

AN ILLUSTRATED KEY TO THE MALACOSTRACA (CRUSTACEA) OF THE NORTHERN ARABIAN SEA

Part III: EUPHAUSIACEA

Nasima M. Tirmizi, Quddusi B. Kazmi and Edward Brinton
Marine Reference Collection and Resource Centre, University of Karachi,
Karachi-75270, Pakistan (NMT, QBK); University of California, San Diego, U.S.A. (EB)

ABSTRACT: The key includes twenty-one species of euphausiids belonging to two families and six genera. The key was prepared following Brinton (1975). Since several authors attributed a fundamental importance to thelycum in systematics of euphausiids therefore the available figures of thelycum are also included.

KEY WORDS: Malacostraca - Arabian Sea - Euphausiacea - key.

INTRODUCTION

The crustacean order Euphausiacea contains the planktonic shrimps, commonly known as 'krill' and distributed throughout the oceans of the world. They have a superficial resemblance to small shrimps. The importance of euphausiids lies in the fact that they occur in vast numbers, comprise a significant portion of the biomass of the oceans of the world and are an important, and often major food for many marine animals (whales, fishes, seals, even birds), which in turn, are being required as a source of nutrition for man. Although a few species occur in coastal as well as bathypelagic regions, the majority live in the oceanic epipelagic and mesopelagic environments. Till now the order contains eighty-six species, (Mauchline, 1980; Brinton, 1987).

From Pakistan no work was available till 1980 when Khan recorded seven species collected during UNESCO Cruise 'Zulun' by PNS 'Zulfiqar'; in 1983 Fatima added another three species to the list by collecting more specimens from PNS 'Zulfiqar' and Norwegian vessel 'Fridtjof Nansen' cruises. Tirmizi and Nayeem (1989) report five species of euphausiids from Cruise 1 of *Fridtjof Nansen* (1977) and discussed the economic importance of the euphausiids in marine life. During the ongoing ONR (USA) research project on marine biodiversity two species have been collected from near shore waters.

Ponomareva (1964) gave nineteen species from the Arabian Sea (taken from Tirmizi and Nayeem, 1989). Weigmann (1970) worked the ecology and feeding habits of twenty-four species during NE monsoon from "the Arabian Sea proper" (Kimor, 1973). However, while giving distribution for the Indian Ocean euphausiids (Brinton and Gopalakrishnan, 1973) and later on for worldwide distribution of southeastern Asian species, Brinton (1975, figs.45a-75b) has shown twenty-one species entering the northern Arabian Sea. Recently Fatima (1992) reported four euphausiid species from central part of northern Arabian Sea (single St.63°E, 20°N), collected by PNS 'Zulfiqar', with their size structure and sex ratio.

A schematic diagram to show technical terms used in the key, morphology of a generalized euphausiid and petasma is given here to aid in identification. Few studies are available on thelycum morphology which describe only a limited number of species.

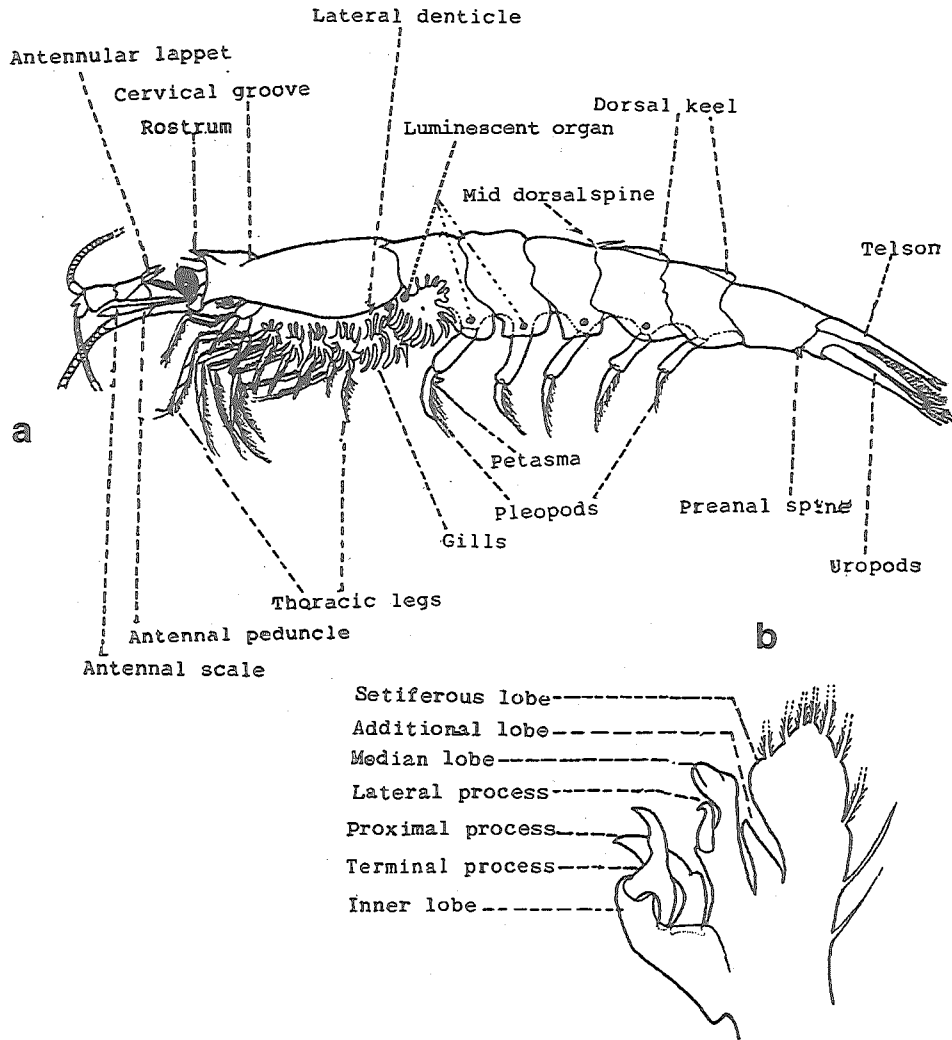


Fig.1 a. Schematic diagram of euphausiid; b. petasma.

1. Endopod of plp.1 in male not modified as petasma (copulatory organs). Basis of plp.1 carries 1-6 spines. Endopod of max₁ 2-jointed. Endopod of max₂ 3-jointed. Outer uropod with a subdistal transverse suture. No photophores. Eyes reduced in size and pigment. Thoracic legs 1-8 well developed.....
Family Bentheuphausiidae Colosi, 1917.
 Monospecific: *Bentheuphausia amblyops* Sars, 1885.
 References: Brinton, 1975; Khan, 1980

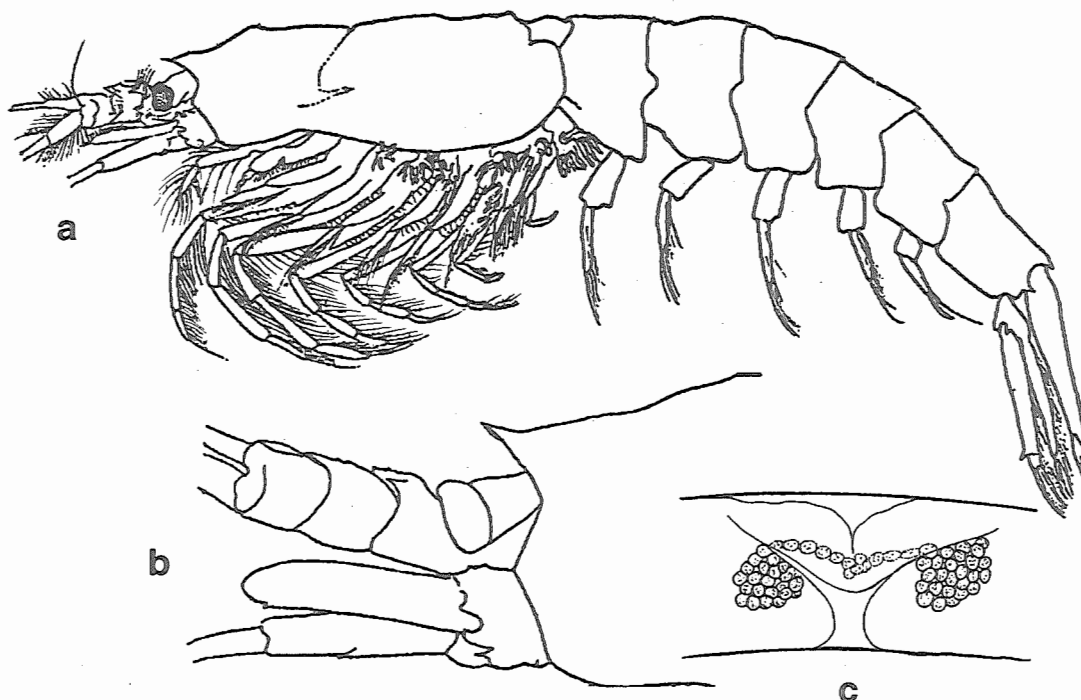


Fig.2. a. *Bentheuphausia amblyops* Sars, 1885; b. head region and peduncles of antenna, male (after Brinton, 1975); c. thelycum (after Guglielmo & Costanzo, 1983)

- Endopod of plp.1 in male modified as petasma. Basipod of plp.1 with no spines. Endopods of max₁ and max₂ single jointed. Outer plates of uropods with no transverse suture. Photophores present on eyestalks, sides of thorax, and ventral side of abdomen. Eyes well developed and black in fresh specimens. Last or penultimate and last pair of thoracic legs rudimentaryFamily Euphausiidae Holt & Tattersall, 1905.....2
- 2. Thoracic legs with more or less equally developed endopods. Eyes spherical or ovoid.....3
- Thoracic legs with endopods unequally developed, 2nd, or 3rd, or both greatly elongated. Eyes higher than broad, with distinct upper and lower lobes.....13
- 3. Thoracic leg 8 with endopod rudimentary. 7th small but 5-segmented.....*Thysanopoda* Milne Edwards, 1830.....4
- Thoracic legs 7 and 8 with endopods equally developed and unsegmented5

4. Lappet on first segment of ant.1 produced dorsoanteriorly as an acute tooth, not elevated as a heavy posteriorly rounded lobe. Carapace with 2 lateral denticles on each side, and with long spiniform process projecting anteriorly from gastric dome..... *T. tricuspadata* Milne-Edwards, 1837.

References: Brinton, 1975

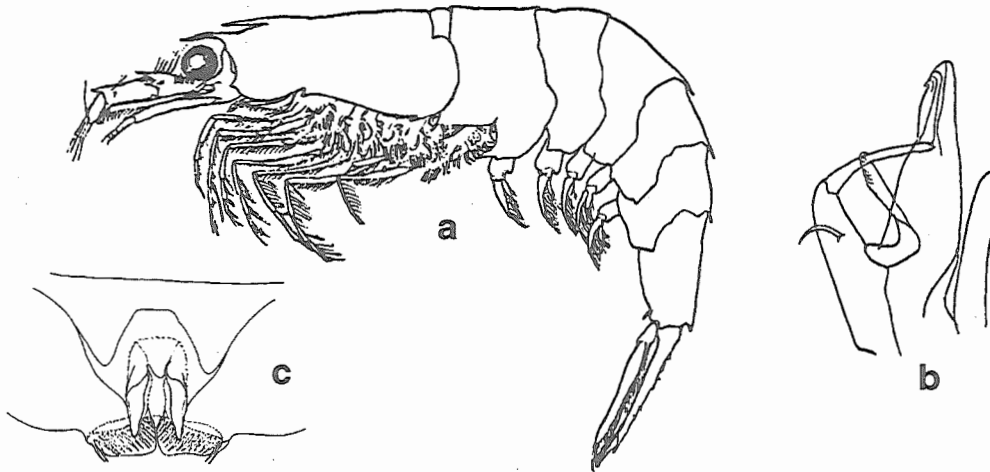


Fig.3. a. *Thysanopoda tricuspadata* Milne-Edwards, 1837; b. petasma. (after Brinton, 1975); c. thelycum (after Guglielmo & Costanzo, 1977).

- Lappet an abruptly elevated, heavy, posteriorly rounded lobe. Carapace without lateral denticles or with only one on each side, and without spiniform process extending forward from gastric dome.....*T. monacantha* Ortmann, 1893.

References: Brinton, 1975

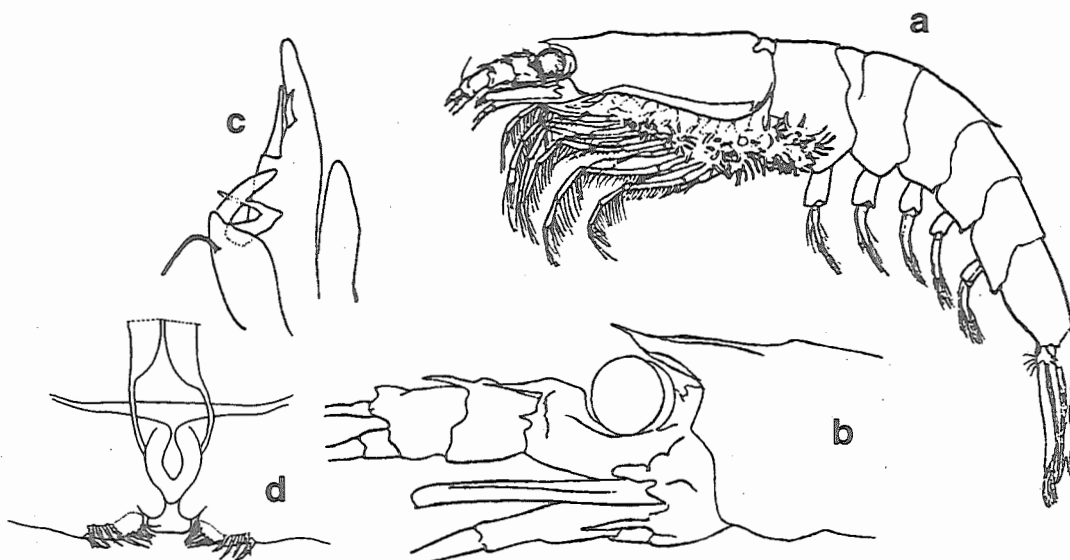


Fig.4 a. *Thysanopoda monacantha* Ortmann, 1893; b. peduncles of antennae and head region; c. petasma (after Brinton, 1975); d. thelycum (after Guglielmo & Costanzo, 1977).

5. Sixth leg with distal 3 segments of endopod greatly reduced. Ovisac present in female*Pseudeuphausia* Hansen, 1910.
 First segment of antennular peduncle with a spine on outer anterior margin; carapace with a prominent median keel. Mandible with a well developed palp. Maxillule without exopod. Distal end and inner lobe of petasma not digitate; spine-shaped processes on outer side similar in size to the ones on inner side and scarcely curved..... A single species: *P. latifrons* (Sars, 1883).
 References: Brinton, 1975; Khan, 1980; Fatima, 1983, 1992; Tirmizi & Nayeem, 1989

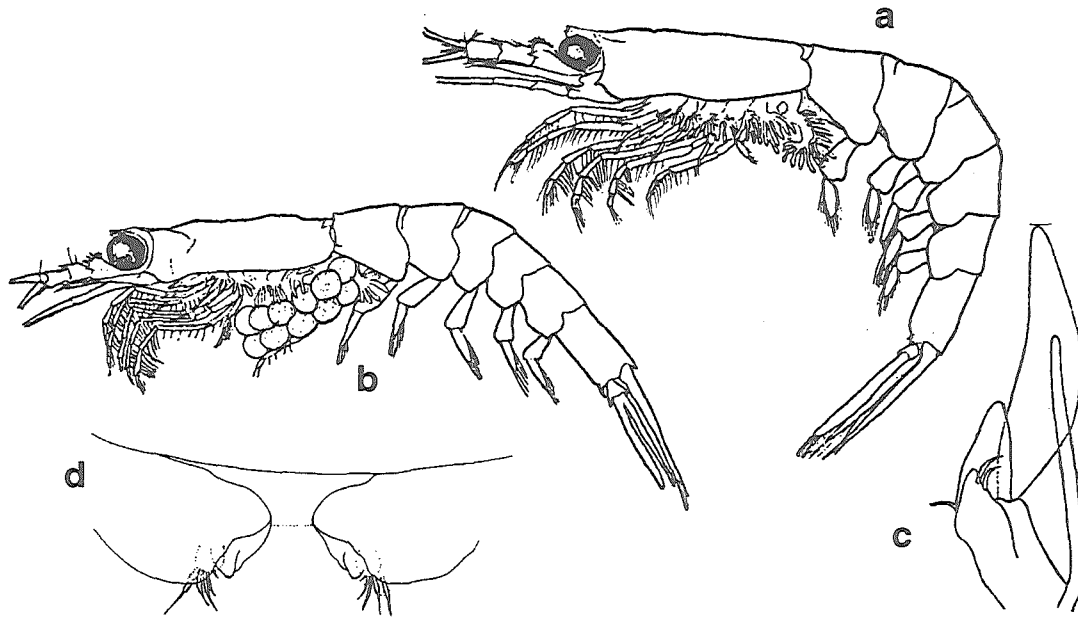


Fig.5 a. *Pseudeuphausia latifrons* (Sars, 1883), male; b. female; c. petasma. (after Brinton, 1975); d. thelycum (after Guglielmo & Costanzo, 1983)

- Sixth and fifth leg with endopods similar in appearance. Ovisac absent.....
*Euphausia* Dana, 1852.....6
6. Rostrum acute, medium to long. Eyes reddish-brown in preserved specimens. Lateral process of petasma hook-shaped without secondary tooth. Lappet with conspicuous acute (simple or bifid) projection.....7
- Rostrum short or lacking. Eyes blackish-brown in preserved specimens. Lateral process of petasma bears small secondary tooth on outer curvature. Lappet low and short, barely angular to rounded.....
 Middorsal spine on abd. somite 3.*E. sibogae* Hansen, 1908
 =*E. distinguenda* Hansen, 1911 in references from Indo-western Pacific region.
 References to change: Ponomareva, 1975
 References: Brinton, 1975; Khan, 1980; Tirmizi & Nayeem, 1989; Fatima, 1992

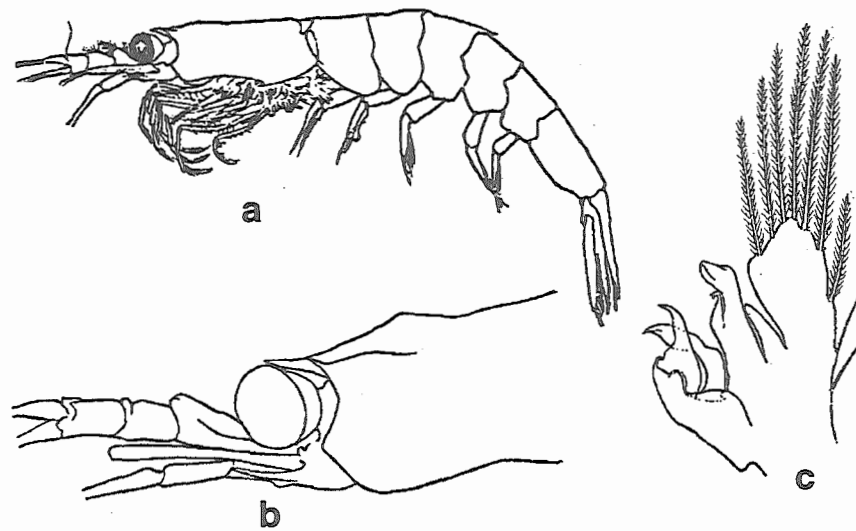


Fig. 6. a. *Euphausia sibogae* Hansen, 1908; b. peduncles of antennae and head region; c. petasma (after Brinton, 1975).

- 7. Lappet bifid. Eyes medium sized.....8
- Lappet simple, acute. Eyes large or small.....11

- 8. Carapace with 2 marginal or submarginal denticles on each side.....9
- Carapace with 1 denticle on each side.....*E. similis* Sars, 1883.

References : Brinton, 1975

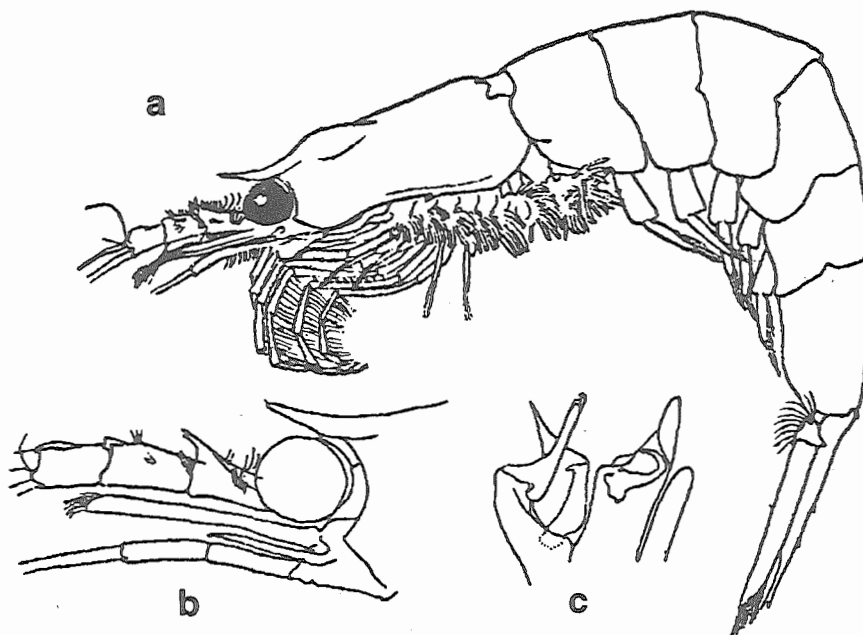


Fig. 7. a. *Euphausia similis* Sars, 1883; b. peduncles of antennae and head region; c. petasma (after Brinton, 1975).

9. Second segment of antennular peduncle without conspicuous subdorsal anterior spines. Lappet low in profile extending forward at angle of about 30° with horizontal
 *E. mutica* Hansen, 1905.

References: Brinton, 1975

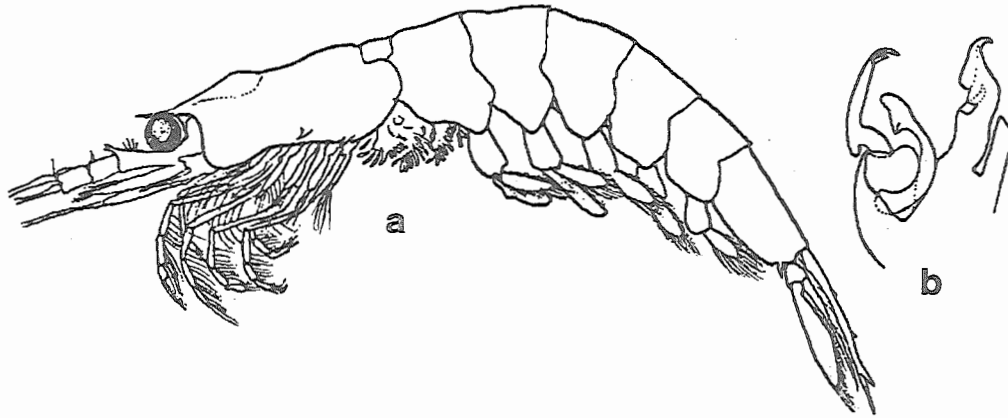


Fig.8. a. *Euphausia mutica* Hansen, 1905; b. petasma (after Brinton, 1975).

- Second segment of antennular peduncle with conspicuous acute or nearly acute spine or spines at subdorsal anterior margin. Lappet high, at angle of 45° with horizontal
 10

10. No spine on inner subdorsal anterior margin of 2nd segment of antennular peduncle. Pleuron of abd. somite 5 ends posteriorly in acute angle
 *E. brevis* Hansen, 1905.

References: Brinton, 1975; Khan, 1980; Tirmizi & Nayeem, 1989

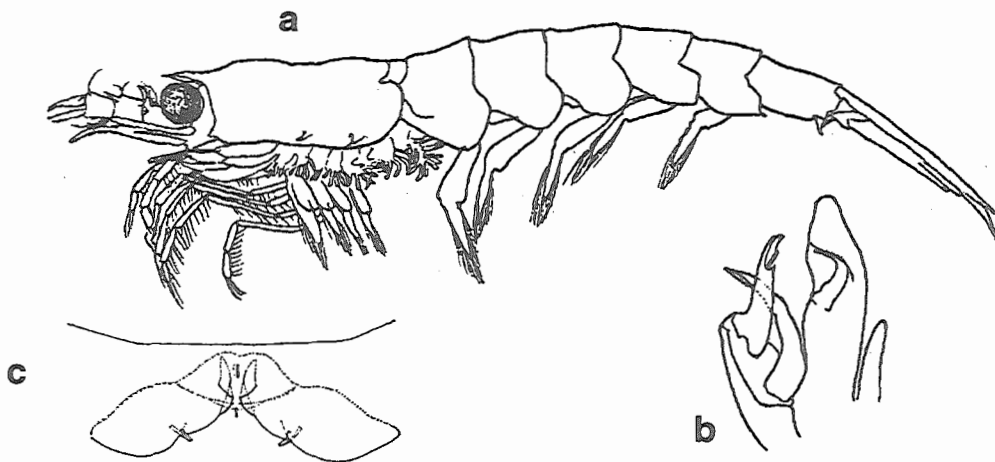


Fig. 9. a. *Euphausia brevis* Hansen, 1905; b. petasma (after Brinton, 1975); c. thelycum (after Costanzo & Guglielmo, 1976a).

- Spine present on inner (as well as outer) anterior margin of 2nd segment of antennular peduncle. Pleuron of abd. somite 5 with rounded posterior margin. Lappet somewhat anteriorly directed, bifid in both sexes.....*E. diomedea* Ortmann, 1894.
References: Brinton, 1975; Khan, 1980; Tirmizi & Nayeem, 1989; Fatima, 1992

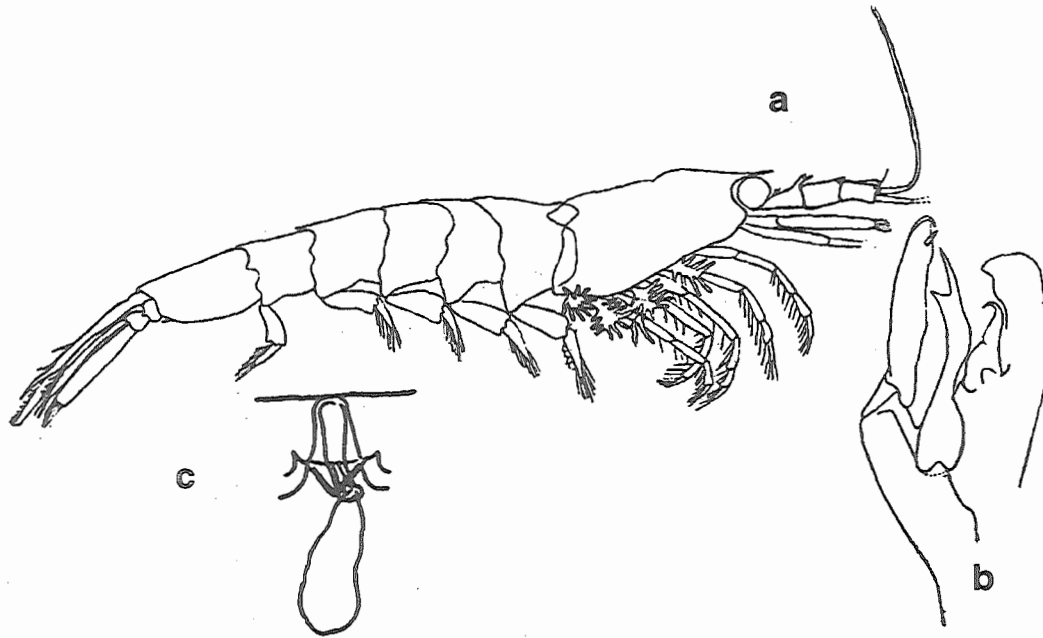


Fig.10. a.*Euphausia diomedea* Ortmann, 1894. TL.15 mm; b. petasma (after Brinton, 1975); c. thelycum (after Sebastian, 1966).

- 11. Eyes large. Middorsal posterior spine on abd. somite 3..... *E. sanzoi* Torelli, 1937.
References: Brinton, 1975; Khan, 1980; Tirmizi & Nayeem, 1989

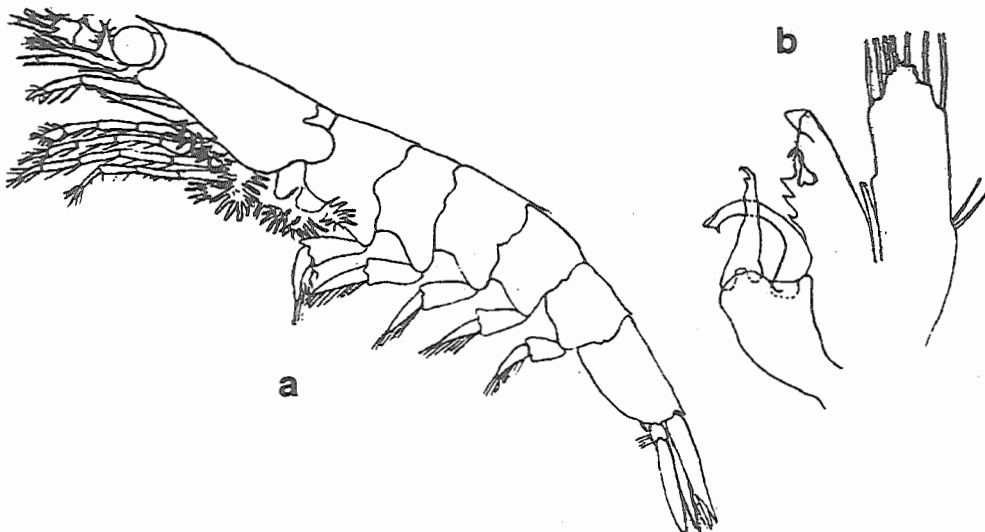


Fig. 11. a. *Euphausia sanzoi* Torelli, 1937. TL.9.9mm; b. petasma (after Brinton, 1975).

- Eyes small.....12

12. Frontal plate with humped keel.....*E. paragibba* Hansen, 1910
Reference: Brinton, 1975

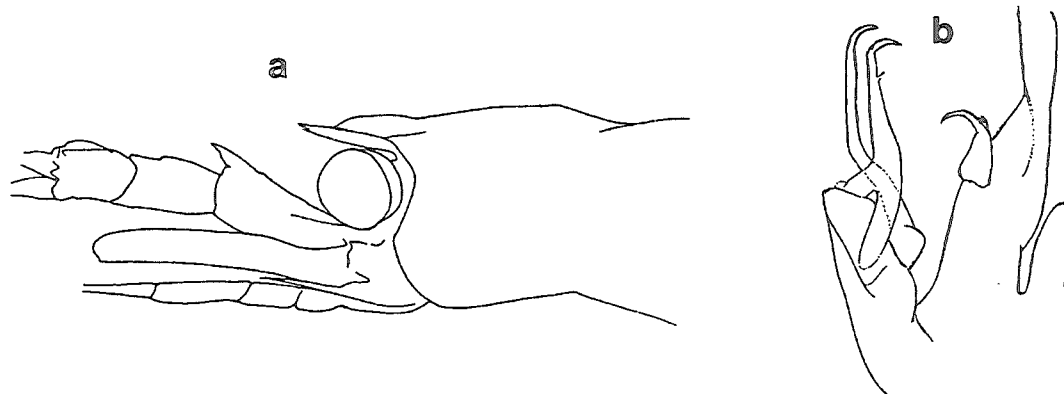


Fig.12. *Euphausia paragibba* Hansen, 1910. a. peduncles of antennae and head region; b. petasma (after Brinton, 1975).

- Frontal plate with low keel, scarcely convex in lateral view.

Petasma with terminal and proximal processes slender, terminal process splitting into 2 teeth or hooks distally, median lobe extending well beyond lateral process, tip of proximal process recurved as hook; 3rd segment of antennular peduncle with keel which drops off abruptly posteriorly..... *E. pseudogibba* Ortmann, 1893.

References: Mauchline & Fisher, 1969; Brinton, 1975; Fatima, 1983.

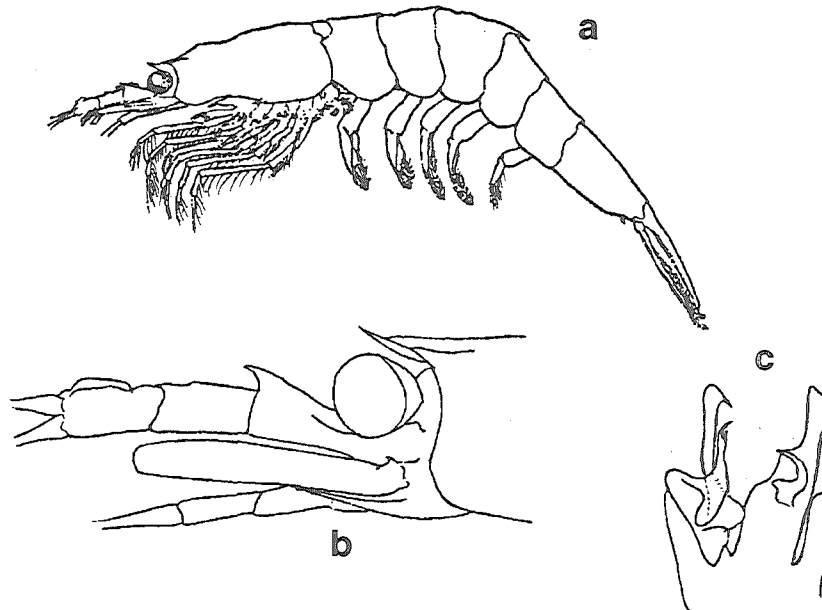


Fig. 13 a. *Euphausia pseudogibba* Ortmann, 1893; b. peduncles of antennae and head region; c. petasma (after Brinton, 1975).

13. 2nd leg with endopod greatly elongated, very slender, naked except for group of long apical bristles *Nematoscelis* Sars, 1883.....14
 - 3rd leg with endopod greatly elongated having penultimate segment broadened and forming together with ultimate segment a kind of prehensile hand with curved bristles.
 Ventral abdominal photophores lacking on all but first segment
*Stylocheiron* Sars, 1883.....16
14. Propodus of 1st thoracic leg with setae arranged in 2 rows. Lateral process of petasma much longer than terminal and spine-shaped process.....15
 - Propodus of 1st thoracic leg with 8-9 setae in a single row, seta bearing margin strongly convex. Lateral process of petasma much shorter than terminal and spine-shaped processes.
 Coxal plates of thelycum angular with sides having deep notches at about mid-way.....*N. microps* Sars, 1883.

References: Brinton, 1975

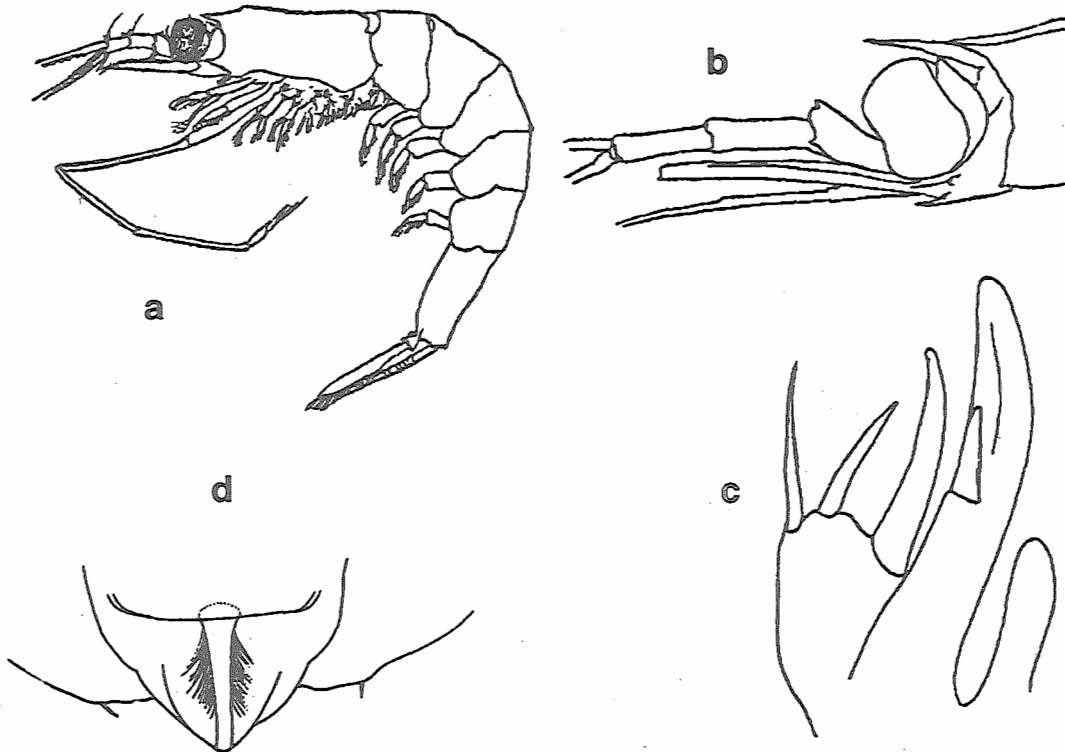


Fig.14. a. *Nematoscelis microps* Sars, 1883; b. peduncles of antennae and head region; c. petasma. (after Brinton, 1975); d. thelycum (after Costanzo & Guglielmo, 1980)

15. Lower lobe of eyes much smaller than upper part. One long seta projects from dorsal surface of dactylus of 1st thoracic leg.
 Thelycum with coxal plates angular with sides arched and without any constriction.....*N. tenella* Sars, 1883.

References: Brinton, 1975.

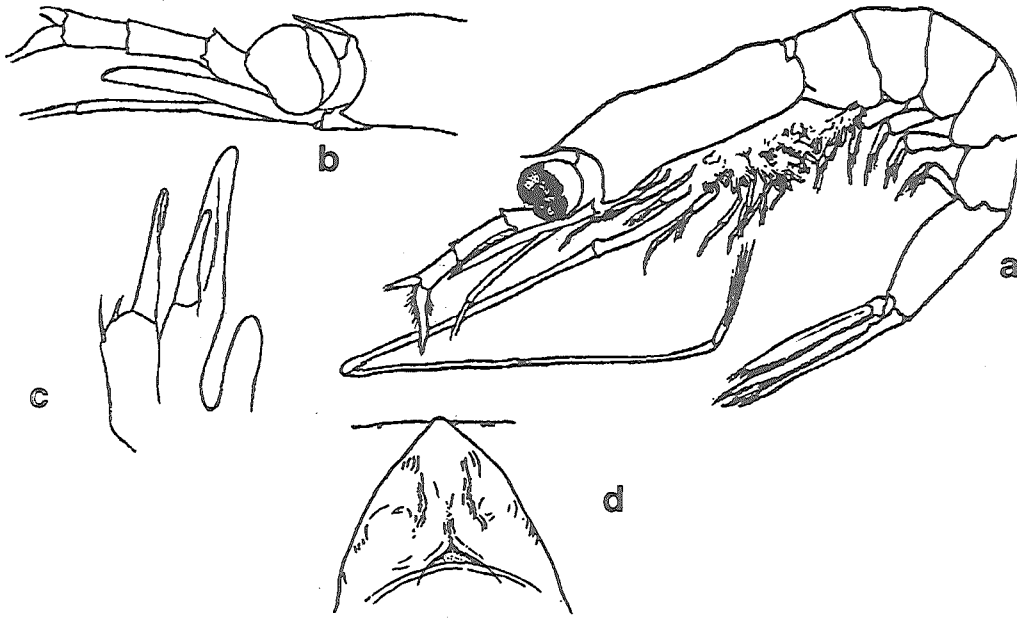


Fig.15. a. *Nematoscelis tenella* Sars, 1883; b. peduncles of antennae and head region; c. petasma. (after Brinton, 1975); d. thelycum (after Sebastian, 1966).

- Lower lobe of eyes as large as or larger than upper part. No seta on dorsal surface of dactylus of 1st thoracic leg.....*N. gracilis* Hansen, 1910.

References: Brinton, 1975; Fatima, 1983

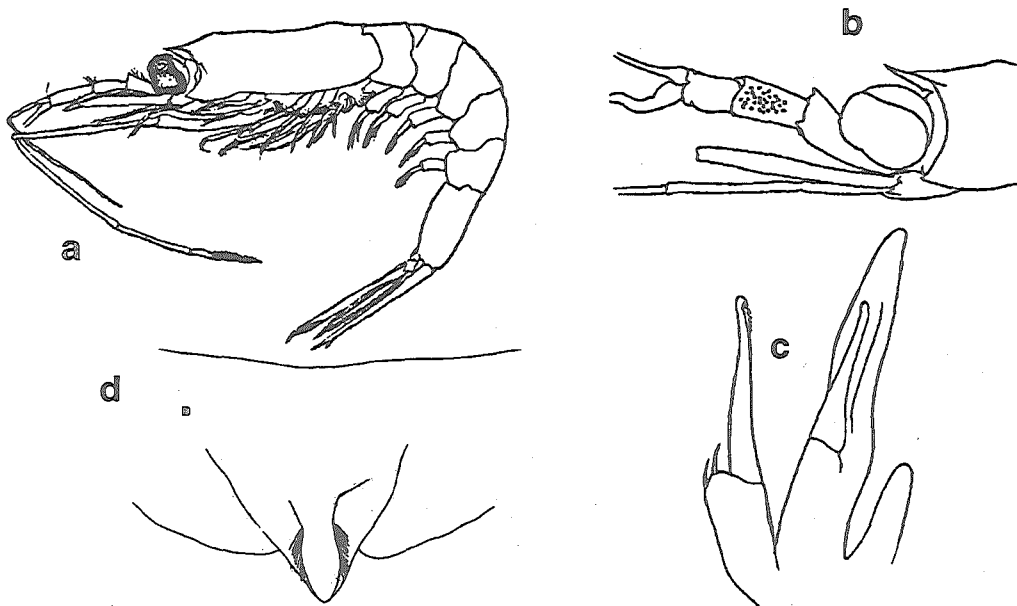


Fig.16 a. *Nematoscelis gracilis* Hansen, 1910; b. peduncles of antennae and head region of female; c. petasma. (after Brinton, 1975); d. thelycum (after Costanzo & Guglielmo, 1980)

16. Penultimate segment of elongated 3rd thoracic leg with setae simple, lateral rather than terminal, nearly equal in length, directed laterodistally, forming, together with similar simply curving setae on dactylus, a grasping organ (false chela). Gastric region carinated but scarcely elevated. Thorax slender.....*S. carinatum* Sars, 1883.
References: Brinton, 1975; Fatima, 1983, 1992.

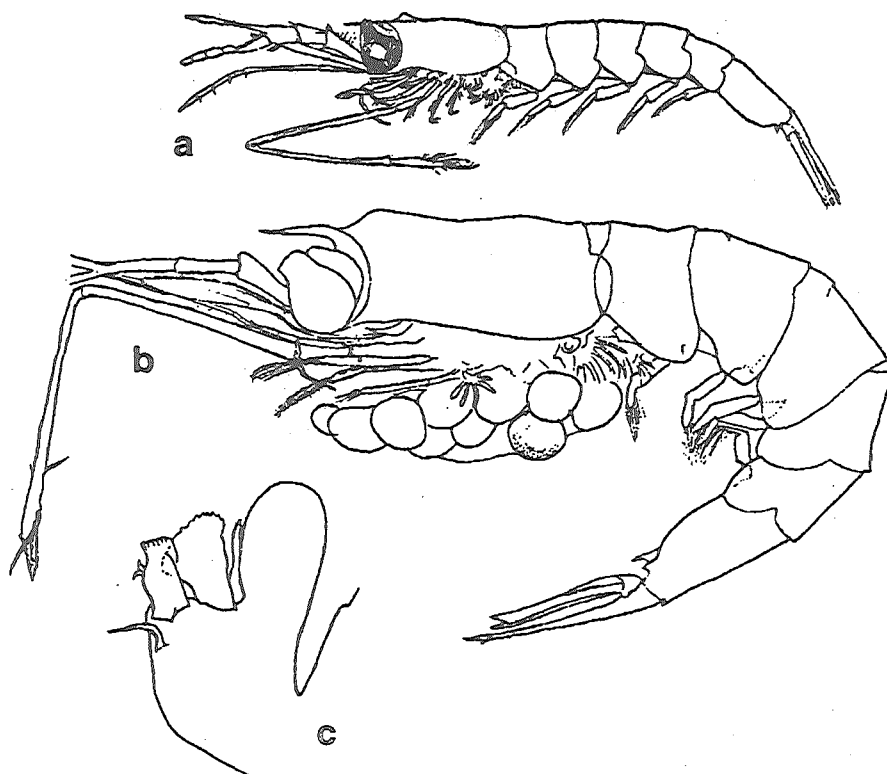


Fig. 17.a. *Stylocheiron carinatum* Sars, 1883, male; b. female; c. petasma (after Brinton, 1975)

- Penultimate segment of elongated 3rd thoracic leg with finely serrate setae on grasping margins, bristlelike, distally curved, unequal in length and extending parallel with axis of limbs so as to form a false chela with similar setae on dactylus. Gastric region domed. Thorax short, somewhat deeper than in *S. carinatum*.....17
- Penultimate segment of elongated 3rd thoracic leg with a long, strong distally curving spine which serves as an immovable finger, opposing the distally serrate dactyl segment so as to form a true chela. Gastric region domed.

Upper lobe of eyes nearly equal in width to lower lobe. Abd. somite 6 more than 2.3 times longer than deep..... *S. maximum* Hansen, 1908.

References: Brinton, 1975

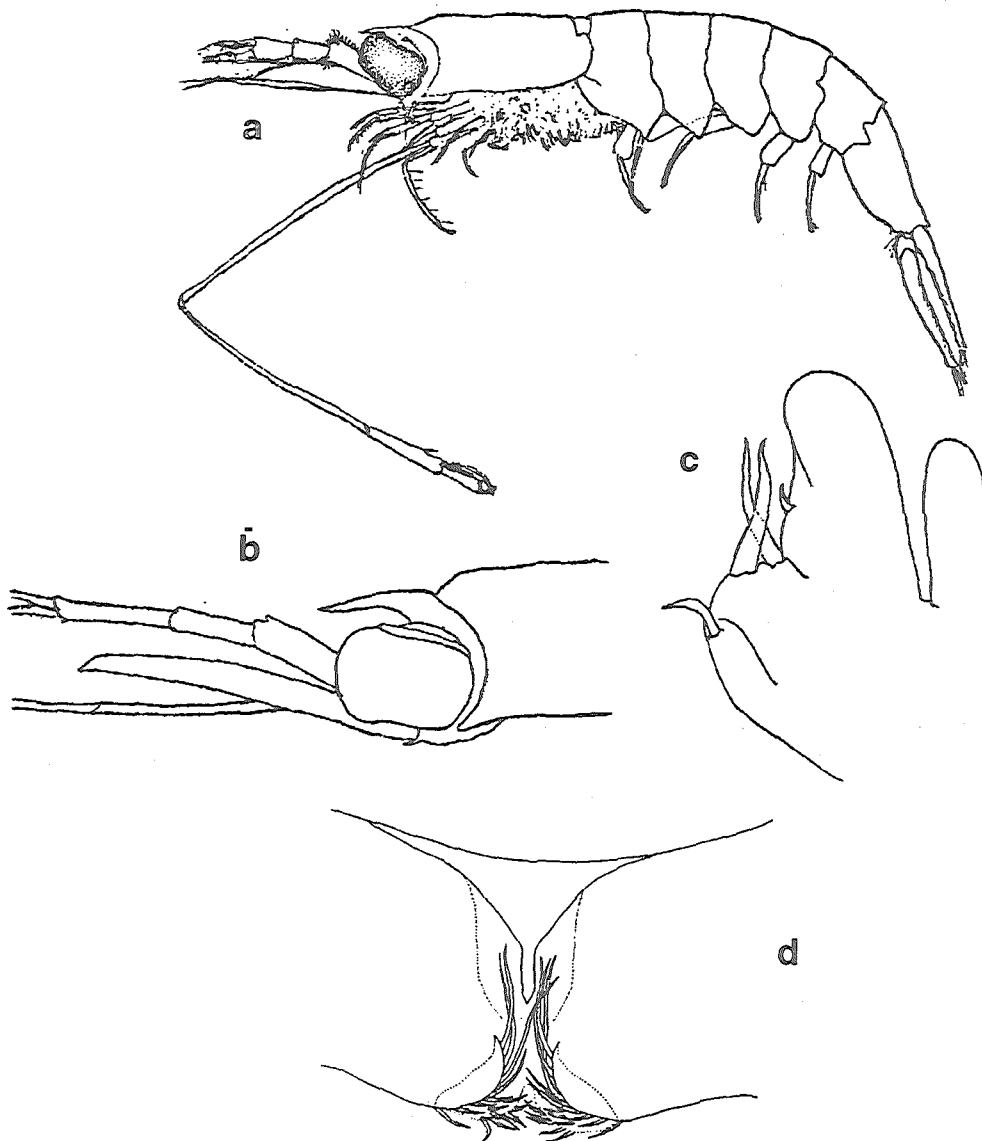


Fig. 18 a. *Stylocheiron maximum* Hansen, 1908, male; b. peduncles of antennae and head region of female; c. petasma (after Brinton, 1975); d. thelycum (after Costanzo & Guglielmo, 1976b)

- 17. Upper lobe of eyes distinctly narrower than lower.....17
- Upper lobe of eyes as wide as, or scarcely narrower than lower lobe.
 - Sixth abd. somite 1.63 to 2.4 times as long as deep, eye with upper lobe as wide as lower in "Long Form" but upper lobe narrower than lower in "Short Form" and "North Indian Ocean Form", only the latter exists in the western Arabian Sea.....
 -*S. longicorne* Sars, 1883.

References: Brinton, 1975

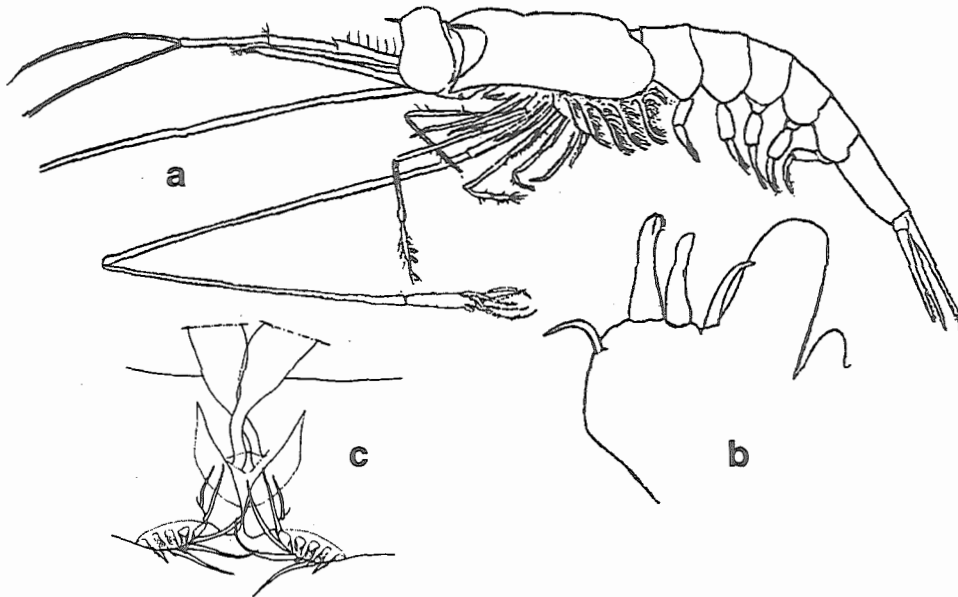


Fig.19. a) *Stylocheiron longicorne* Sars, 1883; b. petasma (after Brinton, 1975);
c. thelycum (after Costanzo & Guglielmo, 1976b).

18. Abd. somite 6 with ventral margin angularly upturning near posterior limit. Upper lobe of eyes approximately 1/4 width of lower lobe with three crystalline cones in distal transverse row.....*S. suhmii* Sars, 1883.

References: Brinton, 1975; Fatima, 1983

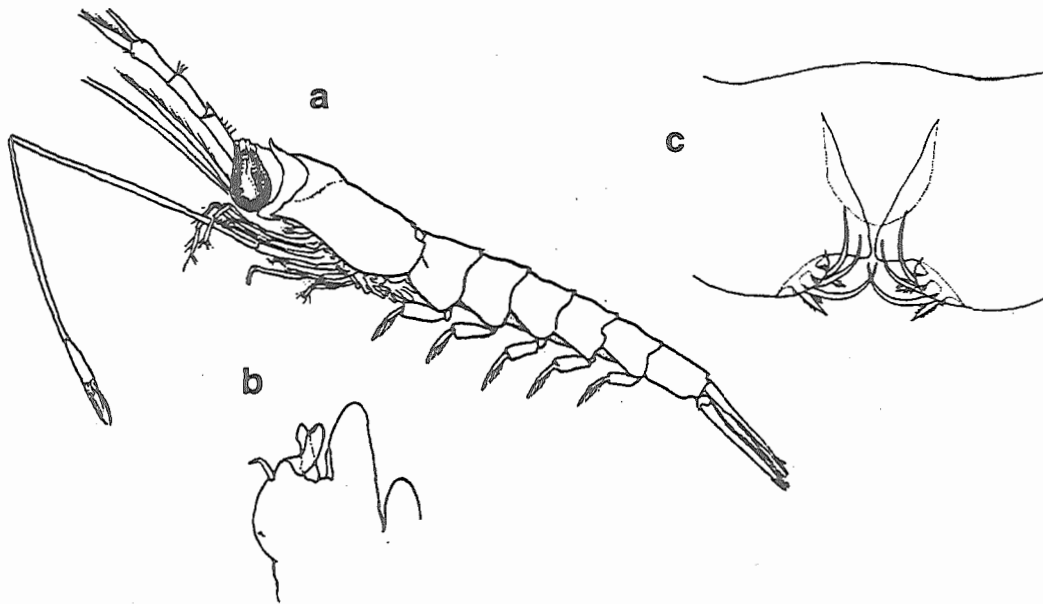


Fig.20.a. *Stylocheiron suhmii* Sars, 1883; b. petasma (after Brinton, 1975); c. thelycum
(after Costanzo & Guglielmo, 1976b).

- Abd. somite 6 smoothly narrowing (in lateral view) posteriorly19
- 19. Upper lobe of eye with 4 to 8 crystalline cones in distal transverse row.....

.....*S. affine* Hansen, 1910. (Indo-Australian form)

References: Brinton, 1975; Fatima, 1983

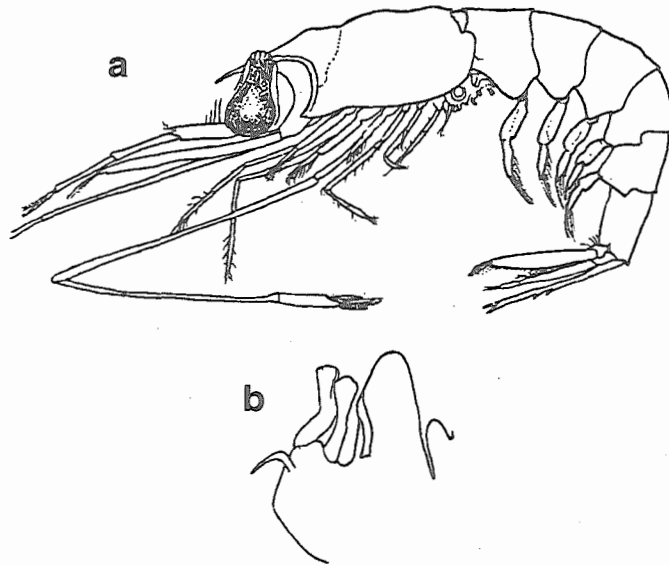


Fig.21. a. *Stylocheiron affine* Hansen, 1910; b. petasma. (after Brinton, 1975, Indo-Australian form)

- Upper lobe of eyes with 14 to 16 crystalline cones in distal transverse row.....

.....*S. indicus* Silas & Mathew, 1967.

References: Brinton, 1975; Khan, 1980

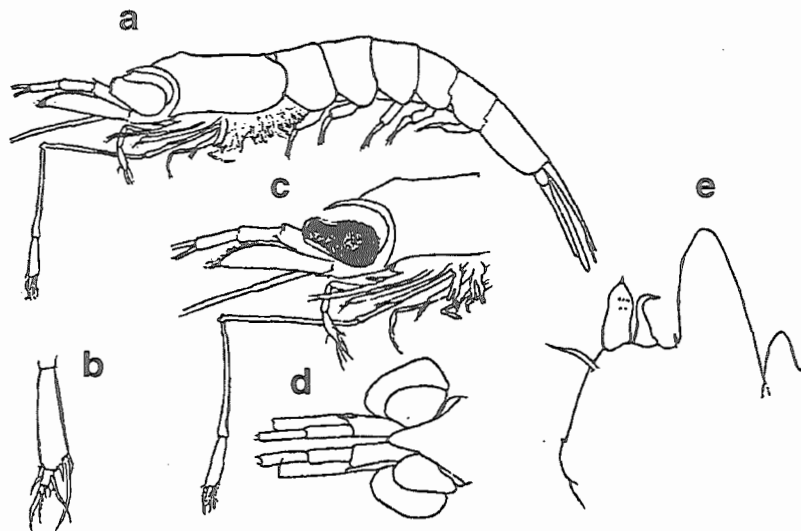


Fig.22. *Stylocheiron indicus* Silas & Mathew, 1967. a. juvenile (7 mm); b. false chela of 3rd thoracic leg; c. anterior parts,lateral; d. same, dorsal; e. petasma.(after Brinton,1975)

ACKNOWLEDGEMENTS

This work was initiated by the grant of Pakistan Science Foundation, Islamabad No.SKU/Bio/(167). Completion was possible through financial assistance under the Office of Naval Research, USA grant No.N00014-86-G-0229.

LITERATURE CITED

- Brinton, E. 1975. Euphausiids of Southeast Asian waters. *Naga Report*, 4(5): 1-287.
- Brinton, E. 1987. A new abyssal euphausiid *Thysanopoda minyops*, with comparisons of eye size, photophores and associated structures among deep living species. *Journal of Crustacean Biology* 7(4): 636.
- Brinton, E. and M. Gopalakrishnan, 1973. The distribution of Indian Ocean Euphausiids. In: *The Biology of Indian Ocean*, Springer Verlag, Berlin. 3: 357-382.
- Costanzo, G. and L. Guglielmo, 1976a. Diagnostic value of the thelycum in euphausiids, I. Mediterranean species (First note). *Crustaceana* 31(1): 45-53, figs.1-7.
- Costanzo, G. and L. Guglielmo, 1976b. Diagnostic value of the thelycum in euphausiids, I. Mediterranean species (Second note). *Crustaceana* 31(2): 178-180, figs.1-6, pl.1-3.
- Costanzo, G. and L. Guglielmo, 1980. Diagnostic value of the thelycum in euphausiids. II, Oceanic species, genus *Nematoscelis*. *Marine Biology* 56: 311-317, figs.1-9.
- Fatima, M. 1983. Occurrence and relative abundance of Euphausiids from the northern Arabian Sea. *Karachi University Journal of Science* 11(2): 207-213.
- Fatima, M. 1992. Species of euphausiids from central part of northern Arabian Sea, collected in S. W. monsoon season. *Marine Research* 1(1): 79-86.
- Guglielmo, L. and G. Costanzo, 1977. Diagnostic value of the thelycum in euphausiid, II. Oceanic species. Genus *Thysanopoda*. Miln Edwards, 1830. *Crustaceana* 33(3): 275-283, figs.1-8, pls.3.
- Guglielmo, L. and G. Costanzo, 1983. Diagnostic value of the thelycum in the euphausiids. II. Oceanic species. Genera *Bentheuphausia*, *Nyctiphanes*, *Pseudeuphausia*, *Tessarabrachion*, and *Nematobrachion*. *Journal of Crustacean Biology*, 3(2): 278-292, figs.1-11.
- Khan, M.A. 1980. Euphausiids of 'Zulun' Cruise. *Biologia*: 1-4, fig.1.
- Mauchline, J. 1980. The biology of Mysids and Euphausiids: In: J.H.S. Blaxter, *Advances in Marine Biology* 18. Pp.681.
- Mauchline, J. and L.R. Fisher, 1969. The biology of euphausiids. In: *Advances in Marine Biology* 7. Pp.1-454.
- Kimor, B. 1973. Plankton Relations of the Red Sea, Persian Gulf and Arabian Sea. In: *The Biology of Indian Ocean*, Springer Verlag, Berlin 3: 221-232, 3 figs.
- Ponomareva, L.A. 1964. On the Euphausiacea of the Arabian Sea and the Bay of Bengal. *Trudy Vsesoyuznogo Nauchno-issledovatel'skogo Instituta Morskogo Rybnogo Khozyaistva i Okeanografii* 64: 265-270.
- Ponomareva, L.A. 1975. Euphausiacea of Indian Ocean and the Red Sea, Moscow, "Nauka". Pp.1-81.
- Sebastian, M.J. 1966. Euphausiacea from Indian seas: systematics and general considerations. In: Symposium series Marine Biology Association, India No.2. 1965, Proceedings of the symposium on Crustacea, Ernakulam 1 : 233-254.
- Tirmizi, N.M. and I. Nayeem, 1989. Economic importance of euphausiids in marine life of Pakistan. *Proceedings Pakistan Congress of Zoology*, 9: 281-289.
- Weigmann, R. 1970. Zur Okologie und Ernährungsbiologie der Euphausiaceen (Crustacea) in Arabischen Meer. "Meteor" *Forschungsergebnisse 'D'* 5: 11-52.

(Received: June 1994)