

**TAXONOMIC STATUS OF *STYLOCHEIRON ARMATUM* COLOSI 1917
(CRUSTACEA : EUPHAUSIACEA)—A CRITICAL EVALUATION**

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ABSTRACT

Stylocheiron armatum originally described by Colosi (1917) closely resembles *Stylocheiron carinatum* G.O. Sars (1883). Colosi described the species based on morphological differences observed with the elongated third cormopod and the male copulatory organ. The species was established partly on Sars' (1883), Ortmann's (1893) and Hansen's (1910) *S. carinatum* and also on the specimens collected from the Indian Ocean and the Caribbean Sea. However, the later workers without perhaps examining the tropical euphausiids of the Indian Ocean, synonymised *S. armatum* with *S. carinatum* stating that the differences between the two species in the petasma and the elongated thoracic leg were too small to give the status of species to the former. In the course of a detailed study of Euphausiacea of the southeastern Arabian Sea, the author had the opportunity to examine vast collections of euphausiids and this has enabled him to have a closer look on the systematic position of *S. armatum*. The study has revealed that the morphological characters between the two species are so distinct that a re-thinking on the validity of the *S. armatum* is necessary. The material examined by the author had characters more akin to *S. armatum*. In the present communication a critical evaluation of the status of *S. armatum* is made. A revised key, incorporating some new characters, for the identification of species and 'forms' of genus *Stylocheiron* is also presented.

INTRODUCTION

HANSEN (1910) divided the species of the genus *Stylocheiron* into three groups on the basis of the armature of the propodus and dactylus of the third cormopod and on this basis *S. carinatum* and *S. armatum* fall under one group which is characterised by the penultimate segment of the third cormopod having only lateral setae. This group is called the 'Carinatum Group'. *S. maximum*, *S. abbreviatum* and *S. robustum* form the 'Maximum Group' in which the third cormopod terminates in a true chela with a well developed immovable finger from the ultimate joint. The rest of the species of this genus are included in the 'Longicorne Group' which is characterised by the third cormopod terminating in a false chela having no real immovable

finger. Of the two species in the 'Carinatum Group', *S. armatum* is at present not considered as a valid species.

The species of the genus *Stylocheiron* being evolutionally less successful than the species of the genus *Euphausia*, appeared to have been undergoing more and more differentiation and specialisation in the body form when populations from different ecological realms were critically examined. This has been observed by Brinton (1962 a) when he found five different 'forms' of *S. affine* and two 'forms' of *S. longicorne*. Added to these the recent description of two new species, namely *S. robustum* by Brinton (1962 b) and *S. indicum* by Silas and Mathew (1967) and a third 'form' of *S. longicorne* by Brinton (1975) points to the rapid process of speciation taking place within

this genus. Similarly a detailed examination of the material obtained from the southeastern Arabian Sea which revealed more affinities to *S. armatum* necessitates further consideration of the status of this discarded species and a discussion to this effect ensues.

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MATERIAL AND METHODS

The material used for the present study has been obtained from the southeastern Arabian Sea between latitudes 7°30' N and 18°00' N and longitudes 70°30' E and 75°58' E. The samples were collected with an open Indian Ocean Standard Net (IOS Net) (Curie, 1963) as vertical hauls from almost bottom to the surface in the continental shelf area and from depths varying from 250 to 1,300 m in the oceanic area. The samples were analysed for all the postnaupliar developmental stages, immature as well as adults of all the available species. Careful examination of the elongated third cormopods at different developmental stages and the male copulatory organs in the adults of the species in question were carried out and necessary illustrations were made.

Stylocheiron armatum Colosi, 1971

S. armatum Colosi, 1917 : 196, Tav, xv, figs. 28, 29, Tav, xvi, fig. 30.

S. Carinatum G. O. Sars, 1883 (partim) : 31 ; 1885 (partim) : 137-142, pl. xxvi, fig. 1-27 ; Ortmann, 1893 (partim) ; Hansen, 1910 (partim) : 113-115, pl. xvi, fig. 1, a-h ; Torelli, 1934 a : 12.

Material : From continental shelf waters : 721 larvae, 259 immatures, 295 males and 473 females. From Oceanic waters : 317 larvae and immatures, 281 males and 415 females.

Maximum length observed : Male 6.75 mm ; Female : 9.00 mm.

S. armatum originally described by Colosi (1917) closely resembles *S. carinatum*. She established the species partly on Sars' (1883) Ortmann's (1893) and Hansen's (1910) *S. carinatum* and also on the specimens collected from the Indian Ocean and the Caribbean Sea by 'LIGURIA'. The main differences between the two species lie in the structure of the elongated thoracic leg and the male copulatory organ. Hansen (1910) noticed some minor differences among specimens from the East Indian Archipelago, Pacific and the Atlantic and attempted to separate them into two or more species but gave up the idea thinking that the differences did not suffice for creating new species.

Colosi (1917) who made a closer examination of the numerous samples of the 'LIGURIA' from several localities in the Pacific, the Indian and the Atlantic oceans could discover more characters of great importance which enabled him to divide the species into two well defined categories which he considered as species. He reserved the name *S. carinatum* for the species taken from places other than the Indian Ocean and the Caribbean Sea because according to him it was the one, representatives of which were evidently the frequently collected and studied by authors. The new name was given to the specimens collected from the Indian Ocean (Arabian Sea) and to similar specimens collected from the Caribbean Sea.

In *S. armatum* according to Colosi (1917) the tubercle and the spine on the antepenultimate segment of the pair of elongated legs are together as long as half the penultimate segment (Fig. 1) while in *S. carinatum* the tubercle and the spine are together a little longer than a quarter of the penultimate segment. The terminal process of the male copulatory organ in *S. armatum* has the serrated distal margin with a short serrated superior

external crest while in the other species the terminal process of the male copulatory organ with distal serrated margin and a ridge of 4-5 teeth on the inner distal end.

Banner (1950) while studying the systematics of *S. maximum* found variability in the structure of male copulatory organ to such an extent that no two specimens were similar. Considering this finding, Sheard (1953) opined

that the species *S. armatum* which is also distinguished from *S. carinatum* mainly on the basis of the male copulatory organ must be treated with reserve. Brinton (1975) is also of the opinion that *S. armatum* is of uncertain validity being similar to or identical with *S. carinatum*. However, a critical study of the degree of differences between the two species has not been made by any of these authors.

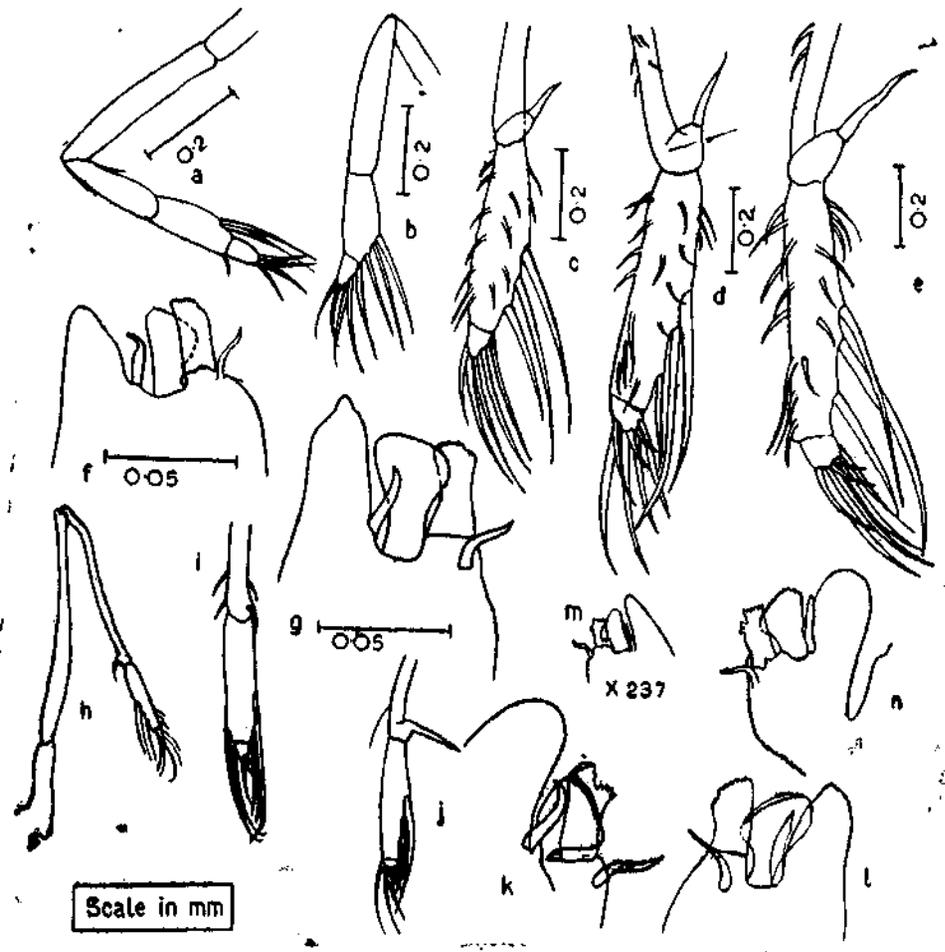


Fig. 1. The diagnostic characters of *Stylocheiron armatum* and *S. carinatum* compared. a-e, development and differentiation of third cormopod in *S. armatum* with body lengths: a. 3.30 mm, b. 3.60 mm, c. 4.50 mm, d. 5.50 mm, e. 6.75 mm. f-g, male copulatory organ of *S. armatum* with body lengths, f. 5.50 mm, g. 6.75 mm, h. 3rd cormopod of *S. carinatum* (after G.O. Sars, 1885), i. 3rd cormopod of *S. carinatum* (after Colosi, 1917), j. 3rd cormopod of *S. armatum* (after Colosi, 1917), k. male copulatory organ of *S. carinatum* (after Colosi, 1917), l. male copulatory organ of *S. armatum* (after Colosi, 1917), m. male copulatory organ of *S. carinatum* (after Hansen, 1910) and n. male copulatory organ of *S. carinatum* (after Brinton, 1975).

In the material examined by the author, there were many specimens of this controversial species obtained from the southeastern Arabian Sea belonging to various life history stages including adults. An observation on the fate of the tubercle and spine on the antepenultimate segment of the third cormopod from the very young stages revealed the following (Fig. 1). A tubercle and a spine were absent in specimens of the size of 3.6 mm and less than that. In still older specimens they were noticed as small protuberance. In the adults the tubercle and the spine were well developed and they together measured as long as half or a little longer than the penultimate segment as found by Colosi (1917) in *S. armatum* (Fig. 1). So also the terminal process of male copulatory organ did not possess a superior external crest with 3, 4, or 5 teeth which is a characteristic feature of *S. carinatum*. Since the male copulatory organ is an important aid in the separation of the euphausiid species, the remarkable differences found in them should be considered seriously. For this very reason it becomes clear that *S. armatum* is a valid species and therefore the present material is attributed to this species. Consequently the post-naupliar developmental stages described by Mathew (1972) for *S. carinatum* are to be considered to belong to *S. armatum*.

Geographic distribution of *S. armatum*

'LIGURIA' collected no specimen of *S. carinatum* from the Indian Ocean but there are records of its capture from the Pacific and the Atlantic oceans by the same vessel. To quote Hansen (1910) 'This small species (*S. carinatum*) is easily separated from other forms by the elongated pair of legs which have a high tubercle armed with a spine at the end of the penultimate joint...'. From the above statement and also from the male copulatory organ figured by him (Plate XVI, fig. 1. g-h, Rept. *SIBOGA Expdn.*) it is quite obvious that the material he examined belonged to

S. armatum. Tattersall (1924) who worked on collections made during the 'TERRA NOVA' Expedition highlighted the morphological dissimilarities observed among the populations of *S. carinatum*. Unfortunately most of the specimens did not retain the elongated legs. She had collections from both Atlantic and New Zealand areas. On examination of the male copulatory organs she found that the males agreed with *S. armatum* but such of the specimens which still retained the elongated legs had them of the form ascribed to *S. carinatum* by Colosi (1917). Hence she concluded that her material contained both *S. carinatum* and *S. armatum*. However, she did not attempt to separate the two species but considered together under *S. carinatum*. Illig (1930) has included *S. armatum* in her key for the identification of euphausiids. But she could not find any specimen of this species in the 'VALDIVIA' material collected from the Indian Ocean or the Atlantic Ocean. Torelli (1934 a) could find only *S. armatum* in material collected from the Red Sea. It was collected from Panama and Galapagos, and from Callao and Honolulu in the Pacific by the same author (1934 b). The above records show that *S. armatum* is a species extensively distributed in the tropical waters in the Indian, Pacific and Atlantic Oceans.

KEY FOR THE IDENTIFICATION OF SPECIES OF GENUS *STYLOCHEIRON*

Keys for the identification of euphausiids have been prepared by several authors and the most recent one is that given by Briton (1975). Considering the re-validation of the species *S. armatum* it is thought worthwhile to give here a revised key for the identification of the various species and 'forms' of this genus taking into consideration some new characters along with the conventional ones.

- 1 a. Elongated 3rd cormopod has on the penultimate segment; long lateral spines

- and its antepenultimate segment at its distal end with a spine on an elevated tubercle.
- 2 a. Tubercle and spine on antepenultimate segment of elonged leg together little longer than a quarter of the penultimate segment ; terminal process of male copulatory organ with distal serrated margin and a ridge of 4 or 5 teeth on the inner distal end....*S. carinatum*
- 2b. Tubercle and spine on antepenultimate segment of elongated leg together as long as half the penultimate segment ; terminal process of male copulatory organ has the serrated distal margin with a short serrated ridge on the inner distal end.....*S. armatum*
- 1b. Elongated 3rd cormopod together with spines on ultimate segment ends in a false chela with no immovable finger ; penultimate segment has spines arranged more or less terminally ; no tubercle or spine on distal end of antepenultimate segment.
- 3a. Squama of 2nd antenna almost 4 times longer than broad.
4. 6th abdominal segment 2-2.5 times longer than deep ; upper lobe of eye with 14-16 crystalline cones in distal transverse row..*S. indicum*
- 3b. Squama of 2nd antenna more than 4 times longer than broad.
- 5a. Squama of 2nd antenna 7 times longer than broad.
6. 6th abdominal segment about 1.5 times longer than deep ; upper lobe of eye with 4, rarely 5 crystalline cones in distal transverse row.... *S. insulare*
- 5b. Squama of 2nd antenna more than 7 times longer than broad.
- 7a. 6th abdominal segment more than 4 times longer than deep*S. elongatum*
- 7b. 6th abdominal segment almost twice or a little more than twice as long as deep.
- 8a. Eye large and oblong with 9-19 crystalline cones in the upper lobe in the transverse row....*S. longicorne*
- 8b. Eye small with 8 or less crystalline cones in the upper lobe in the transverse row.
- 9a. Upper lobe of eye with 4-8 crystalline cones in distal transverse row.*S. affine*
- 9b. Upper lobe of eye with 3 crystalline cones in distal transverse row.*S. submii*
- 9c. Upper lobe of eye with 2 crystalline cones in distal transverse row *S. microphthalmia*
- 1c. Elongated 3rd cormopod ends in a true chela with one immovable finger. No tubercle or spine on distal end of antepenultimate segment.
- 10a. Upper portion of eye little smaller than lower ; 6th abdominal segment about 2.4 times longer than deep.*S. maximum*
- 10b. Upper portion of eye considerably smaller than lower ; 6th abdominal segment about 1.8 times longer than deep.
- 11a. 4th and 5th abdominal segments keeled and slightly toothed dorsally.....*S. abbreviatum*
- 11b. 4th and 5th abdominal segments not keeled and toothed dorsally.*S. robustum*

KEY FOR IDENTIFICATION OF VARIOUS
'FORMS' OF *S. LONGICORNE* (AFTER
BRINTON, 1962 a, 1975)

- 1a. Size of eye comparatively larger and measures 1-1.25 mm in length.
- 2. Length of 6th abdominal segment about 1.6 times or less than deep ; 5-8 crystalline cones in distal transverse row.
.....*S. affine*
(Central 'form')
- 1b. Size of eye comparatively smaller and measures less than 1 mm in length.
- 3a. Width of lower part of eye nearly or little less than twice as the width of the upper part.
- 4a. 6th abdominal segment more than twice as long as deep ; 4-6 crystalline cones in distal transverse row.
.....*S. affine*
(California Current 'form')
- 4b. 6th abdominal segment less than twice as long as deep ; 4-6 crystalline cones in distal transverse row.
.....*S. affine*
(Western Equatorial 'form')
- 3b. Width of lower part of eye more than twice the width of the upper part.
- 5a. 6th abdominal segment more than twice as long as deep ; 4-5 crystalline

cones in distal transverse row.
.....*S. affine*
(Eastern Equatorial 'form')

- 5b. 6th abdominal segmentless than twice as long as deep ; only 4 crystalline cones in distal transverse row.....*S. affine*
(Indo-Australian 'form')

KEY FOR THE IDENTIFICATION OF
VARIOUS 'FORMS' OF *S. LONGICORNE*
(AFTER BRINTON, 1926 a, 1975)

- 1a. 6th abdominal segment almost twice as long as deep.
- 2. Upper lobe of eye rarely wider than lower lobes ; L/D of 6th abdominal segment 1.63-1.98.....*S. longicorne*
(Short 'form')
- 1b. 6th abdominal segment more than twice as long as deep.
- 3a. Upper lobe of eye often wider than lower lobe ; L/D of 6th abdominal segment 2-2.35.....*S. longicorne*
(Long 'form')
- 3b. Lower lobe of eye consistently more broader than upper lobe ; L/D of 6th abdominal segment 2.35-2.60.....
.....*S. longicorne*
(Northern Indian Ocean 'form')

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