serrate setae.

Abdomen (figure 7 m). Posterolateral margins of all somites rounded. Exopod of pleopods 1–5 on somites 2–6 with plumose natatory setae; pleopod5 with long setae.

Telson (figure 7f). Rounded posteriorly, bearing 15 long marginal setae.

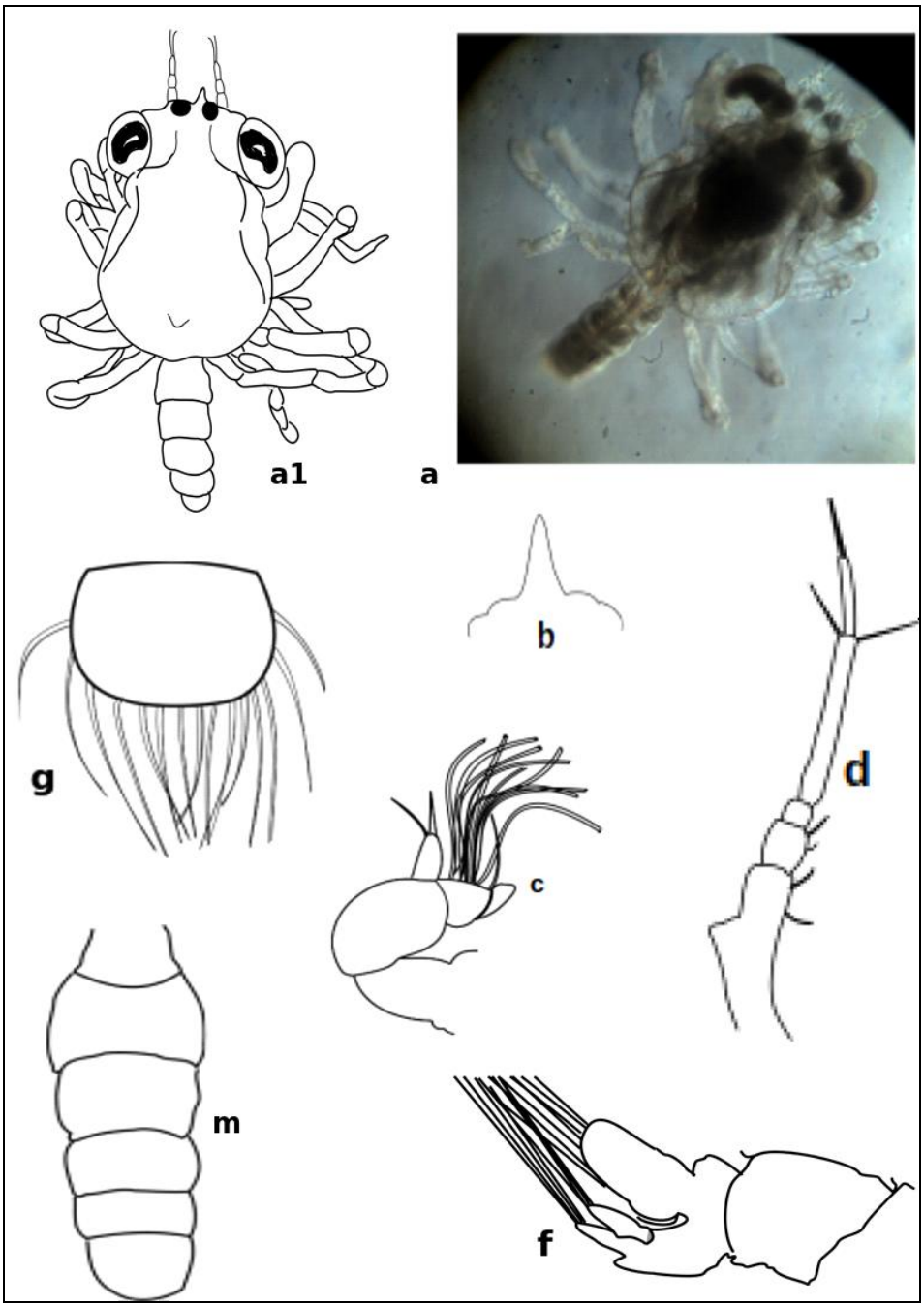

Fig 7: Megalopa of***S. Cervicornis*** a. Dorsal view of megalopa, a1 Sketch of megalopa, b. Rostrum, c. Antennule, d. Antenna, e. Abdomen dorsal view, f. Sixth abdominal segment and telson side view, g. Telson (magnification by 4x and 10x objectives)

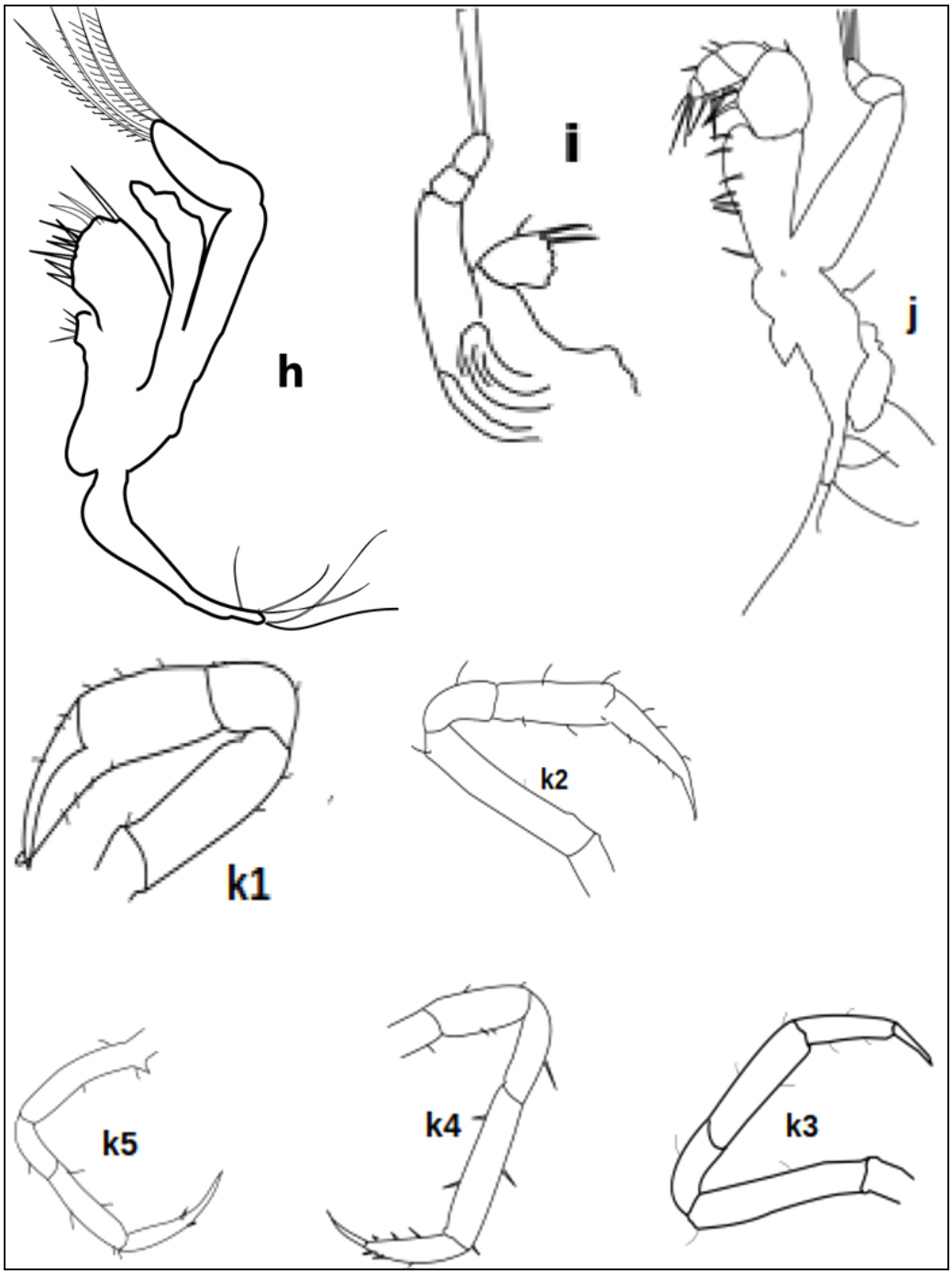

Fig 8: Megalop of ***S.cervicornis***(Cont.) h. First Maxilliped, i. Second Maxilliped, J. Third maxilliped, K1-5. Pereopods one to five . (magnification by 4x and 10x objectives)

Discussion

Epialtidae is a family of crabs, containing the subfamilies: Epialtinae MacLeay, 1838; Pisinae Dana, 1851; Pliosomatinae Števčić, 1994.; Tychinae Dana, 1851 and Actinotocarcininae. (WoRMs). The zoeae of Epialtidae can be characterised by rostral spine shorter than the antennae; dorsolateral processes only in the second abdominal somite. Carapace with rostral and dorsal spines, but without lateral spines, antenna usually well developed, telson with elongated furcae. Carapace without projections, but in *S.cervicornis* wherein small dorsal carapace hump is seen.

Sandifer and van Engel, (1971) [33] documented that the presence of long plumose setae on the ventral margin of the carapace is characteristic of the zoeae of majids. Carapace ventral margin of Zoea I of Epialtidae is beset generally with 5 seate, exception being *Acanthonyx limbatus* (11 setae), *A.lunulatus, Epialtus bituberculatus and Pugettia gracilis* wherein each with 7seate. In the present *S.cervicornis also*, there are 5 setae in Z1 but in ZII 5+1 pointed ribbon like seta on its ventral margin.

Antennule in Epialtinae Zoea I has generally 3 -4 aesthetascs and one-two setae but *S.cervicornis* has 4 aestetascs plus one seta. Maxillule coxa generally has 7 setae and its basis also has 7 setae exception being *A.limbatus (8), Epialtus bituberculatus (7-8) but S.cervicornis* has 7 setae. Endopod of maxillule has 1,4 or 2,4 seate in general and the same number of setae aslo present in *S.cervicornis* ZI.

Coxa of maxilla in Epialtinae Zoea I has usually 4+4 or 5+4 or 5+3 setae except for *A.limbatus* wherein it is 3+3. Basis invariably has 5+4 seate but *A.limbatus* has 5+5 seate. Endopod has 5,4 or 3 setae but *E. bitubercularus* has 6 seate. "The most homogeneous pisid characters in the first zoeal

stage are the number of setae on the coxal and basial endite of the maxillule (excluding Pisoides) and the endopod of first maxilliped (excluding Doclea) "(Table 3 of Santana etal. 2004)

Basis of Maxilliped I in zoeae of Epialtinae has generally setae arranged in 4 groups of 2+2+2+3 seate whereas in *A.limbatus, A.lunulatus, A.petiverii* and *E.bituberculatus* the setal arrangement is 2+2+3+3, this latter pattern also holds good in *S.cervicornis.* Endopod seate are 3,2,1,2,1+4 in majority of the species, so also in *S.cervicornis* the setal pattern is 3,2,1,2,1+4.

The endopod of maxilliped II of Epialtinae zoea I bear 0,1 and 4 setae, including the present species *S.cervicornis* of the subfamily Tychinae.

Since the megalopa is a damaged specimen, we refrain from comparing meglopa of S.cervicornis with others, It may need to be redescribed based on re-rearing. Moreover, the megalopa presents no consistent morphological character among genera (Santana *et al*, 2004).

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