REVISION OF THE GENUS *SERGIA* (DECAPODA: DENDROBRANCHIATA: SERGESTIDAE): TAXONOMY AND DISTRIBUTION

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ABSTRACT

Extensive Danish collections of sergestid shrimp taken during the "Dana I" (1920-22), "Dana II" (1928-30), and "Galathea" (1950-52) Expeditions have been examined. These samples comprise a total of 7,910 specimens: 4,497 females, 3,018 males and 395 juveniles. Additional material (244 specimens) from Dr. Th. Mortensen's expeditions, "Atlantide", "Tenyo-Maru", and Russian expeditions has been used to describe several additional species known from local areas; in all, over 8,150 specimens have been examined. All 28 hitherto known valid species and 6 new species of the genus (*Sergia kensleyi, S. burukovskii, S. vityazi, S. jeppeseni, S. oksanae* and *S. crosnieri*) are considered, and the taxonomic position of one species under description by another author is indicated.

The history of the genus is briefly reviewed; morphology, development, and taxonomy are considered. Keys to species groups and species within each species group are given. Five species are newly transferred to the genus *Sergia*: *Sergestes inous, S. phorcus, S. plumeus, S. challengeri,* and *S. stellatus*; and *Sergestes profundus* is newly referred to synonymy with *S. japonicus*.

The genus *Sergia* is divided into 9 species groups or isolated species: *S. tenuiremis* (only species), *S. inoa* (only species), *S. japonica* (2 species), *S. gardineri* (5 species), *S. phorca* (9 species), *S. robusta* (4 species), *S. prehensilis* (2 species), *S. challengeri* (8 species), and *S. lucens* (2 species). Each species group is diagnosed. Division is based upon structure, position and number of photophores; development of hepatic tubercle/spine; prominence of ocular papilla; articulation of first maxilliped endopod; form of posterior branchial lobe on somite XII; structure of petasma (development and armature of processus ventralis; presence of lobus inermis and lobus armatus; presence, division and twisting of lobus terminalis and lobus connectens).

All species are described in a uniform manner with special attention paid to the petasma and photophore pattern; numerous morphometric characters are given. The description of each species is provided with a synonymy, list of material, species diagnosis and remarks treating synonymy confusion and interspecific morphological affinities and differences; data on geographical distribution and a brief record of vertical range and the species' mode of life are given. Illustrations of lateral carapace view, scaphocerite, uropods, petasma, male clasping organ and distribution maps are given for each species; figures of other characters are provided if appropriate.

Dr. K. Stephensen's watercolours, made during the "Dana I" Expedition, are herein reproduced in colour for the first time. Scanning electron photomicrographs of male copulatory organs are provided for several species.

CONTENTS

INTRODUCTION

Numerous obstacles encountered when I tried to identify specimens of one of the most abundant and regularly sampled group of shrimps, the family Sergestidae, especially the genera *Sergia* and *Sergestes*, suggested that the group needed to be revised. This monograph was initially proposed by members of the Johannes Schmidt Foundation, Drs. Erik Bertelsen, Jørgen Nielsen, and Torben Wolff, as a full redescription of Burkenroad's types. A closer examination of the material has revealed the

necessity of complete examination of the "Dana" material, because the type specimens seem to have been simply picked at random from the collection; many new species and specimens of the species described by Burkenroad remained unnoticed.

Therefore, when the late Dr. Bertelsen and Dr. Nielsen suggested examining the extensive Danish "Dana" collections and Dr. Wolff, former curator of Crustacea, confirmed the possibility of such long-term studies, I was glad for the opportunity to begin this work. During several visits to the Zoological Museum, University of Copenhagen (ZMUC) over 5 years, I studied the main part of the collections and prepared this monograph, which is just about half of the total work, as revision of the genus *Sergestes*, equal to *Sergia* in size, has yet to be completed. *Sergestes* is characterised by the presence of the organs of Pesta, which have recently been shown to vary in number, shape, and position (Foxton 1972, Walters 1976).

Among dendrobranchiate shrimps, the Sergestidae remains one of the most poorly understood families. This is due to several reasons. The habitat has strongly influenced their external morphology, and such reliable taxonomic characters as spines, setae, grooves, etc., vary very little within the family. The female external copulatory organ (thelycum) shows insignificant and often uncertain variation, and dissection, preparation, and mounting of this organ for examination is a time-consuming procedure that makes the practical value of this character very low. It is the male organ (petasma) that is the only important character for the final identification of sergestid shrimps.

Many species of the genus *Sergia* are circumglobal and very often demonstrate significant geographical variation. Only a very extensive material, like that taken during the Danish circumglobal "Dana" expeditions, can provide an opportunity for successful systematic analysis. Gurney & Lebour (1940), studying *Sergestes* larvae in the Atlantic Ocean, found unidentifiable larvae that were believed to represent several unknown species. A preliminary examination of the "Dana" collections led to the following remark by Burkenroad (1940: 35): "the proportion of unnamed forms is greater than even such [an] extensive collection might have been expected to include...". This citation is from the first preliminary report on the pelagic penaeids with schematic descriptions of 21 new species without illustrations. The second, more detailed examination of the same collections presented here has resulted in the erection of several additional new species and synonymization of some described ones, because a more complete systematic analysis has become possible, and a more mature picture of the group taxonomy could be obtained.

As the genus *Sergia* Stimpson, 1860 comprises almost one half of the sergestid species, I decided to begin studies on the sergestids with this genus. The work was split into two stages: (1) studies on the morphology, systematics (with the description of new species), geographical and vertical distribution, and biology of the North Atlantic and Caribbean species based on the material collected by the "Dana I" North Atlantic Expeditions in 1920-22, and (2) studies on the world fauna of the genus *Sergia* with the emphasis on the taxonomy, systematics, and geographical distribution of the species, based on the material collected during the "Dana II" Expedition in 1928-30. Extensive data on distribution of the shrimps, obtained through the examination of pelagic collections of the "Galathea" Expedition 1950-52, are a supplement to the second part of the work. The first part of these studies has been published (Vereshchaka 1994a). A detailed analysis of the vertical distribution and biology of the genus based on the "Dana" cruises is in preparation.

The present monograph contains descriptions of the morphological characters used in the taxonomy and systematics, keys to and descriptions of the species, a description of the geographical distribution of each species, with maps, and brief remarks on the vertical range. In addition to the necessary description of several new species, redescription of all known species is done in a uniform manner with a standard set of figures including at least: lateral carapace view, antennal scale, uropod rami, petasma, and male clasping organ. This should help marine biologists to identify these shrimps quickly and reliably; redescriptions are necessary because some original descriptions are very old and do not contain the necessary information for identification. Although morphological proportions presented in the descriptions might appear too detailed, they are necessary as a replacement for quantitive characters such as number of spines, setae, etc. commonly used for other penaeids but absent in this group. Sometimes, in the description of mouthparts and appendages, they replace numerous detailed figures of the same organs, differing only

in proportions. Sergestids in the pelagic collections are usually not in good condition, but smashed and with most appendages broken. At the same time, the "Dana" material provides a unique opportunity to find those very rare undamaged specimens with all appendages present that can exemplify the complete external morphology of the species. This information (shape and articulation of maxilliped 3 and pereopods 1-3, photophore position, etc.) has been included in the descriptions; otherwise, it would either be lost or too voluminous (in the form of figures) to be represented in the monograph.

When possible, I examined and figured type specimens. In some cases this was not possible. My requests to Calcutta and some other places where certain types may have been kept since the beginning of the 20th century received no replies, or none until after the manuscript had been completed (ZSI). Some types were lost during a loan from the Zoological Museum, University of Copenhagen. When a loan was too difficult to obtain, types of some well known species were not examined as the original description was complete enough for species identification and the abundant "Dana" material agreed with the description.

In a morphologically uniform genus such as *Sergia* with only small differences between species, divergence is mainly due to the geographical isolation. Therefore, the geographical distribution of species may provide additional arguments for separation/synonymization and identification of species. In addition to the general biogeographical interest, this makes it necessary to provide as detailed information as possible on the geographical distribution, based both upon new data presented herein and information published earlier.

In spite of their planktonic mode of life, the sergestids show different relationships to the main oceanic biotopes: the pelagic, the benthopelagic, and the benthic. Although even comparatively modern publications (e.g., Judkins 1978) call them "holopelagic", the information available makes it possible to refer known species either to pelagic or to benthopelagic ecological groups of organisms. Following Marshall & Merrett (1977) and Vereshchaka (1995a), organisms dependent on the benthos at any stage of their ontogeny will be considered benthopelagic; the others, not related to the seafloor and spending all their life in the water column, will be regarded as pelagic. Vertical and geographical distribution of animals have been shown (Vereshchaka 1995a) to be reliable criteria for referring a species to either one of these groups. As vertical distribution of species is not discussed in detail here, I provide several biological remarks and arguments to characterise the species either as pelagic or benthopelagic.

MATERIALS AND METHODS

Material studied

These studies on the genus *Sergia* are mainly based upon the huge material collected during the Danish "Dana" expeditions. Collections of the "Dana I" Expedition in the North Atlantic and Caribbean Sea in 1920-22 were examined thoroughly (Vereshchaka 1994a). Re-examination of several species from the "Dana I" as well as examination of the "Dana II" round the World Expedition material have, however, made it possible to correct some errors in my previous conclusions. A station list of the "Dana I" Expedition can be found in Schmidt (1929) and Tåning (1944).

The most voluminous and essential part of the material derives from the collection taken during the "Dana II" Expedition round the World in 1928-30. This extensive material was thoroughly examined from the beginning through St. 4000. Further stations, taken in the North Atlantic and Mediterranean, were not used as they represent the North Atlantic fauna more poorly than do collections of the "Dana I" Expedition, stations of the latter covering all the temperate and tropical North Atlantic. A station list of the "Dana II" Expeditions with more detailed information can be found in the Introduction to the report from the Carlsberg Foundation's Oceanographic Expedition Round the World 1928-30 (Jespersen & Tåning 1934).

The third important collection used for the present paper is that taken during the Danish "Galathea" Expedition round the World in 1950-52. About half of the known species of *Sergia* are represented in the "Galathea" material, and information on their geographical distribution in many

cases makes it possible to extend the known areas of the species' occurrence. The "Galathea" shrimp collection was sorted totally, and all *Sergia* specimens found were examined. The list of the "Galathea" stations and more detailed information can be found in Bruun (1958). Available material of some other Danish expeditions was used, for example, that of Dr. Th. Mortensen's Pacific Expedition, and the West African "Atlantide" Expedition. Since the well known carcinologist Dr. H. J. Hansen also worked at ZMUC, the crustacean collection includes specimens collected during the "Talisman" and "Tenyo-Maru" expeditions, and this material has also been studied.

Material of Russian expeditions has been examined and published in several Russian papers (e.g., Vereshchaka 1990b, 1995b). These collections are not considered in this paper except for *S. umitakae*, which was first found in 1988 during one of the Russian expeditions and later was recorded and described by Hashizume & Omori (1995) from Japanese waters (see details in the remarks to this species). Since the Danish collections have only few specimens of this newly described species, the material of the 17th cruise of the Russian R/V "Vityaz" was examined for the redescription of *S. umitakae*. A station list and more details of this expedition can be found in Vereshchaka (1995a).

During the "Dana I" Expedition, Dr. K. Stephensen painted several watercolours showing the appearance of freshly caught sergestids. Since the colour of most species is still unknown, it was decided to reproduce Stephensen's pictures and to include them in this revision as Plates 2-3. Members of the genus *Sergia* were believed to be red; Stephensen's watercolours of *S. talismani* and *S. hansjacobi* show both species to be almost completely transparent.

In the maps of the species' geographical distribution, black symbols always refer to the "Dana I" and "Dana II" material, and similar white symbols usually correspond to other available material.

Pelagic shrimps were mainly collected by stramin nets (S 50, S 150, S 200): open, conical, 50, 150, 200 cm in diameter at the opening, respectively. Some were caught by a ring trawl (E 300), an open, conical net, 300 cm in diameter at the opening; in the upper third of the length, meshes of the net, from knot to knot, are 24 mm; in the middle part 18 mm; and in the lowest third only 12 mm. Duration of hauls usually ranged from 60-90 min at 50-300 m to 120-180 min below 300 m of actual depth.

In order to estimate the vertical range of each species, the total meters of wire out was divided by 3, as was generally accepted by those participating in the "Dana" expeditions. In most cases when various stramin nets were used, the actual depth is generally close to 1/3 of the length of wire paid out. If a ring trawl was attached to the bottom end, the reduction may be closer to 1/2. Some errors may also be caused by catching a few additional specimens while retrieving the net. However, possible deviations from actual vertical ranges should not be so much as to be misleading in estimation of the depths of occurrence of the animals. More detailed information and data on the vertical distribution will appear elsewhere (Vereshchaka, in prep.).

In the description of the material of each species, the following format is used (all lengths are in mm):

Expedition: station number - sample number (number of females, range of Cp length (mm); number of males, range of Cp length; number of juveniles, range of Cp length). For example:

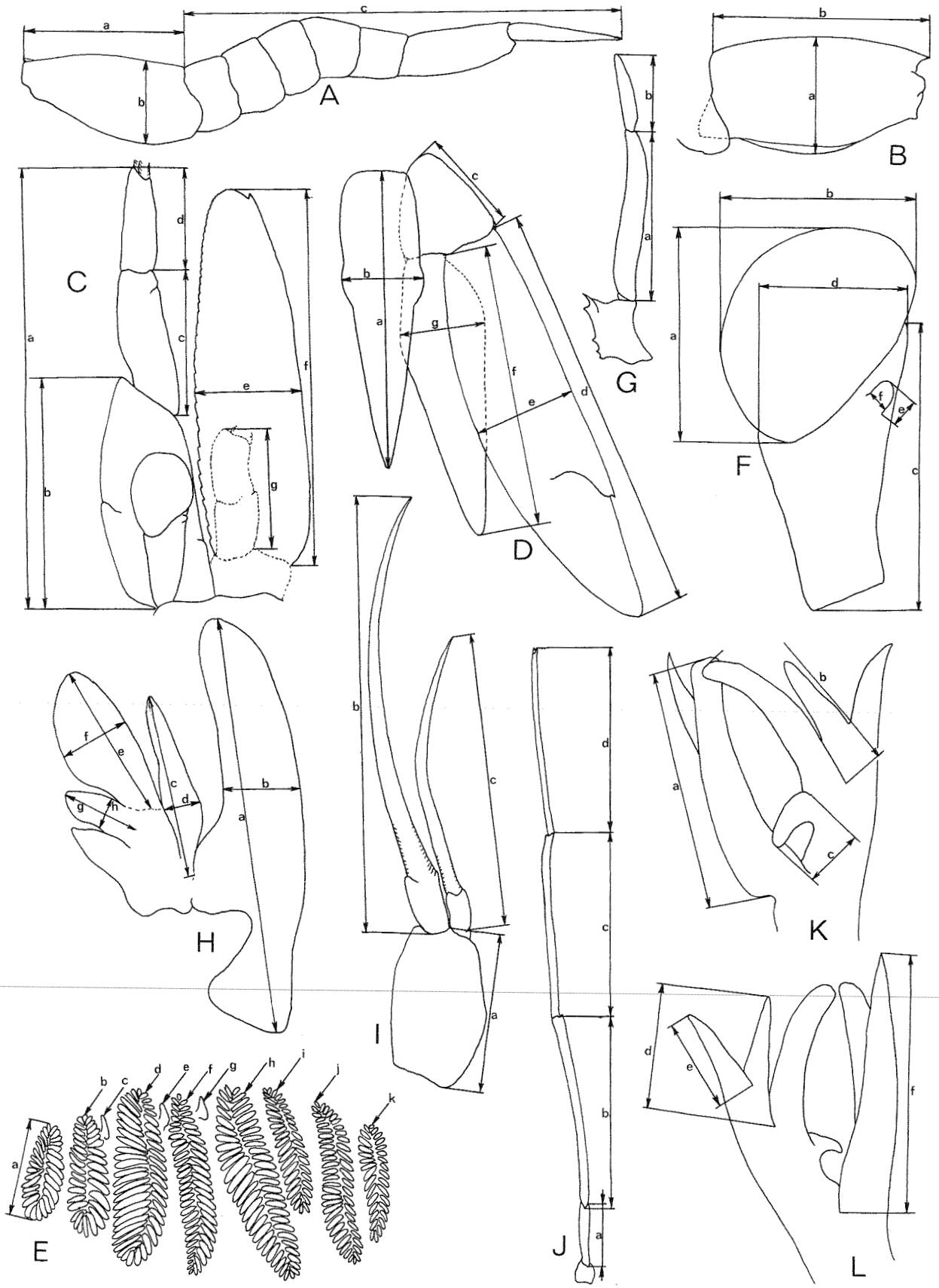
"Dana" station: 1142-2 (3f 6½-8, 4m 7-9 & 1j 2½).

If one or two groups (f, m, or j, see below) are not found, the format will be incomplete.

Abbreviations

The following abbreviations are used throughout the text and in figure texts:

A I – antenna I (Antennula)
A II – antenna II
BMNH – British Museum (Natural History), abbreviation for catalogue numbers at NHM
Cp – carapace
f – female(s)
j – juvenile(s)
LA – lobus armatus
LAc – lobus accessorius
LC – lobus connectens
LI – lobus inermis
LT – lobus terminalis
m – male(s)
MCZ – Museum of Comparative Zoology, Harvard
Md – mandible


A
B
C
D
E
F
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J
K
L

MNHN – Museum National d'Histoire Naturelle, Paris
mw – meters wire out
Mx I – maxilla I (Maxillula)
Mx II – maxilla II
Mxp I-III – maxillipeds I-III
NHM – Natural History Museum, London (formerly BMNH)
NMNH – National Museum of Natural History, Washington, D.C. (formerly USNM)
NSMT – National Science Museum, Tokyo
P I-V – pereopods I-V
Pl I-V – pleopods I-V
PU – processus uncifer
PV – processus ventralis
Up – uropods
USNM – United Stated National Museum, abbreviation for catalogue numbers at NMNH
ZMB – Zoologisches Museum, Berlin (Museum für Naturkunde, Humboldt Universität)
ZMUB – Zoological Museum, University of Bergen (ZMBN for catalog numbers)
ZMUC – Zoological Museum, University of Copenhagen
ZSI – Zoological Survey of India, New Alipore, Calcutta (contains many collections earlier in the Indian Museum)

Measurements

Fig. 1

All measurements were taken with an ocular micrometer. Parts measured are shown in Fig. 1. The narrow triangular telson with paired dorsal movable spines shows no morphological variation within the genus.

All measurements were made on three typical specimens of each species (where available, including holotypes and paratypes). Variation was low and did not usually exceed 7% of mean values; only averages have been used in descriptions and taxonomic analyses. Some presented values may disagree slightly with measurements obtained from figures; this is because of the 3-dimensional position of morphological structures and the deviation between the presented average values and certain figured individuals.

All observations, measurements, and figures were made using Wild compound or stereo dissection microscopes with drawing apparatus, magnification ranging from 6 to 500.

Fig. 1. Explanation of measurements. - A, **carapace and abdomen**: *Cp length* (a) = posterior margin of ocular sinus to dorsoposterior margin of carapace, measured dorsally; *Cp height* (b) = maximal Cp height in lateral view, usually at about 2/3 length of carapace; *abdomen length* (c) = from anterior margin of somite I to posterior margin of telson. - B, **abdominal somite VI**: *height* (a) = maximal height in lateral view; *length* (b) = shortest distance between anterior and posterior dorsal margins. - C, **anterior part of body** (eye removed on right side): *total length of A I peduncle* (a) = measured in lateral view; *maximal length of its segments* (b, c, d) = measured in lateral view; *scaphocerite width* (e) and *length* (f) = measured in dorsal aspect from base to distal point of blade, distolateral tooth not included; *length of A II peduncle* (g) = measured in lateral view. - D, **tail fan**: *telson length* (a) = measured along dorsal midline; *telson width* (b) = maximal width, usually at about 1/5 length of telson; *Up basipod length* (c) = measured in lateral view; *Up exopod length* (d) and *maximal width* (e) = measured in lateral view; *Up endopod length* (f) and *width* (g) = measured in lateral view. - E, **branchial chamber**: *length of arthrobranch on somite VIII* (a) = measured in straightened position along dorso-ventral axis; *length of pleurobranchs on somites IX* (b, c), *X* (d, e), *XI* (f, g), *XII* (h, i), and *XIII* (j, k) = measured as arthrobranch. - F, **eye**: *corneal length* (a) and *width* (b) = measured in lateral view; *eyestalk length* (c) and *width* (d) = measured in lateral view; *papilla length* (e) and *width* (f) = measured in dorsolateral view. - G, **mandible**: *length of segments 1* (a) and *2* (b) = measured along lateral sides in ventral view. - H, **maxilla II** (measurements on Mx I and Mxp I are similar): *exopod length* (a)= measured along medial side and *width* (b) = maximal width in ventral view, at about 1/4 length; *palp length* (c) = measured along lateral side and *width* (d) = measured at base; *endopod length* (e) = measured along longitudinal axis, from basal suture to tip, and *width* (f) = maximal width, at about 1/2 length; *endite length* (g) = average of lengths of two endites measured along their longitudinal axes and *width* (h) = average width of their bases. - I, **pleopod**: *lengths of basipod* (a) and *exopod* (b) = measured in straightened position, along lateral sides; *length of endopod* (c) = measured along medial sides. - J, **pereopod III** (measurements on Mxp II-III and other pereopods are similar): *maximal lengths of ischium* (a), *merus* (b), *carpus* (c), and *dactyl* (d) = measured in lateral view. - K-L, **dorsal and ventral views of petasma** (exemplified by *S. bisulcata*): *LA* (a) *lobules of LC* (b, c), *LT* (d), *LI* (e), *PV* (f).

HISTORY OF THE GENUS *SERGIA*

The first sergestid species was described by H. Milne-Edwards (1830), who established the new genus *Sergestes* for a single new species, *Sergestes atlanticus*. Krøyer published descriptions of 15 new species, first as preliminary short diagnoses of 11 species without figures (1855), and later of the first 11 plus 4 more, all 15 in full (1856, 1859); three of these were later shown (Hansen 1896) not to belong to *Sergestes*. Stimpson (1860) briefly described 5 new species and erected a new genus, *Sergia,* for one of them. Until recently, most sergestid researchers, including Bate and Hansen, considered *Sergestes* plus *Sergia* as a single genus *Sergestes* sensu lato. Bate (1881) published preliminary descriptions of 4 new species of *Sergestes*, and later (1888) described 31 species of *Sergestes* sensu lato, 24 of which were new to science, from the "Challenger" collection; the others were considered to be the ones described by Milne-Edwards and Krøyer. However, of all these species only 6 were really mature forms, 25 being larvae.

In addition to these huge contributions to the knowledge of *Sergestes*, several minor works were published (e.g., Smith 1881, 1882, 1886; Ortmann 1893; Adensamer 1898; Alcock 1901), some with descriptions of a few new species. Regrettably, most of these descriptions were far from satisfactory; the main reliable character for distinguishing the species within the group, the male copulatory organ, the petasma, was often ignored. When researchers described mature males, which happened very rarely, the drawings of the petasma were not satisfactory for comparing the species with certainty. Thus, by the end of the 19th century, within *Sergia* and *Sergestes,* 59 species had been established, 7 of which had been referred to other genera (not always with good reason!) by various authors.

It is therefore not surprising that until Hansen's papers (1896, 1903) one could find nothing but complete disorder in the systematics of *Sergestes* sensu lato. It was Hansen's efforts that made it possible to obtain a much clearer impression of the real taxonomic situation within the genera. Having examined all Krøyer's type specimens in ZMUC and several other types, Hansen (1896: 936) pointed out that "of the 59 (or 60) hitherto described species only about 20, or one-third of the total number, have been established on adult animals, such as have almost or entirely arrived at sexual maturity; and that almost all the other species are true larvae, and even of these a considerable portion are larval stages of species already established on adult specimens".

During the first three decades of this century, Hansen (1919, 1920, 1922, 1925, 1927) continued to accumulate and scrutinise knowledge on sergestid taxonomy. At the same time, several descriptions appeared that each contained the description of 1 (rarely 2) new species. Within this period, three important monographs provided great insight on three regional sergestid faunas: Hansen (1919), on Indo-West Pacific sergestids; Hansen (1922), on North Atlantic sergestids; and Illig (1927), on Indian Ocean sergestids.

It is during this period that two Danish expeditions, "Dana I" and "Dana II", took place, first in the North Atlantic (1920-22), and later round the world (1928-1930). The exhaustive material from these expeditions was sorted and studied for several years afterwards, and in 1940, M. Burkenroad published very brief preliminary descriptions of 21 new sergestid species, without any figures. This did not improve the situation, because ever since even expert carcinologists have published descriptions of new species that were already described by Burkenroad. The situation became even more awful when several of Burkenroad's holotypes were lost (in transit) during loans of material from the Copenhagen Museum.

In the last half of the 20th century, descriptions of new species of *Sergestes* sensu lato became very rare. Instead, detailed papers on the biology of selected species (Omori 1969) and on general sergestid taxonomy (Yaldwyn 1957, Omori 1974) appeared. Records of the regional sergestid fauna were made for the waters around South Africa (Kensley 1971), the North Pacific (Krygier & Wasmer 1988), and the North Atlantic (Vereshchaka 1994a).

Over the years, the status of *Sergestes* and *Sergia* has changed. Since *Sergestes* Milne-Edwards, 1830 and *Sergia* Stimpson, 1860 were established, some carcinologists (e.g., Ortmann 1893) have supported the generic status of *Sergia*. However, later Hansen (1896: 938) pointed out that *Sergia* "should be cancelled as being of no value at all". Indeed, the characters used by Stimpson (1860) are not of generic value. However, Stimpson's type species of the

genus *(Sergia tenuiremis)* was the first in a group of species, morphologically different from the others, that made the genus valid. The great authority of Dr. Hansen supported keeping all members of *Sergestes* sensu lato within one genus for a long time. The concept of the single genus was gradually broken. Burkenroad (1940) and, especially, Yaldwyn (1957) were the first who noticed several characters that distinguished two groups within *Sergestes* (presence and character of photophores, organ of Pesta) and proposed division of the enormous genus *Sergestes* sensu lato into 2 subgenera: *Sergestes* sensu stricto and *Sergia*.

Another argument for keeping the two groups separate was given by Gurney & Lebour (1940), who studied the ontogeny of Atlantic sergestids. The most interesting feature in the development of *Sergestes* sensu lato is the striking difference which exists between the larvae of the different species, while the adults are often separable only with difficulty (see next chapter). These divergences at earlier developmental stages indicated heterogeneity of the group, similar adult stages being the result of convergence due to the planktonic mode of life.

In his monograph on the pelagic shrimps, Omori (1974) once again reviewed the ontogenetic and morphological differences between Yaldwyn's subgenera *Sergestes* and *Sergia* and believed them to be of generic significance. Since Omori raised their taxonomic status, most recent authors have supported the separation of the two genera.

During the last years, combined efforts have been made to understand the faunistic composition and morphology of the Dendrobranchiata as a whole. One of the best examples is the book by Pérez-Farfante & Kensley (1997), who consider the family Sergestidae within the superfamily Sergestoidea and provide keys and diagnoses to the families and genera of penaeoid and sergestoid shrimps and prawns of the world.

DEVELOPMENT

Our knowledge of sergestid development is very restricted by the enormous practical difficulties of keeping pelagic animals alive under the laboratory conditions. Only few observations have been made on the development of selected sergestid species in the laboratory: Nakazawa (1916), Gurney & Lebour (1940), Gurney (1942), Omori (1969, 1971), Knight & Omori (1982), and Mallo (1986). Development as reflected by changes in measurements of the prebuccal somite was studied by Alvarez (1988), and development and/or life cycles based on plankton collections has been reported by Mallo & Boschi (1982), Omori & Jo (1989), and Oshiro & Omori (1996).

The period between spawning and hatching seems to be rather short, about 30 hours in *Sergia lucens* under natural conditions (Omori 1971). The larva hatches as a nauplius with 3 pairs of limbs: A I, A II, and Md.

The next stage, elaphocaris (protozoea), possesses functional mouthparts and a carapace not fused with the thorax; paired eyes are present at the 1st elaphocaris instar, although probably not functional; at the 2nd instar, the abdomen becomes segmented, and the Md has lost its natatory function. Larvae swim by means of A I, biramous A II, and the exopods of Mxp I-II, usually head upward and forward.

The next stage, the acanthosoma (zoea), has pereopods well developed and pleopods rudimentary or missing. Larvae swim by means of Mxp III and some of P, usually ventral side up, abdomen first.

The next stage, the mastigopus (megalopa or post-larval stage), has all the appendages developed, slightly resembling adults. Post-larvae usually swim by means of pleopods.

There are 3 elaphocaris instars; the number of other instars seems to vary depending on the species. Moulting probably occurs each few days (e.g., *S. lucens*, from 4 to 6 days (Omori 1971)).

The elaphocaris at instars 2-3 may be divided into 3 distinct types called *S. dohrni*, *S. ortmanni*, and *S. hispida* types (Gurney 1924). Their carapaces bear the same number of processes, differing in the form and position (Gurney & Lebour 1940):

S. dohrni type: Supraorbital, lateral and posterior processes with numerous long lateral spines. This type is characteristic for several groups of the genus *Sergestes* sensu stricto.

S. ortmanni type: Lateral and posterior processes without lateral spines, but with long spines attached to the carapace at the bases of the processes. This type is characteristic for the *Sergestes corniculum* species group (see Yaldwyn 1957) of the genus *Sergestes* sensu stricto.

S. hispida type: Lateral and posterior processes without long spines, sometimes with long spinules at the base. This type is characteristic for the genus *Sergia*.

The *S. ortmanni* type seems to be a derivative of the *S. dohrni* type rather than of the *S. hispida* type, since the postorbital processes have long spines as in the former type (Gurney & Lebour 1940).

Observed divergence in the morphology of the larvae provides evidence for divergence within *Sergestes* sensu lato. Developmental patterns as well as dermal photophores and the absence of the organ of Pesta were some of the main arguments for the last division of this artificial taxon by Omori (1974). Other evidence is related to the hypertrophied (relative to other genera of sergestids) ovaries that in mature females extend to the pleon: This character has never been observed in the genus *Sergestes* sensu stricto.

TAXONOMY

Summary of the sergestid genera

The family Sergestidae consists of 7 genera: *Lucifer* Thompson, 1830 in the subfamily Luciferinae Bate, 1888 and *Acetes* Milne-Edwards, 1830, *Peisos* Burkenroad, 1845, *Petalidium* Bate, 1881, *Sergestes* Milne-Edwards, 1830, *Sergia* Stimpson, 1860 and *Sicyonella* Borradaile, 1910 in the subfamily Sergestinae. Within the Dendrobranchiata, the Sergestidae are generally characterised by the (1) laterally compressed body, (2) reduction of chelae, and (3) reduction of 2 posterior pereopods that are natatory if present.

The genus *Lucifer* comprises very aberrant shrimps with rudimentary chelae present only on P III, without a male clasping organ or any trace of branchs, with specialised male ventral processes on abdominal somite VI and the telson, and with other minor peculiar characters. This genus is usually positioned alone within the subfamily Luciferinae. Among the rest of the genera, *Sicyonella* is closer to the common sergestid root: (1) all chelae on P I-III well developed; (2) P IV-V, although natatory, 7-segmented and long; (3) branchiae voluminous on somite XIII.

Very closely related to each other, the genera *Acetes* and *Peisos* include nearshore and estuarine species which are very rare in planktonic collections offshore. Members of these genera have either completely lost the natatory pereopods (*Acetes*) or these are very strongly reduced to a non-functional state (*Peisos*). Gills are present; chelae, although rudimentary, are found in P I-III.

Another group includes mainly pelagic genera, occurring offshore: *Petalidium, Sergestes*, and *Sergia*. In these genera, natatory P IV-V, although lacking segment 7, are paddle-like, long, and functional. Two other characters, in contrast to the condition in the *Acetes-Peisos* group, are the more reduced chelae on P II-III and their absence on P I. Branchiae are present on somite XIII (somewhat rudimentary in *Petalidium*), the clasping organ is well developed, and the petasma is the most complicated in the family (and probably among all shrimps), with several lobes and processes. In *Sergestes* sensu stricto a specialised luminescent organ in the form of a modified gland (organ of Pesta) appears, while in most species of *Sergia*, dermal photophores are present.

Affinities and differences between *Sergia* and all other known sergestid genera are shown in Table 1.

Synonymy and diagnosis

Genus *Sergia* Stimpson, 1860

Sergestes. – Krøyer 1855 (part): 22; 1856 (part): 3; 1859 (part): 219 [not Milne Edwards, 1830]. – Bate 1881: 193; 1888: 387. – Smith 1881: 445; 1882: 97; 1884: 416; 1886: 93. – Wood-Mason *in* Wood-Mason & Alcock 1891a: 190; 1891b: 353. – Faxon 1893: 216; 1895: 163. – Ortmann 1893: 114. – Hansen 1896: 947; 1903: 56; 1908: 83; 1919: 5; 1920: 478; 1922: 38; 1925: 23; 1927: 2. – Adensamer 1898: 626. – Riggio 1900: 20. – Alcock 1901: 49. – Lo Bianco 1903: 181. – Stebbing 1905: 87; 1910: 318. – Kemp 1910a: 25; 1910b: 640; 1913: 55. – Pesta 1913a: 64; 1913b: 405; 1914: 195; 1915: 120; 1916: 227. – Balss 1914: 17. – Illig 1914: 349; 1927: 283. – Nakazawa 1915: 1; 1932a: 31; 1932b: 32; 1933: 365. – Nakazawa & Terao 1915: 622. – Terao 1916: 220; 1917: 299. – Sund 1920: 7. – Gurney 1924: 94. – Cecchini 1928: 34. – Boone 1930: 121. – Miranda 1933: 5. – Yokoya 1933: 12. – Gordon 1935: 308; 1939: 498. – Okada

Table 1. Affinities and differences between *Sergia* and all other known sergestid genera. NA = not applicable, + = present, – = absent.

Genera	Male clasping organ	Chelae on P I	Chelae on P II	Chelae on P III	Functional P IV-V	No of segments in functional P IV-V	Branchs on somites VII-XIII	Complex petasma	Bifid PV of petasma	Male PV on abdominal somite V and telson	Organ of Pesta
Acetes	+	+	+	+	–	NA	+	–	–	–	–
Lucifer	–	–	–	+	–	NA	–	–	–	+	–
Peisos	+	+	+	+	–	NA	+	–	–	–	–
Petalidium	+	–	+	+	+	6	+	+	+	–	–
Sergestes	+	–	+	+	+	6	+	+	–	–	+
Sergia	+	–	+	+	+	6	+	+	–	–	–
Sicyonella	+	+	+	+	+	7	+	+	–	–	–

1935: 699. – Zariquiey y Cenarro 1935: 94. – Burkenroad 1937: 323; 1940: 43. – Welsh & Chace 1938: 367. – Gurney & Lebour 1940: 21. – Legendre 1940: 224, fig. 39. – Gurney 1942: 188. – Zariquiey Alvarez 1946: 57; 1956: 407; 1968: 61. – Barnard 1946: 384; 1950: 641. – Holthuis 1952b: 87. – Dieuzeide 1955: 20. – Dennell 1955: 400. – Springer & Bullis 1956: 134. – Kurian 1956: 23. – Dieuzeide & Roland 1958: 59. – Holthuis & Gottlieb 1958: 111. – Richardson & Yaldwyn 1958: 26. – Huzita 1959: 235. – Kubo 1960: 113; 1965: 595. – Bacescu & Mayer 1961: 192. – Maurin 1963: 2; 1968: 480. – Allen 1967: 33. – Aizawa 1969: 60. – Okutani 1969: 16. – Omori 1969: 1. – Lagardère 1970: 1027; 1972: 661. – Foxton 1970: 974. – Ribeiro 1970: 6. – Vilela 1970: 122. – Sakai & Nakano 1985: 26.

Sergia Stimpson, 1860: 46 [p. 115 in reprint]. – Ortmann 1893: 37. – Caullery 1896: 371. – Kemp 1906: 7. – Pearcy & Forss 1966: 1137. – Omori 1974: 236. – Walters 1976: 816. – Butler 1980: 49. – Kensley 1981: 64. – Krygier & Pearcy 1981: 97. – Krygier & Wasmer 1988: 50. – Vereshchaka 1994a: 73; 1995a: 1650. – Hashizume & Omori 1995: 72.

Subgenus *Sergia* Yaldwyn, 1957: 9. – Foxton 1970: 976. – Kensley 1971: 247; 1972: 30; 1977: 18. – Crosnier & Forest 1973: 307. – Donaldson 1975: 45. – Lagardère 1978: 7. – Vereshchaka 1990b: 138.

Diagnosis: Carapace and abdomen smooth, rostrum as small protrusion of carapace; inner flagellum of A I transformed into male clasping organ; Mxp I with 3 or 4-segmented endopod; Mxp III 7-segmented, propodus and dactylus subdivided into several subsegments; P I 6-segmented, lacking dactylus, with propodus subdivided (in many species incompletely) into numerous subsegments; distal part of carpus and proximal part of propodus with strong, curved setae on the flexor margin, forming sort of subchela instead of true chela; P II-III progressively increasing in length, 7-segmented, with propodus subdivided into several subsegment; P IV-V progressively decreasing in length, flat, 6-segmented, lacking dactyli, with all segments setose except anterior margins of carpus and propodus of P IV; ovaries extending into pleon; petasma symmetrical, consisting of 3 parts: pars astrigens, pars media, and pars externa; organ of Pesta absent, dermal photophores usually present.

Generic morphology

Sergia is characterised by a smooth carapace with a small rostrum having a rounded, acute, or bifid tip. The form of the rostrum in many species varies in shape not only within one species but also within a single sample (Vereshchaka 1994a) and is of much less taxonomic value than was believed earlier (e.g., Kensley 1971). The abdomen is smooth, with or without a postdorsal terminal spine on somite VI. The pleurae are not serrated.

Eyes have the cornea pigmented, brown or black, with the eyestalk usually bearing a distolateral papilla. Antenna I has a 3-jointed peduncle, with a statocyst in the proximal part of the basal segment. The outer flagellum is long and slender; the inner flagellum is sexually dimorphic. Females have the inner flagellum simple and slender; in males the flagellum is transformed into a clasping organ (Fig. 2B): segment 3 usually has a finger-like distoventral protrusion usually bearing a terminal tubercle; segments 4 and 5 are elongated and swollen on their

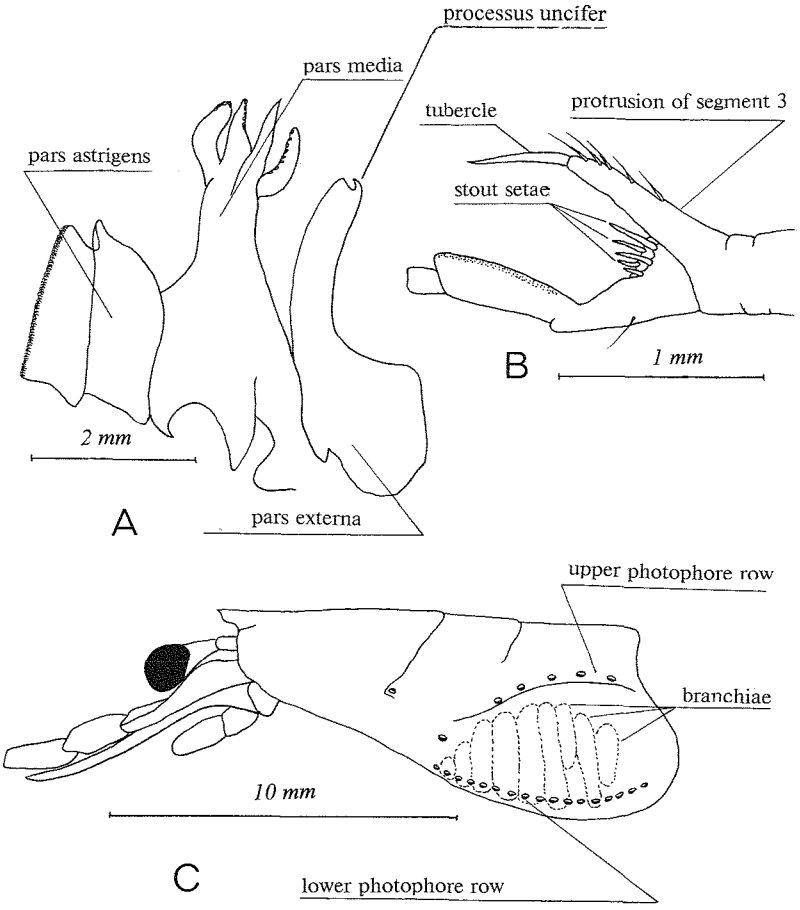


Fig. 2. Illustrations of selected characters in *Sergia*. – A, total petasma exemplified by *Sergia splendens*, male, "Dana" St. 1217-4, Cp length 7.3 mm. – B, outer male flagellum (clasping organ) exemplified by *Sergia bisulcata*, male, "Dana" St. 3683-2, Cp length 23.6 mm. – C, photophore position on Cp exemplified by *Sergia prehensilis*, male, "Dana" St. 3664-1, Cp length 11.4 mm.

outer margin; one or more serrated bristles, and a few setae are usually present on the dorsal side of segment 4. Male clasping organs are present in (and figured for) all studied species. The scaphocerite is lanceolate, usually with a distolateral tooth, with anterior and inner margins entirely serrate. Proximal muscles of the scaphocerite are distinctive and vary in shape. Dorsal views of scaphocerite with proximal muscles are given for all studied species.

Mandibles have the pars molaris well developed, wide and powerful, the right one with 2 teeth on the outer margin, the left one with a single tooth at the same position. The mandibular palp is 2-segmented. Maxilla I has a 1-segmented palp, an endopod, and an endite, with the palp bearing 1 stronger stout spine near the apex. Maxilla II has a well developed exopod (scaphognathite) bearing a rounded anterior and subtriangular posterior lobes, a 1-segmented palp with numerous small spines near the end, an endopod, and 2 subequal endites.

Maxilliped I has a long, wide and flat endite, with a 3- or 4-segmented endopod, a 1-segmented flattened exopod, and an epipod; the basal segment of the endopod has several stout spines on the distomedial margin. Maxilliped II is 7-segmented and flexed, with each segment thickly covered with setae. Maxilliped III is 7-segmented, straight, long and slender; each segment is setose along both inner and outer margins; the propodus and dactylus are subdivided into several subsegments, with articulations sometimes more or less incomplete. Hansen (1920), Kensley (1971) and some other authors found no subsegments in *S. splendens* Sund, 1920 (= *S. crassus* Hansen, 1922). After examination of glycerine-preserved appendages of this species, I did find dactyli and propodi subdivided, although this subdivision is sometimes difficult to see.

Pereopod I is 6-segmented, lacking a dactylus, with the propodus subdivided (in many species incompletely) into numerous subsegments; the distal part of the carpus and proximal part of the propodus bear strong curved setae on the flexor margin, forming sort of a subchela instead of a true chela, which is absent. Pereopods II-III progres-

Table 2. Types and distribution of branchiae in *Sergia*. + = present, – = absent.

Appendages	Epipods	Arthro-branchs	Pleurobranch, anterior lobe	Pleurobranch, posterior lobe
Mxp I	lamellar	–	–	–
Mxp II	lamellar	+	lamellar	–
Mxp III	–	–	+	lamellar
P I	–	–	+	lamellar
P II	–	–	+	lamellar
P III	–	–	+	+ (sometimes lamellar)
P IV	–	–	+	+
P V	–	–	–	–

sively increase in length and are 7-segmented, with the propodus subdivided into several subsegments, although articulations sometimes are incomplete and barely visible; the distal part of the dactylus and propodus bear tufts of setae partly hiding the proper chelae. Pereopods IV-V progressively decrease in length; they are flat, 6-segmented, and lack dactyli, with all segments setose except the anterior margins of the carpus and propodus of pereopod IV.

No proper thelycum is present in females, but sternites between pereopods III and IV as well as coxae of pereopods III are somewhat modified as sperm receptacles. Since these receptacles are very similar within the genus and not very helpful in taxonomy, they are not considered further.

The types and distribution of branchiae are given in Table 2.

Pleopods I are without an endopod in females and have the endopod transformed into a copulatory organ (petasma) in males. The appendix interna on pereopods II is simple, 1-segmented, and armed with strong setae; as it is of little taxonomic value, this appendix is not considered further. Pleopods II-V have long exopods and short endopods.

The petasma is a symmetrical, very complicated, taxonomically important organ, which is the most reliable character for specific identification. The petasma consists of 3 parts (Fig. 2A): pars astrigens (innermost), pars media, and pars externa (with processus uncifer). The pars media, used in taxonomy, is divided into processes and lobes bearing various hooks and suckers; the form and proportions of these are very important. The complete set of lobes and processes is as follows (in mesio-lateral direction, indicated in figures for each species, see for example Fig. 4): (1) processus uncifer with terminal hook-like protrusion, (2) processus ventralis, (3) lobus armatus, (4) lobus accessorius, (5) lobus connectens, (6) lobus terminalis, and (7) lobus inermis.

The uropodal exopod overlaps the endopod, and has a distinct suture; both rami are longer than the telson. The outer margin of the exopod is ciliated along the distal part.

The presence of dermal photophores is the unique character distinguishing most species of *Sergia*. In few species photophores are lost (or have not been yet found); in all others they are present either in the form of lens-less "opaque spots" or well defined, lens-bearing, luminescent organs. The lens-less type is difficult to study in alcohol-preserved specimens. Specimens from the "Dana" expeditions have been preserved in alcohol for 65-75 years, and any study of these organs is extremely difficult; in order to avoid any misleading information, the position of "opaque spots" is discussed only for two locations: the scaphocerite and uropods. These appendages are very flat and make it possible to register the photophores reliably; in addition, the photophore position at these locations appears to be an important diagnostic character and is illustrated for each photophore-bearing species. Photophores with lenses are much easier to find; their position on the scaphocerite and uropod is illustrated for each species, and their number on the body and appendages is indicated. However, different authors have reported different number and position of luminescent organs even in *Sergia lucens*, which occurs in a restricted geographical area: for example, Nakazawa & Terao (1915) reported 6 photophores on the sternite between the bases of pereopods V and a single pair of organs on the sternite of abdominal somite VI, while Omori (1969) found 4 and 3 organs, respectively. Gordon (1935) found 42 photophores on the ventral surface of the abdomen, but Omori (1969) counted only 33 organs. Therefore, recording body (not scaphocerite or uropodal) photophores in the "Dana" specimens, preserved in alcohol for about 70 years, might not be very certain either.

Generic taxonomy

Yaldwyn (1957) proposed division of *Sergia* into 3 species groups according to the presence/absence of photophores and their type. First examination of the extensive "Dana" and "Galathea" collections revealed that this character, although usually help-

Table 3. Basic taxonomic characters of isolated species and species groups of *Sergia*. as = acute spine, bs = blunt spine, l = length, NA = not applicable, t = tubercle, w = width, + = present, – = absent.

Characters	Isolated species		Species groups						
	S. tenuiremis	*S. inoa*	*S. japonica*	*S. gardineri*	*S. phorca*	*S. robusta*	*S. prehensilis*	*S. challengeri*	*S. lucens*
Photophores	–	–	–	+	+[1]	+	+	+	+
Lens on photophores	NA	NA	NA	–	–	–	+	+	+
Photophore arrangement (see text)	NA	NA	NA	1	3	2	1a	2a	3a
Hepatic prominence	–	–	–	t	t	t	t/bs	as/bs[2]	bs
Ratio l/w in ocular papilla	>1	<1/4	<1/4	1/2-3/4	1/4-1/3	1/4-1/3	–	–	–
No of segments Mxp I endopod	3	3	4	3	3	3	3	3	3
Lamellar branch on somite XII	–	–	+	–	–	–	–	–	–
PV enlarged, armed	–	–	–	–	–	–	–	–	+
LI and LT both present	+	+	+	–	+	+	+	+	–
LT divided	–	–	–	–	–[3]	–	–	+[4]	–
LT and LC twisted	–	–	–	–	–	+	–	–	–
LC divided	–	–	–	–[5]	+	–	–[6]	–	–
LA present	+	+	+	+	+	+	+	–	–

[1]Photophores invisible in *S. plumea* and barely visible in *S. wolffi*.
[2]Hepatic spine acute in *S. challengeri, S. talismani, S. fulgens, S. oksanae* n. sp.
[3]LT secondarily divided in *S. potens*.
[4]LT undivided, without proximal lobule in *S. umitakae*.
[5]LC divided in *S. gardineri* and *S. inequalis* only.
[6]LC divided in *S. prehensilis*.

ful, may sometimes be misleading. For example, *S. plumea*, which in other characters is close to the photophore-bearing species (especially in the complicated form of the petasma, which is hardly convergent), does not possess visible photophores. At the same time, *S. prehensilis* with advanced lens-bearing photophores looks closer to *S. regalis* with "opaque spots" (with respect to the number and position of luminescent organs) than to *S. lucens* with lens-bearing photophores.

I tried to find characters of taxonomic value for subdivision of the genus. Most external characters were examined, including not only those usually treated (petasma, photophores), but also the division of mouthparts, subdivision of appendage segments, and proportions of the branchiae and pleopods. Among them, I found the following characters most useful in the taxonomy of *Sergia* (summarized in Table 3):

1. Photophores. Organs of the "opaque spot" type almost disappear in specimens preserved in alcohol for a long period and should be be considered carefully. As a rule, they can be observed with certainty only on the scaphocerite and Up rami. Only lens-bearing photophores provide a possibility for discussing their position in other body parts; since these organs are pale in alcohol and may be very small, their number and position also should be observed very carefully. There are 3 general types of arrangement of "opaque spot" photophores:

- Small organs, in a single longitudinal medial row on the scaphocerite and a single row very close to the inner margin on the Up exopod (see Fig. 18B, C)
- Large organs, in a single longitudinal medial row on the scaphocerite and 1-2 medial rows on the Up exopod (see Fig. 52B, C)

- Large organs, in a single longitudinal medial row and a single oblique row on the scaphocerite and 1-2 medial rows on the Up exopod (see Fig. 27B, C).

  Among the lens-bearing photophores, 3 basic types of arrangement may also be found:
- Very abundant (225-359) organs varying in number and position
- Moderately abundant (within very strict range 193-209) organs with fixed position and number (sometimes revealing slight sexual dimorphism in both features)
- Less abundant (within very strict range 138-162) organs with fixed position and number (sometimes revealing slight sexual dimorphism in both features). The first type is associated with the presence of 2 lateral rows of luminescent organs on Cp; the 2nd type refers to 4-6 organs in the lateral Cp row, 2-3 organs on the scaphocerite, and 4-6 organs on the Up exopod; the 3rd type is associated with 2-3 organs in the Cp row, 2-3 organs on the scaphocerite, and 1-2 organs on Up. Thus, the following photophore features are used in the taxonomy of *Sergia*: presence /absence of photophores, structure of organs (with or without lens), abundance, arrangement, and position of organs (one of 3 described for each type).

2. Prominence on the hepatic region. The hepatic region may lack an obvious prominence or have a hepatic tubercle or a blunt or acute hepatic spine.
3. Ocular papilla. This organ varies greatly during development (longer in larvae and reduced in adults) and is described only in adults. The papilla, although rarely treated in species description by other authors, is of taxonomic value. There are 5 stages in the reduction of this organ: (a) papilla longer than wide; (b) papilla about 1/2-3/4 as long as wide; (c) papilla 1/4-1/3 as long as wide; (d) papilla <1/4 as long as wide; (e) papilla absent.
4. Articulation of the Mxp I endopod. This character has never before been considered. The endopod may be either 3-segmented or 4-segmented.
5. Posterior branchial lobe on somite XII. It may be either lamellar or of usual "dendrobranch" type.
6. Structure of the petasma. Although showing extreme diversity within the genus, this organ may be referred to one of several types regarding division, strong reduction, or absence of various lobes and processes. The main problem is related to revealing homologies within these structures. Actually, the characteristic armature of most lobes as well as transitional cases enable us to homologise the lobes with satisfactory precision. The following petasma characters may be used in the taxonomy of *Sergia*: PV enlarged-armed/not enlarged-unarmed; LI present/absent; LT present/absent and, if present, entire/divided; LT and LC twisted/not twisted; LC entire/divided; LA present/absent.

Other characters of lesser taxonomic importance are used for distinguishing the species from each other. The characters mentioned above allow the division of *Sergia* into several subgroups that share fixed sets of these characters (see Table 3). I choose a more conservative approach and introduce new species groups.

KEY TO SPECIES GROUPS AND ISOLATED SPECIES OF *SERGIA*

Two isolated species and 7 species groups (summarized in Table 3) are included in *Sergia*.

1. Hepatic tubercle/spine absent. Postdorsal spine on abdominal somite VI rudimentary or absent. Dermal photophores absent. All lobes and processes of petasma (with possible exception of LAc) present, not twisted or divided 2
– Hepatic tubercle/spine present. Postdorsal spine on abdominal somite VI well defined. Dermal photophores usually present. Some lobes or processes of petasma (in addition to LAc) either absent or twisted/divided 4

Ocular papilla extremely long, cylindrical, longer than wide. Male clasping organ with 3 very long setae on ventral side. LAc of petasma present, LA with distal part strongly curved, so that tip is directed proximally ..... *S. tenuiremis* (only species), p. 84

– Ocular papilla short, less than 1/4 as long as wide. Male clasping organ without very long setae on ventral side. LAc of petasma absent, LA with distal part not strongly curved, tip directed medially or distally 3

3. Endopod of Mxp I with 3 segments. Posterior branchial lobe above P III reduced but not lamellar. Serrated bristles on inner surface of male clasping organ absent. LA of petasma reduced ..... *S. inoa* (only species), p. 88
– Endopod of Mxp I with 4 segments. Posterior branchial lobe above P III lamellar. Serrated bristles on inner surface of male clasping organ present. LA of petasma not reduced ..... *S. japonica* species group (2 species), p. 90
4. Ocular papilla present (1/4-3/4 as long as wide). Photophores when present without lenses, of "opaque spot" type 5
– Ocular papilla absent. Photophores of lens-bearing type 7
5. Photophores small, creating continuous row close to medial margin of Up exopod. Ocular papilla long, 1/2-3/4 as long as wide. Hepatic tubercle well developed. LI or LT of petasma rudimentary or absent ..... *S. gardineri* species group (5 species), p. 98
– Photophores, when present, medium or large, not creating continuous row close to medial margin of Up exopod. Ocular papilla short, 1/4-1/3 as long as wide. Hepatic tubercle small. LI and LT of petasma not rudimentary 6
6. Photophores, if present, forming 2 rows on scaphocerite (1 longer from base to tip and 1 shorter oblique) and triangular group in distal part of Up exopod. One or more lobes of petasma divided, LC and LT not twisted, LC not thickened in proximal part ..... *S. phorca* species group (9 species), p. 116
– Photophores, if present, forming single group on scaphocerite and never triangular group in distal part of Up exopod. All lobes of petasma undivided, LC and LT twisted, LC thickened in proximal part ..... *S. robusta* species group (4 species), p. 144
7. Photophores forming 2 rows on lateral side of Cp (above branchial region and along ventral Cp side); 7 or more photophores on scaphocerite, 3 or more photophores on Up exopod. LA of petasma developed ..... *S. prehensilis* species group (2 species), p. 159
– Photophores forming single row on lateral side of Cp (above branchial region); 6 or fewer photophores on scaphocerite, 3 or fewer photophores on Up exopod. LA of petasma reduced or absent 8
8. Lateral Cp row with 4 or more photophores, scaphocerite with 4 or more photophores. Inner surface of male clasping organ either with 8-12 serrated bristles or without any. PV of petasma without hooks ..... *S. challengeri* species group (8 species), p. 167
– Lateral Cp row with 3 or fewer photophores, scaphocerite with 3 or fewer photophores. Inner surface of male clasping organ with 4-6 serrated bristles. PV of petasma armed with 1 or more hooks ..... *S. lucens* species group (3 species*), p. 195

*one species under description by Dr. N. Iwasaki, Japan.

Sergia tenuiremis (isolated species)

Diagnosis: No photophores; no hepatic tubercle; no postdorsal spine on abdominal somite VI; ocular papilla extremely developed, longer than wide; clasping organ with 3 dorsal serrated bristles and 3 extremely long setae on ventral side; endopod of Mxp I with 3 segments; posterior branchial lobe above P III reduced but not rudimentary and lamellar. All lobes and processes in petasma developed and undivided; LA with distal part strongly curved, with tip directed proximally.

Species included: *Sergia tenuiremis* (Krøyer, 1855).

Sergia tenuiremis (Krøyer, 1855)

Figs. 3-5

Sergestes tenuiremis Krøyer, 1855: 30, 34 (pp. 9, 13 in reprint); 1856: 39, 62, 67-70 (keys, tables with measurements), pl. 4, fig. 11a, b; 1859: 255, 278, 283-286 (keys, tables), pl. 4, fig. 11a, b. – Bate 1888: 420. – Illig 1914: 349; 1927: 283, figs. 6-10. – Hansen 1920: 478; 1922: 81, pl. 4, figs. 4-5, pl. 5, figs. 1-2; 1927: 4. – Sund 1920: 7. – Gurney & Lebour 1940: 21.

Sergestes krøyeri Bate, 1881: 193; 1888: 388, pl. 70, figs. 3-4. – Hansen 1903: 58; 1920: 479. – Illig 1914: 354 (part); 1927: 289 (part). – Burkenroad 1940: 50. – Dennell 1955: 403. – Richardson & Yaldwyn 1958: 26. – Synonymized with *Sergestes tenuiremis* by Burkenroad (1940).

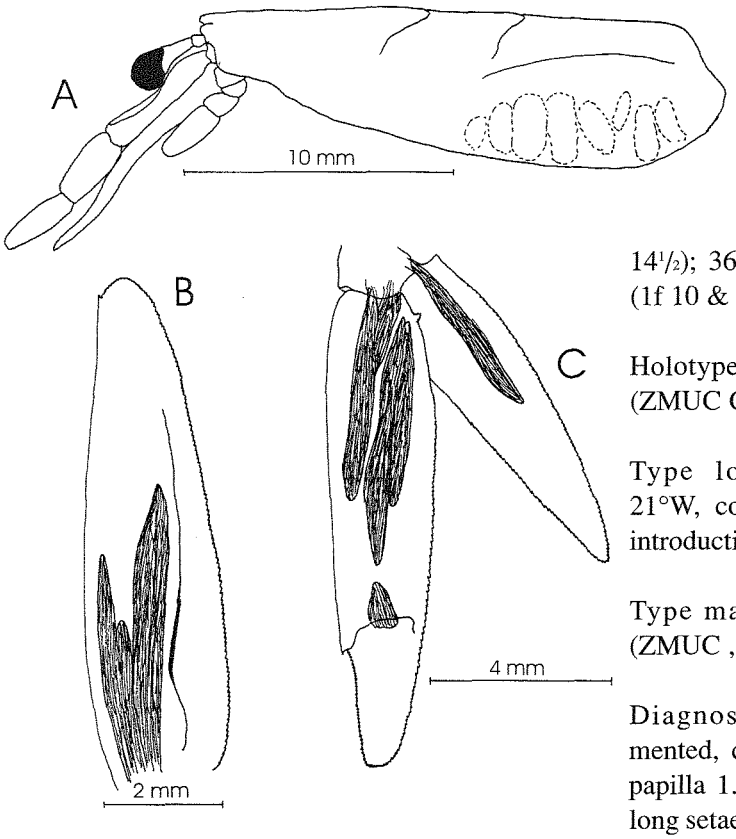


Fig. 3. *Sergia tenuiremis*, male, "Dana" St. 1156-5, Cp length 17.9 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

Sergestes junceus Bate, 1888: 416, pl. 76, fig. 1. – Synonymized with *Sergestes tenuiremis* by Hansen (1903).

Sergestes longicollis Bate, 1888: 421, fig. 1. – Synonymized with *Sergestes tenuiremis* by Hansen (1903).

Sergestes tropicus Sund, 1920: 18, figs. 27-28, 30-32. – Synonymized with *Sergestes tenuiremis* by Hansen (1922).

Sergestes (Sergia) tenuiremis. – Yaldwyn 1957: 9. – Donaldson 1975: 45.

Sergestes (Sergia) krøyeri. – Yaldwyn 1957: 9. – Crosnier & Forest 1973: 308. – Lagardère 1978: 7.

Sergia tenuiremis. – Pearcy & Forss 1966: 1137. – Walters 1976: 823. – Butler 1980: 49. – Krygier & Pearcy 1981: 101, fig. 1. – Vereshchaka 1994a: 76, figs. 1-3, 26.

Sergia krøyeri. – Krygier & Wasmer 1988: 72.

Material examined: "Dana" stations: 1142-6 (1f 14 & 1m 19); 1142-9 (2f 12); 1152-3 (3m 12½-14); 1156-5 (1f 20 & 2m 18-18½); 1156-6 (1m 20); 1156-7 (1f 20½ & 1m 14); 1239-1 (1m 16); 1365-9 (1f 21 & 2m 18-19); 3576-1 (1m 20); 3593-1 (1f 14½); 3627-2 (1f 18); 3627-3 (1m 18½); 3981-1 (1f 10 & 1m 18); 4180-1 (2f 10½-13 & 1m 15½).

Holotype of *Sergestes tenuiremis* (juvenile) (ZMUC CRU 8362).

Type locality: Tropical Atlantic, ca. 4.5°N, 21°W, coll. Hr. Fries [information from Danish introduction in Krøyer 1855].

Type material: Holotype of *Sergestes tenuiremis* (ZMUC , see above).

Diagnosis: Integument firm; cornea well pigmented, considerably wider than eyestalk; ocular papilla 1.3-1.4 times as long as wide in adults; 3 long setae on outer margin of clasping organ almost reaching tip of flagellum; scaphocerite with small distal tooth; LA of petasma curved at about 3/4 length; LI and LC overlapping LT and PV.

Description: Cp with blunt rostrum, 2.9 times as long as high and 0.45 times as long as abdomen (Fig. 3A). Abdomen with somite VI 1.9 times as long as high and 1.3 times as long as telson; telson 3.8 times as long as wide.

Eyestalk with papilla 1.4 times as long as wide; cornea well pigmented, brown, as long as wide, 0.7 times as long and 1.4 times as wide as eyestalk.

A I peduncle 0.6 times as long as Cp, with segments 2 and 3 0.56 times as long as segment 1; segment 3 of outer A I flagellum in male with tubercle reaching about 4/5 of segment 4; latter with 3 serrated bristles and several setae on inner surface of clasping organ and 3 very long setae, almost reaching tip of flagellum, on outer surface (Fig. 4C). A II peduncle 0.4 times as long as scaphocerite; latter with small distal tooth (Fig. 3B), 3.8 times as long as wide, 0.8 times as long as A I peduncle.

Md palp 0.37 times as long as Cp, with proximal segment 2.0 times as long as distal. Mx I with palp 2.3 times as long as wide and 0.05 times as long as Cp; endopod 1.8 times as long as wide and 1.6 times as long as palp; endite 1.7 times as long as

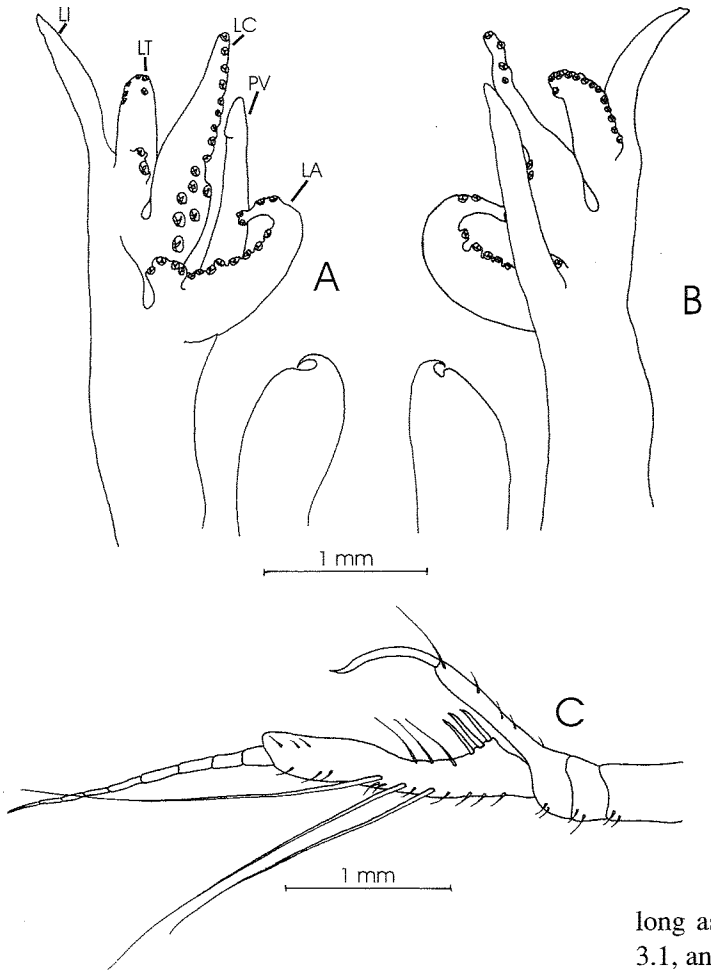


Fig. 4. *Sergia tenuiremis*, male, "Dana" St. 1156-5, Cp length 17.9 mm. - A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

wide and 1.1 times as long as palp. Mx II with exopod 3.4 times as long as wide and 0.27 times as long as Cp; palp 6.4 times as long as wide and 0.09 times as long as Cp; endopod 2.0 times as long as wide and 1.0 times as long as palp; endites subequal, 1.7 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 3.1 times as long as wide and 0.17 times as long as Cp; endopod 1.2 times as long as exopod; segments 2 and 3 1.1 and 1.3 times as long as segment 1, respectively. Mxp II 0.9 times as long as Cp, with merus 1.0, carpus 0.8, propodus 0.9, and dactyl 0.5 times as long as ischium. Mxp III 1.4 times as long as Cp, with merus 1.2, carpus 1.2, propodus 1.4, and dactyl 0.7 times as long as ischium; propodus incompletely divided into 4 subsegments, subdivision of dactyl uncertain (Hansen 1922, reported 7 subsegments in dactyl).

P I 1.1 times as long as Cp, with merus 3.2, carpus 1.7, and propodus 3.4 times as long as ischium, subdivision of propodus uncertain. P II 1.5 times as long as Cp, with merus 3.1, carpus 2.2, propodus 3.1, and dactyl 0.2 times as long as ischium, subdivision of propodus uncertain. P III 1.9 times as long as Cp, with merus 3.5, carpus 2.6, propodus 3.3, and dactyl 0.2 times as long as ischium, subdivision of propodus uncertain. P IV 1.3 times as long as Cp, with merus 2.1, carpus 1.0, and propodus 1.0 times as long as ischium. P V 0.7 times as long as Cp, with merus 1.0, carpus 0.7, and propodus 0.5 times as long as ischium.

Somite VIII with arthrobranch 0.09 times as long as Cp and 2.3 times as long as epipod. Somite IX with anterior pleurobranch 0.11 times as long as Cp and 3.0 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.17 times as long as Cp and 4.4 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.17 times as long as Cp and 4.6 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.17 times as long as Cp and 1.7 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.13 times as long as Cp and 1.4 times as long as posterior pleurobranch.

Pl I with basipod 0.32 times as long as Cp and

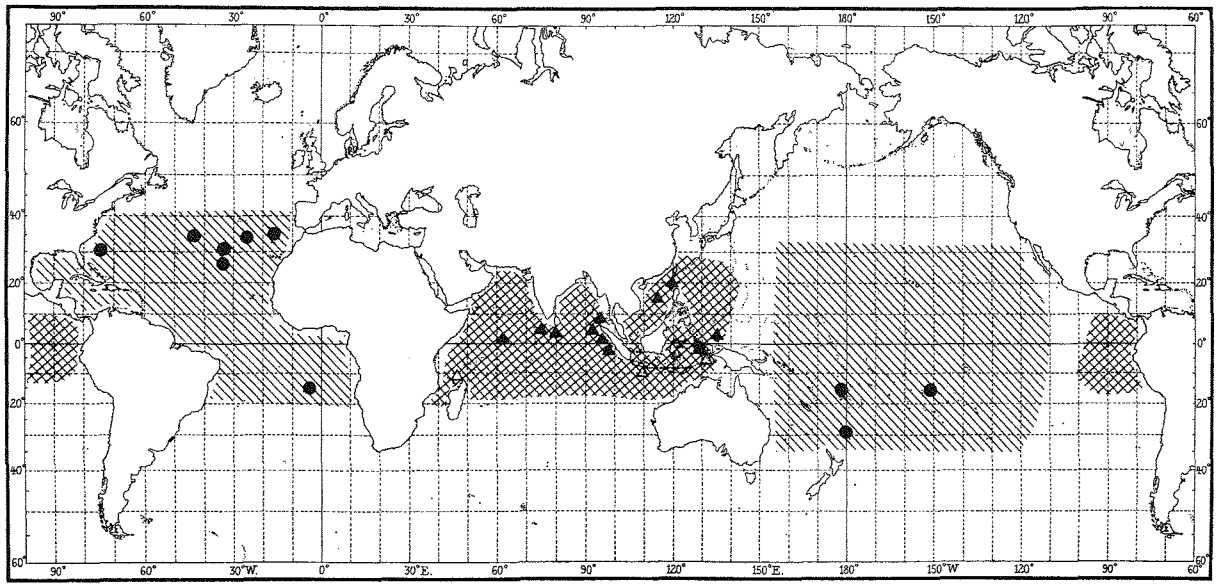


Fig. 5. Probable geographical distribution of *Sergia tenuiremis* (circles, hatching) and *S. inoa* (triangles, cross hatching). Black symbols indicate "Dana" stations, white symbol "Galathea" stations. Shaded areas without symbols are supported by literature data.

exopod 2.3 times as long as basipod. Pl II with basipod 0.29 times as long as Cp, exopod 2.7 and endopod 1.6 times as long as basipod, respectively. Pl III with basipod 0.27 times as long as Cp, exopod 2.6 and endopod 1.5 times as long as basipod, respectively. Pl IV with basipod 0.23 times as long as Cp, exopod 2.7 and endopod 1.5 times as long as basipod, respectively. Pl V with basipod 0.20 times as long as Cp, exopod 2.4 and endopod 1.5 times as long as basipod, respectively.

Up with exopod 4.7 times as long as wide, 9.0 times as long as basipod and 0.6 times as long as Cp; endopod 3.9 times as long as wide and 0.7 times as long as exopod (Fig. 3C).

Petasma (Fig. 4A-B). PV tapering, with blunt tip, 5.4 times as long as wide. LI 5.9 times as long as wide and 0.7 times as long as PV. LT 2.4 times as long as wide and 0.5 times as long as PV, armed with 2 stronger hooks at basal part of dorsal side and with distal row of smaller hooks along distomedial margin. LC 3.8 times as long as wide and 1.0 times as long as PV, overlapping LT and almost reaching LI, bearing group of larger hooks at slightly thickened proximal part and row of smaller hooks at distal part of dorsal side. LAc as long as wide and 0.2 times as long as PV, armed with few hooks at tip. LA 3.3 times as long as wide and 1.1 times as long as PV, armed with numerous hooks along ventral margin and around tip, strongly curved at c. 3/4 of length, tip directed proximally.

Remarks: Since they live at bathyal depths, mature adults of this species have been collected very rarely and have been described under several names. Among the rather numerous "Dana" specimens, I observed slight variability which, however, is not sufficient to justify separate species. Hansen (1927) wrote that *Sergestes krøyeri* and *S. tenuiremis* might be the same species and that the final solution would be possible only after comparison of the petasma of the Atlantic *S. tenuiremis* and Pacific *S. krøyeri* (the latter species was established by Bate for a specimen from northwest of New Zealand). After examination of the "Dana" specimens from both localites, I agree with Burkenroad (1940) that the two names should be regarded as synonymous. *Sergestes tropicus* is also a synonym of *S. tenuiremis*, because the petasma in the two species is identical (the petasma of the former species is illustrated by Sund 1920: 19, fig. 33). Late larval stages undergo a remarkable metamorphosis, and were described by Bate (1888) under two different names: *S. junceus* and *S. longicollis*.

Geographical distribution (Fig. 5): Tropical and temperate waters of the Atlantic and Pacific Oceans.

Atlantic Ocean: North Atlantic ("Dana"),

Canaries and Azores (Hansen 1920, 1922), Madeira and the Gulf of Guinea (Illig 1927). South Atlantic (one "Dana" station; 24°S, 4°W, as *S. tenuiremis* and between 25°S and 30°S, as *S. krøyeri*: Illig 1914).

Pacific Ocean: Southwest Pacific ("Dana"), 29°55′S, 178°14′W (as *S. krøyeri*: Bate 1888); off the Kermadec Islands (Richardson & Yaldwyn 1958); east of New Zealand (as *S. krøyeri*: Wilson 1978), northeast of New Zealand (Walters 1976). North Pacific (Krygier & Wasmer 1988); off Hawaii (Rathbun 1906, Walters 1976); off Oregon (Krygier & Pearcy 1981).

Illig's (1927) report from the Indian Ocean is based upon specimens that belong to *S. phorca*. The distribution of *S. tenuiremis* indicates that there are at least two isolated areas inhabited by this species: the Pacific and the Atlantic. It is remarkable that *S. tenuiremis* and the following species, *S. inoa*, both deep-water species and similar ecologically, are allopatric.

Vertical range: Probably an interzonal species (sensu Vinogradov 1968) migrating daily between the upper bathypelagic and lower mesopelagic zones. "Dana" specimens were taken throughout the depth range 330-2000 m. Most specimens occur at 500-2000 m at night and at 1500-2000 m during the day. These data agree with results of Foxton (1970) and Vereshchaka (1994a).

Sergia inoa (isolated species)

Diagnosis: No photophores; no hepatic tubercle; postdorsal spine on abdominal somite VI rudimentary; ocular papilla reduced in adults, less than 1/4 as long as wide; clasping organ without serrated bristles; endopod of Mxp I with 3 segments; posterior branchial lobe above P III reduced but not rudimentary and lamellar; LAc absent; all other lobes and processes of petasma developed and undivided; LA reduced, with distal part directed medially.
Species included: *Sergia inoa* (Faxon, 1893).

Sergia inoa (Faxon, 1893), n. comb.

Figs. 5-7, Pl. 2F

Sergestes inous Faxon, 1893: 216; 1895: 208, pl. 51, fig. 2. - Alcock 1901: 50. - Hansen 1919: 8, pl. 1, fig. 1a-c.

Sergestes (Sergia) inous. - Yaldwyn 1957: 9.

Material examined: "Dana" stations: 3548-1 (1m 16½); 3548-2 (1f 22); 3549-4 (1m 24); 3558-2 (2j 9½); 3677-1 (1f 25); 3714-6 (1m 30½); 3716-2 (2m 29-31½); 3768 [sample number unknown] (1f 40½); 3824-4 (1f 23½); 3828-5 (2f 24½-26½); 3902-1 (2m 18-28); 3920-3 (1m 23½).

"Galathea" stations: 263 (2f 28-32); 466 (1f 19); 494 (1f 23).

Type locality: East Pacific, off Malpelo Island, Colombia, "Albatross" St. 3380, 04°03′N, 81° 31′W, 899 fms.

Type material: Holotype female of *Sergestes inous* (MCZ 4666, not examined).

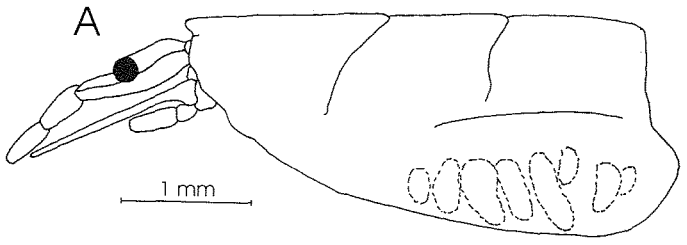
Diagnosis: Integument membranous; cornea poorly pigmented, almost equal in width to eyestalk; clasping organ in male somewhat rudimentary; scaphocerite with small distal tooth; PV of petasma with rounded apex, overlapping LI and LT; LC overlapping PV, armed only in distal half; LA curved laterally, armed only in distal half.

Description: Cp with blunt rostrum, 2.0 times as long as high and 0.48 times as long as abdomen (Fig. 6A). Abdomen with somite VI 1.8 times as long as high and 1.1 times as long as telson; telson 3.7 times as long as wide.

Cornea 1.4 times as long as wide, 0.3 times as long and 1.1 times as wide as eyestalk.

A I peduncle 0.5 times as long as Cp, with segments 2 and 3 0.42 and 0.47 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle overlapping segment 4s of flagellum; segment 4 divided into 2 subsegments; clasping organ reduced, bearing several setae on inner and outer surface, without serrated bristles on inner surface (Fig. 7C). A II peduncle 0.4 times as long as scaphocerite; latter with small distal tooth (Fig. 6B), 3.0 times as long as wide, 0.83 times as long as A I peduncle.

Md palp 0.37 times as long as Cp, with proximal segment 2.0 times as long as distal one. Mx I with palp 2.3 times as long as wide and 0.04 times as long as Cp; endopod 1.4 times as long as wide and 1.9 times as long as palp; endite 1.3 times as long as wide and 1.0 times as long as palp. Mx II with exopod 3.0 times as long as wide and 0.25 times as long as Cp; palp 3.3 times as long as wide and 0.08



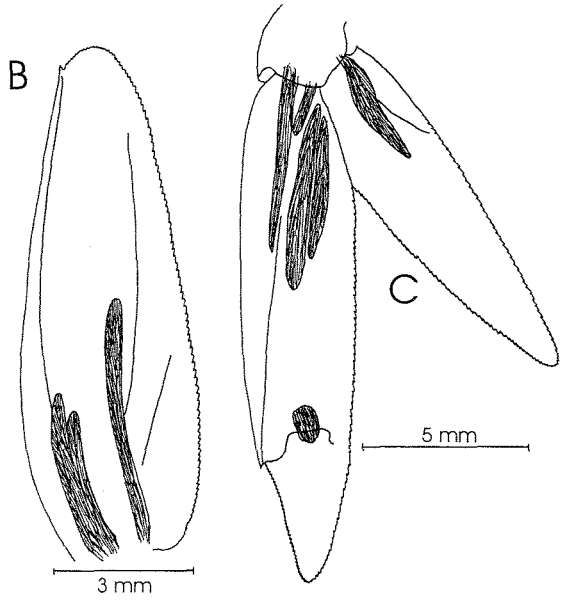


Fig. 6. *Sergia inoa*, male, "Dana" St. 3716-2, Cp length 29.0 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

times as long as Cp; endopod 1.8 times as long as wide and 1.0 times as long as palp; endites subequal, 2.4 times as long as wide and 0.6 times as long as palp.

Mxp I with exopod 2.8 times as long as wide and 0.15 times as long as Cp; endopod 0.9 times as long as exopod; segments 2 and 3 1.3 and 1.0 times as long as segment 1, respectively. Mxp II 0.8 times as long as Cp, with merus 1.0, carpus 0.8, propodus 0.9, and dactyl 0.4 times as long as ischium. Mxp III 1.7 times as long as Cp, with merus 1.2, carpus 1.5, propodus 1.4, and dactyl 0.9 times as long as ischium; propodus and dactyl divided into 4 and 8 subsegments, respectively.

P I 1.0 times as long as Cp, with merus 3.1, carpus 1.6, and propodus 3.4 times as long as ischium; propodus divided into 10 subsegments. P II 1.4 times as long as Cp, with merus 3.3, carpus 2.6, propodus 3.7, and dactyl 0.2 times as long as ischium; propodus subdivided into 14 subsegments. P III 1.7 times as long as Cp, with merus 3.0, carpus 2.4, propodus 2.8, and dactyl 0.1 times as long as ischium; propodus divided into 15 subsegments. P IV 1.0 times as long as Cp, with merus 1.4, carpus 0.9, and propodus 0.8 times as long as ischium. P V 0.5 times as long as Cp, with merus 1.1, carpus 0.7, and propodus 0.5 times as long as ischium.

Somite VIII with arthrobranch 0.11 times as long as Cp and 2.2 times as long as epipod. Somite IX with anterior pleurobranch 0.13 times as long as Cp and 2.7 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.18 times as long as Cp and 3.6 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.17 times as long as Cp and 3.1 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.21 times as long as Cp and 2.1 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.14 times as long as Cp and 1.7 times as long as posterior pleurobranch.

Pl I with basipod 0.26 times as long as Cp and exopod 2.3 times as long as basipod. Pl II with basipod 0.26 times as long as Cp, exopod 2.5 and endopod 1.5 times as long as basipod, respectively. Pl III with basipod 0.23 times as long as Cp, exopod 2.7 and endopod 1.4 times as long as basipod, respectively. Pl IV with basipod 0.22 times as long as Cp, exopod 2.3 and endopod 1.4 times as long as basipod, respectively. Pl V with basipod 0.18 times as long as Cp, exopod 2.3 and endopod 1.5 times as long as basipod, respectively.

Up with exopod 4.6 times as long as wide, 6.8 times as long as basipod and 0.6 times as long as

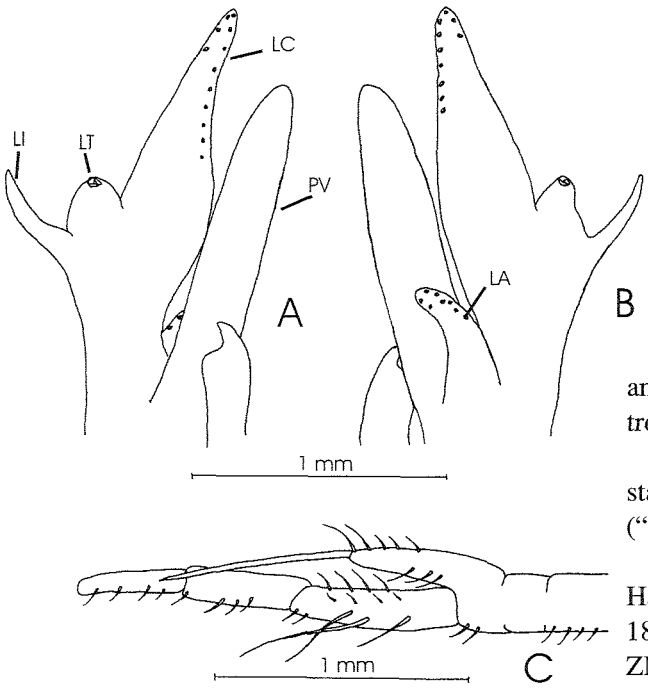


Fig. 7. *Sergia inoa*, male, "Dana" St. 3716-2, Cp length 29.0 mm. – A, caudal view of petasma. – B, oral view of petasma. – C, male outer A I flagellum.

Cp; endopod 3.7 times as long as wide and 0.7 times as long as exopod (Fig. 6C).

Petasma (Fig. 7A-B). PV not tapering, 4.4 times as long as wide. LI curved, 4.0 times as long as wide and 0.3 times as long as PV. LT reduced and very short, 0.9 times as long as wide and 0.2 times as long as PV, armed with single stronger apical hook. LC extremely powerful, 2.4 times as long as wide and 0.6 times as long as PV, overreaching LI and LT several times, bearing group of smaller hooks at lateral side of distal half and around apex. LA 2.3 times as long as wide and 0.4 times as long as PV, armed with several hooks along ventral margin of distal half and around tip, slightly curved, tip directed laterally.

Remarks: Colour of freshly caught animal is shown in Pl. 2F.

This gigantic deep-sea species appears extremely rarely in planktonic collections. Since this very remarkable species is easy to identify, no confusion in the synonymy has appeared. Nevertheless, the figure of the petasma of *S. inoa* provided here can be helpful for identification; to my knowledge, this is the first time the petasma has been figured for the species.

Geographical distribution (Fig. 5): This species occurs in 2 separate areas: the Indian Ocean and the extreme western and eastern part of the tropical Pacific.

Indian Ocean: North of Madagascar ("Galathea" station), off Sri Lanka and near Seychelles Islands ("Dana" stations), Arabian Sea (Alcock 1901).

Pacific: West Pacific ("Dana" and "Galathea", Hansen 1919); East Pacific: Malpelo Island (Faxon 1893); K. Stephensen (unpublished notes in ZMUC) records one specimen of this species near the same locality in his pencil remarks on the water colours of "Dana I" sergestids, although the specimen was not found in the "Dana I" collection.

There are at least two isolated areas inhabited by this species: the Indian Ocean - Indo-West Pacific, and the Eastern Pacific. *S. inoa* and *S. tenuiremis*, both deep-living and similar ecologically, are allopatric. The rarity of these species does not enable us to judge to what extent their populations are contiguous, and whether their distribution is parapatric instead of allopatric.

Vertical range: Bathypelagic species. "Dana" specimens were taken throughout the depth range 330-2000 m. Most specimens live at 1000-2000 m. Only 2 specimens are present in the samples from a depth of 330 m.

Sergia japonica species group

Diagnosis: No photophores; no hepatic tubercle; postdorsal spine on VI abdominal somite rudimentary or absent; ocular papilla reduced, less than 1/4 as long as wide; clasping organ with 3 weak bristles; endopod of Mxp I with 4 segments (Fig. 8); posterior branchial lobe above P III rudimentary, lamellar or almost lamellar; LAc absent; all other lobes and processes in petasma developed and undivided.

Species included: *Sergia japonica* (Bate, 1881) and *S. laminata* (Burkenroad, 1940).

Key to species of the *Sergia japonica* species group

1. Integument membranous. Cornea almost equal to eyestalk in width. A I flagellum in male with tubercle much overlapping segment 4 of flagellum. Scaphocerite with distal tooth inconspicuous. Penultimate segment of Mxp I considerably longer than terminal segment. Propodus in Mxp III divided into 3 subsegments. PV of petasma slender, not leaf-like, with apex bifid; LC longer than LT ..... *Sergia japonica*
– Integument firm. Cornea considerably wider than eyestalk. A I flagellum in male with tubercle not overlapping segment 4 of flagellum. Scaphocerite with distal tooth distinct. Penultimate segment of Mxp I endopod as long as terminal segment. Propodus in Mxp III divided into 4 subsegments. PV of petasma leaf-like, with apex not bifid; LC shorter than LT ..... *Sergia laminata*

Sergia japonica (Bate, 1881)

Figs. 8-11, Pl. 4A

Sergestes japonicus Bate, 1881: 194. – 1888: 387, pl. 70, figs. 1-2. – Hansen 1896: 947; 1903: 57; 1919: 6. – Balss 1914: 17. – Illig 1927: 292, figs. 26-29. – Burkenroad 1940: 53. – Dennell 1955: 403. – Richardson & Yaldwyn 1958: 26.

Sergestes sp. indet. – Smith 1882: 100.

Sergestes mollis Smith, 1884: 419; 1886: 93, pl. 20, figs. 3-5. – Wood-Mason *in* Wood-Mason & Alcock 1891b: 353. – Faxon 1895: 164. – Hansen 1920: 478; 1922: 75, pl. 4, fig. 3; 1927: 3. – Sund 1920: 20, fig. 34. – Welsh & Chace 1938: 367, fig. 2. – Zariquiey Alvarez 1946: 57; 1968: 61. – Allen 1967: 33. – Okutani 1969: 16. – Synonymized with *Sergestes japonicus* by Hansen (1896).

Sergestes profundus Bate, 1888 (part): 428. – Hansen 1903: 69 (designation of lectotype). – Illig 1927: 301. **New synonym.**

Sergestes (Sergia) japonicus. – Yaldwyn 1957: 22. – Foxton 1970: 976. – Crosnier & Forest 1973: 341, figs. 113c, 117. – Sakai & Nakano 1983: 97.

Sergestes (Sergia) profundus. – Yaldwyn 1957: 9.

Sergia japonicus. – Omori 1974: 236.

Sergestes (Sergia) mollis. – Sakai & Nakano 1983: 97.

Sergia japonica. – Krygier & Wasmer 1988: 74. – Vereshchaka 1994a: 78, figs. 4-5, 26; 1995a: 1651.

Material examined: "Dana" stations: 1142-6 (1f 15); 1142-7 (3f 6-13½); 1156-5 (3f 14½-17 & 1m 16); 1156-6 (1f 17); 1157-5 (6f 8-16 & 4m 11-14); 1157-6 (20f 5-15 & 6m 6-17); 1157-7 (2f 15½-16); 1157-10 (1f 14); 1159-1 (12f 7-22½ & 1m 17); 1159-5 (1m 17); 1239-14 (2m 14-15); 1239-15 (1m 12); 1342-1 (2f 7-9); 1342-3 (2m 15½-17); 1358-5 (1f 10 & 1m 8½); 1365-9 (1m 11); 3556-1 (1f 18½); 3627-1 (2f 22-23½ & 1m 20); 3630-1 (1f 23½); 3653-6 (9f 11½-23½ & 6m 13½-19½); 3656-1 (2f 24-24½ & 3m 17-20½); 3663-1 (3f 15-23 & 2m 19½-21½); 3676-7 (2f 13-15½); 3677-1 (1f 19½ & 2m 13-16); 3677-3 (12f 5-13½ & 9m 6½-8½); 3678-1 (5f 10-18 & 2m 15-17½); 3678-2 (6f 11-19); 3680-1 (7f 12-18 & 3m 13-15½); 3716-1 (2f 13-19 & 1m 16); 3996-1 (2f 10-11); 3998-8 (1f 13); 4000-6 (2f 17-18 & 1m 15); 4000-7 (1m 15); 4000-8 (3m 12½-14).

"Galathea" stations: 436 (1f 11); 443 (3m 7); 461 (1m 13½); 464 (1f 18½); 495 (1f 18 & 2m 12-13) 654 (1f 25); 663 (1f 21).

Type of *Sergestes mollis*, western North Atlantic off Nantucket Shoals, Massachusetts, ca. 41° 11′30″N, 70°47′40″W (USNM 7106).

Lectotype of *Sergestes profundus*, "Challenger" St, 300, southeastern Pacific west of Valparaiso, Chile, 33°42′S, 78°18′W, 1375 fms (BMNH 1888.22).

Type locality: Western Pacific off southern coast of Japan, "Challenger" St. 232, 35°11′N, 139° 28′E, 345 fms.

Type material: Holotype female of *Sergestes japonicus* (BMNH 1888.22.1, not examined).

Diagnosis: Integument membranous; cornea poorly pigmented, almost equal in width to eyestalk; segment 3 of outer A I flagellum in male with tubercle significantly overlapping segment 4 of flagellum; scaphocerite with small inconspicuous distal tooth; Mxp I endopod with penultimate segment considerably longer than terminal segment; PV of petasma with bifid apex, overlapping LA and overreaching several times LI and LT; LC overlapping PV; LA curved at about 4/5 length, tip directed midventrally.

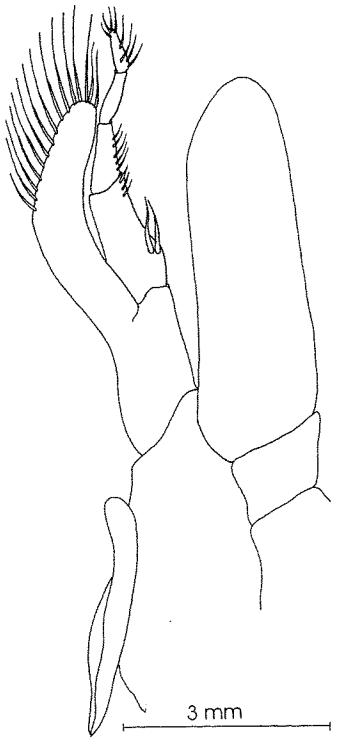


Fig. 8. *Sergia japonica*, male, "Dana" St. 3656-1, Cp length 19.0 mm. Mxp I, oral view.

Description: Cp with blunt rostrum, 2.1 times as long as high and 0.50 times as long as abdomen (Fig. 8A). Abdomen with somite VI 1.7 times as long as high and 1.0 times as long as telson; telson 3.6 times as long as wide.

Cornea 0.8 times as long as wide, 0.3 times as long and 1.1 times as wide as eyestalk.

A I peduncle 0.5 times as long as Cp, with segments 2 and 3 0.45 and 0.53 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle overlapping segment 4 of flagellum by 0.3 of its length; segment 4 of flagellum bearing 3 stouter setae (or weak bristles) and several smaller setae on dorsal surface and single long and several shorter setae on ventral surface (Fig. 10C). A II peduncle 0.4 times as long as scaphocerite, the latter with very small inconspicuous distal tooth (Fig. 9B), 3.0 times as long as wide, 0.83 times as long as A I peduncle.

Md palp 0.38 times as long as Cp, with proximal segment 1.9 times as long as distal one. Mx I with palp 2.3 times as long as wide and 0.04 times as long as Cp; endopod 1.4 times as long as wide and 1.6 times as long as palp, endite 1.8 times as long as wide and 1.1 times as long as palp. Mx II with exopod 3.5 times as long as wide and 0.24 times as long as Cp; palp 3.5 times as long as wide and 0.09 times as long as Cp; endopod 1.6 times as long as wide and 0.9 times as long as palp; endites subequal, 1.3 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 2.7 times as long as wide and 0.15 times as long as Cp; endopod 0.8 times as long as exopod, segments 2, 3, and 4 0.7, 0.3, and 0.2 times as long as segment 1, respectively. Mxp II 0.8 times as long as Cp, with merus 1.0, carpus 0.9, propodus 0.9, and dactyl 0.3 times as long as ischium. Mxp III 1.5 times as long as Cp, with merus 1.2, carpus 1.4, propodus 1.3, and dactyl 1.0 times as long as ischium; propodus and dactyl divided into 3 and 7-8 subsegments, respectively.

P I 1.0 times as long as Cp, with merus 3.8, carpus 1.8, and propodus 3.9 times as long as ischium, subdivision of propodus uncertain. P II 1.5 times as long as Cp, with merus 4.4, carpus 2.9, propodus 4.7, and dactyl 0.2 times as long as ischium, subdivision of propodus uncertain. P III 1.7 times as long as Cp, with merus 3.9, carpus 2.9, propodus 3.8, and dactyl 0.2 times as long as ischium, subdivision of propodus uncertain. P IV 1.0 times as long as Cp, with merus 1.4, carpus 0.9, and propodus 0.8 times as long as ischium. P V 0.5 times as long as Cp, with merus 1.0, carpus 0.7, and propodus 0.5 times as long as ischium.

Somite VIII with arthrobranch 0.06 times as long as Cp and 1.3 times as long as epipod. Somite IX with anterior pleurobranch 0.10 times as long as Cp and 2.0 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.16 times as long as Cp and 3.1 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.16 times as long as Cp and 2.9 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.15 times as long as Cp and 3.0 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.11 times as long as Cp and 2.1 times as long as posterior pleurobranch.

Pl I with basipod 0.28 times as long as Cp and exopod 2.0 times as long as basipod. Pl II with basipod 0.24 times as long as Cp; exopod 2.4 and endopod 1.5 times as long as basipod, respectively. Pl III with basipod 0.23 times as long as Cp; exopod 2.3 and endopod 1.4 times as long as basipod, respectively. Pl IV with basipod 0.21 times as long as Cp; exopod 2.4 and endopod 1.5 times as long as basi-

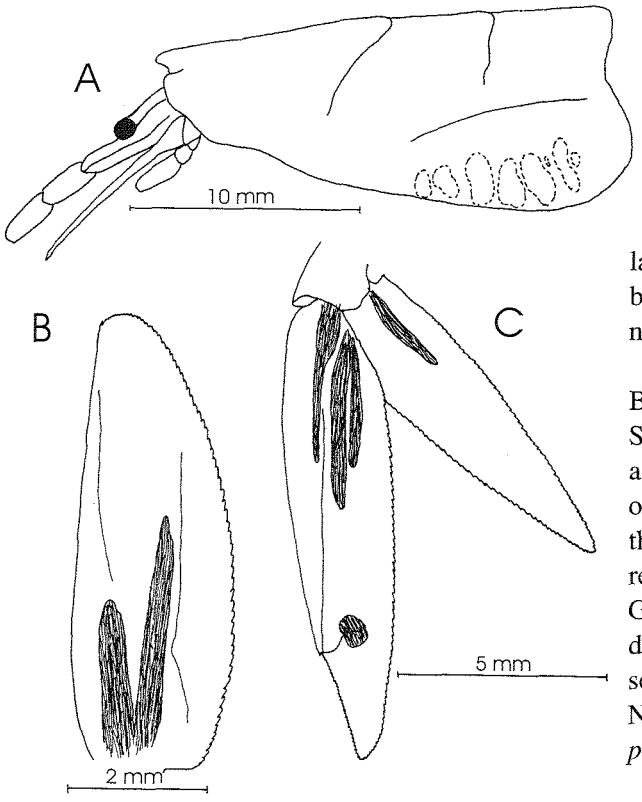


Fig. 9. *Sergia japonica*, male, "Dana" St. 3656-1, Cp length 19.0 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

pod, respectively. Pl V with basipod 0.17 times as long as Cp; exopod 2.3 and endopod 1.6 times as long as basipod, respectively.

Up with exopod 4.6 times as long as wide, 7.8 times as long as basipod and 0.6 times as long as Cp; endopod 3.8 times as long as wide and 0.7 times as long as exopod (Fig. 9C).

Petasma (Fig. 10A-B, Pl. 4A). PV not tapering, 2.8 times as long as wide. LI curved, 4.0 times as long as wide and 0.4 times as long as PV. LT reduced, 1.3 times as long as wide, 0.2 times as long as PV, distally armed with few small hooks. LC voluminous, 3.7 times as long as wide and 1.1 times as long as PV, overreaching PV by 1/3, several times as long as LI or LT, bearing group of stronger hooks on lateral margin of proximal part and row of smaller hooks on distoventral margin and near apex; proximal part of LC covered with numerous very small hooks (Pl. 4A). LA 5.2 times as long as wide and 0.8 times as long as PV, armed with row of hooks along distomedial margin.

Remarks: This species has also been known under the names *Sergestes profundus* and *S. mollis*. The description by Smith (1882) of an indeterminate species, although very incomplete, refers to the lamellar posterior lobe of the penultimate pleurobranch and membranous integument, thus leaving no doubt that the specimen belongs to *S. japonica*.

The species *Sergestes profundus* was erected by Bate (1888) for 2 specimens. One of these, from the South Atlantic, was shown by Hansen (1903) to be a representative of the genus *Petalidium*. The second specimen, from 33°42′S, 78°18′W, was made the lectotype by Hansen (1903). Illig (1927) referred a damaged specimen from the Gulf of Guinea to this species, at the same time expressing doubts about keeping *S. profundus* and *S. japonicus* separate. The lectotype of *S. profundus* from the NHM is a mutilated juvenile specimen of *S. japonica*.

Although Hansen (1896) synonymized *Sergestes japonicus* and *S. mollis*, which was followed by most researchers, a few authors continued to keep the two species separate. Sund (1920) retained *S. mollis* on the basis of the form of rostrum. However, this character varies individually in Sergestidae even within the same sample and is not taxonomically useful (Vereshchaka 1994a). In their detailed studies on *S. japonicus* and *S. mollis*, Sakai & Nakano (1983) found several differences between them: (1) distal part of PV trilobed in *S. japonicus* and bilobed in *S. mollis*; (2) LA distally curved posteriorly in *S. japonicus* and inward in *S. mollis*; (3) slightly different position of hooks on LT; (4) LI stout in *S. japonicus* and "more slender" in *S. mollis*; (5) proximal leaf of coxa of 3rd pereopod in females with truncate tip in *S. japonicus* and rounded tip in *S. mollis*. Both authors seem to follow a conservative approach to the sergestid taxonomy (which is also clear from their referral of both species to *Sergestes*, not *Sergia*). However, one of the PV of *S. mollis* figured by Sakai & Nakano (1983: fig. 8d) looks trilobed and not different from the PV of *S. japonicus*, while the PV of *S. japonicus* (Sakai & Nakano 1983: fig. 4e) looks bifid; LI and the proximal leaf of female pereopod 3 of *S. japonicus* illustrated by these authors look very similar, if not identical, to those of *S. mollis*, and individual morphological variations are not clearly

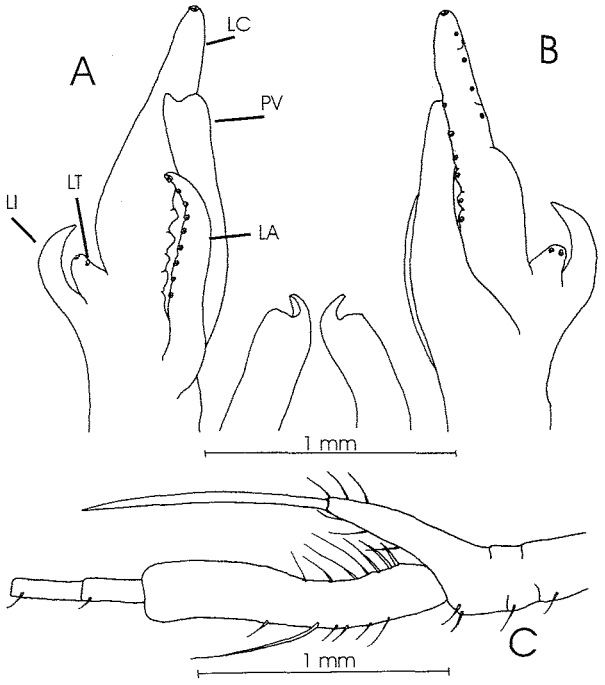


Fig. 10. *Sergia japonica*, male, "Dana" St. 3656-1, Cp length 19.0 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

shown for these characters; the direction of the LA curvature (inward or posteriorly) and the position of hooks on the LT depend upon orientation of the petasma and the degree of maturity (and always remain a little bit subjective). Therefore, these characters may at most indicate the presence of different morphs of *S. japonica*, but they are not of species level.

Sergia japonica is similar to *S. laminata*. It lives deeper than *S. laminata* and seems not to migrate vertically, as does *S. laminata*. This is reflected in some morphological characters: (1) membranous integument (firm in *S. laminata*), (2) reduced eyes (as wide as eyestalk and poorly pigmented in *S. japonica* and considerably wider than eyestalk and well pigmented in *S. laminata*); (3) shorter abdomen (2.0 times as long as Cp in *S. japonica* and 2.2 times as long as Cp in *S. laminata*), (4) shorter 6th abdominal segment (1.7 times as long as high in *S. japonica* and 2.1 times as long as high in *S. laminata*), (5) morphology of scaphocerite (with reduced apical spine in *S. japonica* and with well defined spine in *S. laminata*). Other distinguishing characters seem not to refer so directly to the mode of life of both species: *S. japonica* also differs in having (1) the penultimate segment of Mxp I considerably longer than the terminal segment (equal to this in *S. laminata*), (2) the tubercle of the male A I flagellum greatly overlapping segment 4 of the flagellum (nearly reaching end of it in *S. laminata*), (3) the form of the PV of the petasma, bifid at the apex and not leaf-like (converse in *S. laminata*), (4) relative lengths of LC and LT (the former longer in *S. japonica* and shorter in *S. laminata*), and in several other minor characters.

Geographical distribution (Fig. 11): A cosmopolitan species that occurs in tropical and temperate waters of the Atlantic, Indo-West Pacific, and Northeast Pacific waters.

Atlantic Ocean: North Atlantic (type locality of *Sergestes mollis*, Smith 1884; "Dana"), Caribbean and Mediterranean (Hansen 1927, Zariquiey Alvarez 1968). Central Atlantic (Hansen 1922), off Marocco, Dakar, Congo, and Angola, (Illig 1927). South Atlantic ("Dana"; Hansen 1920, 1922, 1927; Crosnier & Forest 1973).

Indian Ocean: Eastern part ("Dana" and "Galathea" stations; Illig 1927), off Sri Lanka (Illig 1927).

Pacific: West Pacific ("Dana" and "Galathea" stations), East Pacific ("Dana" station), northeastern Pacific and off southern Japan (type locality of *Sergestes japonicus,* Bate 1881; Wasmer 1972, Krygier & Wasmer 1988), off the Philippines (type locality of *Sergestes profundus*, Bate 1888), Tasman Sea and northeast of New Zealand ("Dana" and "Galathea" stations), Cook Strait (Yaldwyn 1957, Richardson & Yaldwyn 1958).

This species probably occurs in two isolated areas: the Atlantic Ocean and the Indo-Pacific. That the northeastern Pacific and Indo-West Pacific populations do not appear to meet may be related to the scarcity of deep-sea sampling in the Central Pacific. The sister species *S. japonica* and *S. laminata* are sympatric, the former species occurring at a greater depth than the latter.

Vertical range: Bathypelagic species. "Dana" specimens were taken within the depth range 330-2000 m. Most specimens live at 800-2000 m. Only 2 specimens are present in samples from a depth of 330 m. These data agree with the results of Foxton (1970), who recorded this species from depths greater than 800 m and with studies of Vereshchaka (1994a), who found *S. japonica* living mainly at 1000-2500 m.

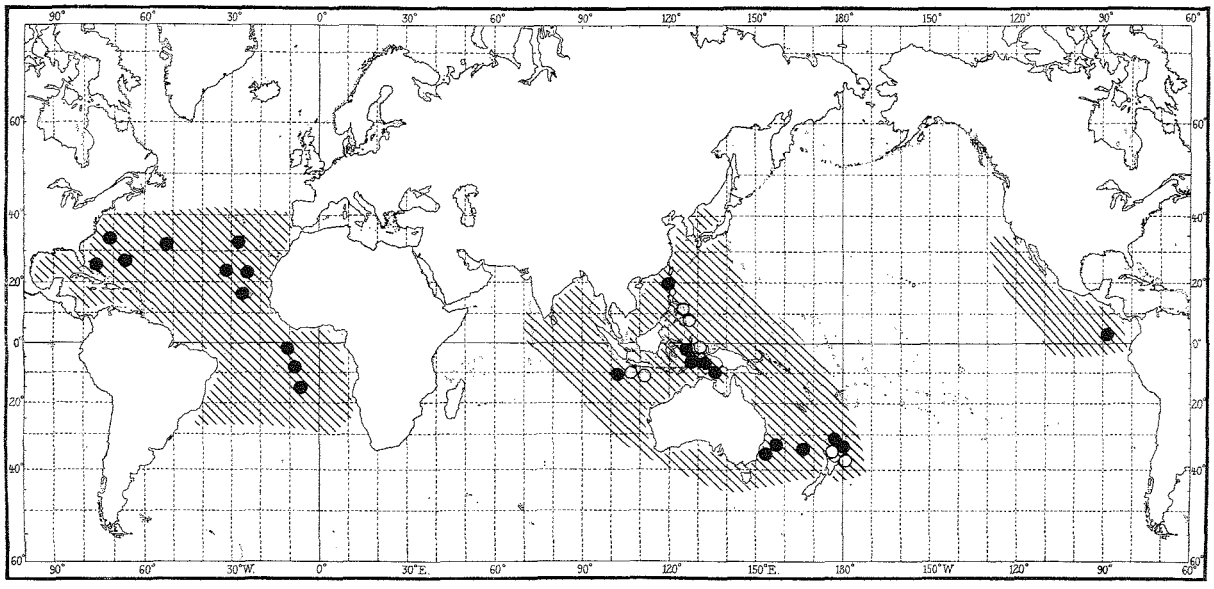


Fig. 11. Probable geographical distribution of *Sergia japonica*. Black symbols indicate "Dana" stations, white symbols indicate "Galathea" stations. Shaded areas without symbols are supported by literature data.

Sergia laminata (Burkenroad, 1940)

Figs. 12-14

Sergestes laminatus Burkenroad, 1940: 52.
Sergestes (Sergia) laminatus. – Yaldwyn 1957: 9. – Kensley 1971: 251, fig. 18; 1977: 18. – Vereshchaka 1990b: 138.
Sergestes (Sergia) guineensis Crosnier & Forest, 1973: 343, fig. 118.
Sergestes guineensis. – Vereshchaka 1994a: 79 (synonymized with *Sergia laminata*).
Sergia laminata. – Omori 1974: 236. – Walters 1976: 824. – Krygier & Wasmer 1988: 50. – Vereshchaka 1994a: 79, figs. 6-7, 26; 1995a: 1651.
Sergia guineensis. – Krygier & Wasmer 1988: 50.

Material examined: "Dana" stations: 1157-5 (2m 8-8½); 1159-5 (2f 7½-9); 1163-2 (4f 7-9½ & 3m 7-8); 1172-1 (5f 9-10 & 1m 9); 3558-1 (2f 10-11); 3561-3 (3m 9-11); 3561-4 (1f 10½); 3920-2 (1m 8); 3921-1 (1m 9); 3933-1 (1f 10½ & 1m 9½); 3933-2 (2f 5-11); 3964-8 (1f 5½); 3996-1 (1f 8); 3996-2 (1m 7½); 3996-3 (5f 5-7 & 3m 4½-7½); 3996-4 (7f 6½-11 & 1m 6); 3996-6 (5f 8-8½); 3996-7 (6f 5-6½ & 2m 5½-6½); 3997-1 (5f 7-9 & 5m 7-9); 3998-1 (1f 10 & 2m 8-10); 3998-2 (6f 6-7½ & 5m 5-6½); 3998-9 (1f 11 & 1m 8); 4000-6 (1f 6½); 4000-8 (1f 9); 4000-9 (1f 5 & 2m 4½-9); 4000-10 (2f 8-8½ & 1m 7).

Holotype of *Sergestes laminatus,* "Dana" St. 3933-1 (ZMUC CRU 1605).

Holotype of *Sergestes (Sergia) guineensis* (MNHN-Na 10150); paratype of same (MNHN-Na 4369).

Type locality: Western Indian Ocean, 11°18′S, 50°03′E.

Type material: Holotype of *Sergestes laminatus* (ZMUC, see above).

Diagnosis: Integument firm, cornea well pigmented, dark brown, much wider than eyestalk; segment 3 of outer A I flagellum in male with tubercle just reaching segment 4 of flagellum; scaphocerite with conspicuous distal tooth; Mxp I endopod with penultimate segment equal to terminal segment; PV of petasma of leaf-like form, overlapping LI and LC; LT reaching end of PV; LA curved at about 3/4 of its length, tip directed midventrally.

Description: Cp with blunt rostrum, 2.3 times as long as high and 0.45 times as long as abdomen (Fig. 12A). Abdomen with somite VI 2.1 times as long as high and 1.2 times as long as telson; telson 4.0 times as long as wide.

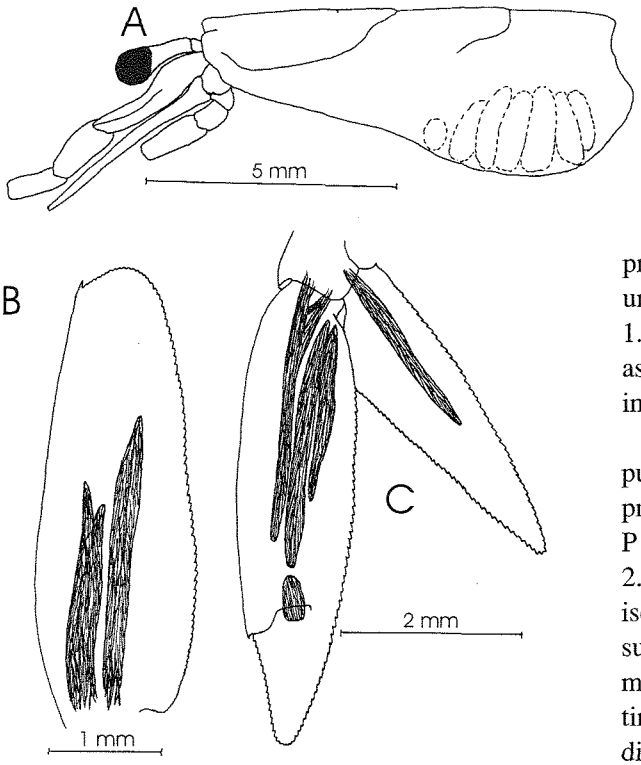


Fig. 12. *Sergia laminata*, male, "Dana" St. 3933-1, Cp length 9.5 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

Cornea 1.0 times as long as wide, 0.7 times as long and 1.3 times as wide as eyestalk.

A I peduncle 0.6 times as long as Cp, with segments 2 and 3 0.50 times as long as segment 1; segment 4 of flagellum bearing 3 bristles and several setae on dorsal surface and several setae on ventral surface (Fig. 13C). A II peduncle 0.5 times as long as scaphocerite; latter with distinct distal tooth (Fig. 12B), 3.0 times as long as wide, 0.83 times as long as A I peduncle.

Md palp 0.38 times as long as Cp, with proximal segment 2.2 times as long as distal one. Mx I with palp 1.9 times as long as wide and 0.07 times as long as Cp; endopod 1.3 times as long as wide and 1.4 times as long as palp; endite 1.7 times as long as wide and 0.9 times as long as palp. Mx II with exopod 2.9 times as long as wide and 0.32 times as long as Cp; palp 3.3 times as long as wide and 0.12 times as long as Cp; endopod 1.7 times as long as wide and 1.0 times as long as palp; endites subequal, 1.7 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 2.9 times as long as wide and 0.21 times as long as Cp; endopod 0.9 times as long as exopod; segments 2, 3, and 4 0.7, 0.4, and 0.4 times as long as segment 1, respectively. Mxp II 1.0 times as long as Cp, with merus 1.0, carpus 0.8, propodus 0.9, and dactyl 0.4 times as long as ischium. Mxp III 1.4 times as long as Cp, with merus 1.1, carpus 1.0, propodus 1.0, and dactyl 0.9 times as long as ischium; propodus and dactyl divided into 4 and 7 subsegments, respectively.

P I 1.1 times as long as Cp, with merus 2.6, carpus 1.5, and propodus 2.8 times as long as ischium; propodus incompletely divided into 7 subsegments. P II 1.6 times as long as Cp, with merus 2.5, carpus 2.3, propodus 2.8, and dactyl 0.2 times as long as ischium; propodus incompletely divided into 9-11 subsegments. P III 1.8 times as long as Cp, with merus 3.3, carpus 2.5, propodus 2.9, and dactyl 0.2 times as long as ischium; propodus incompletely divided into 12 subsegments. P IV 1.3 times as long as Cp, with merus 1.6, carpus 1.2, and propodus 0.9 times as long as ischium. P V 0.6 times as long as Cp, with merus 0.9, carpus 0.6, and propodus 0.4 times as long as ischium.

Somite VIII with arthrobranch 0.11 times as long as Cp and 2.6 times as long as epipod. Somite IX with anterior pleurobranch 0.19 times as long as Cp and 4.0 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.22 times as long as Cp and 4.1 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.22 times as long as Cp and 4.2 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.22 times as long as Cp and 4.2 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.20 times as long as Cp and 1.3 times as long as posterior pleurobranch.

Pl I with basipod 0.31 times as long as Cp and exopod 2.1 times as long as basipod. Pl II with basipod 0.29 times as long as Cp; exopod 2.3 and endopod 1.5 times as long as basipod, respectively. Pl III with basipod 0.29 times as long as Cp; exopod 2.4 and endopod 1.5 times as long as basipod, respectively. Pl IV with basipod 0.22 times as long as Cp; exopod 2.2 and endopod 1.4 times as long as basipod, respectively. Pl V with basipod 0.24 times as long as Cp; exopod 1.8 and endopod 1.2 times as long as basipod, respectively.

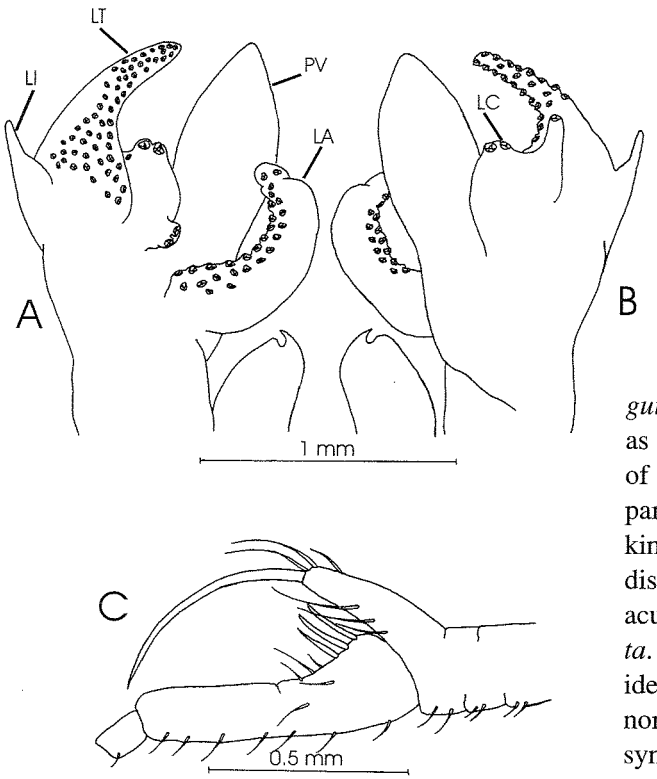


Fig. 13. *Sergia laminata*, male, "Dana" St. 3933-1, Cp length 9.5 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

Up with exopod 4.1 times as long as wide, 7.8 times as long as basipod and 0.6 times as long as Cp; endopod 3.8 times as long as wide and 0.7 times as long as exopod (Fig. 12C).

Petasma (Fig. 13A-B). PV with rounded apex, 1.7 times as long as wide. LI slender, 3.3 times as long as wide and 0.2 times as long as PV. LT greatly overlapping LI and LC, reaching end of PV, 1.7 times as long as wide, 0.8 times as long as PV, armed with numerous hooks along lateral side and around apex. LC short, reaching end of LI, elevated in distal part, 1.2 times as long as wide and 0.5 times as long as PV, bearing few stronger hooks at basal part and near apex on dorsal surface. LA 2.7 times as long as wide and 0.9 times as long as PV, armed with row of hooks on medial side.

Remarks: All the "Dana" specimens correspond to the original description of Burkenroad (1940). They are also very close to the South African specimens described and figured by Kensley (1971), although slight morphological variations in the structure of petasma, due either to the geographical isolation or the manner of drawing, may be found. Since the original description of *S. laminata* (Burkenroad 1940) was very brief and included no figures, this misled several carcinologists. *S. guineensis*, described by Crosnier & Forest (1973) as a new species, appeared to be a junior synonym of *S. laminata* (Vereshchaka 1994a). Having compared both holotypes (that of *S. guineensis* was kindly sent by Dr. A. Crosnier), I found the only distinction to be the form of the rostrum: more acute in *S. guineensis* and more blunt in *S. laminata*. Since the form of the petasma of both species is identical and the rostrum in *Sergia* has little taxonomic value, *S. guineensis* should be regarded as a synonym of *S. laminata*.

S. laminata is most closely related to *S. japonica;* affinities and differences may be found in the remarks to *S. japonica*.

Geographical distribution (Fig. 14): The species occurs in the lower latitudes of all oceans.

Atlantic: North Atlantic south of 20°N ("Dana"). Equatorial Atlantic ("Dana"; as *Sergestes (Sergia) guineensis* Crosnier & Forest 1973), from Congo to Angola (Crosnier & Forest 1973). South Atlantic ("Dana"; Kensley 1971).

Indian Ocean: Southwest Indian Ocean ("Dana"; Kensley 1971), Madagascar (Burkenroad 1940), throughout the western Indian Ocean (Vereshchaka 1990a), southeastern Indian Ocean (Wasmer 1992 [1993]).

East Pacific Ocean: Northeast Pacific (Krygier & Wasmer 1988), off Hawaii (Walters 1976). Southeast Pacific ("Dana"), above Nazca and Sala-y-Gomez Ridges (Vereshchaka 1990b).

There are at least two isolated areas occupied by populations of this species: the Atlantic-Western Indian Oceans and the Pacific Ocean. Since the Indo-West Pacific area has been studied and sampled very well (in particular, during the "Dana" and "Galathea" expeditions), it is hardly probable that both groups are contiguous in this area. *S. laminata* and its sister species *S. japonica* are sympatric, the former species occurring in shallower water (mainly 300-1000 m) than the latter.

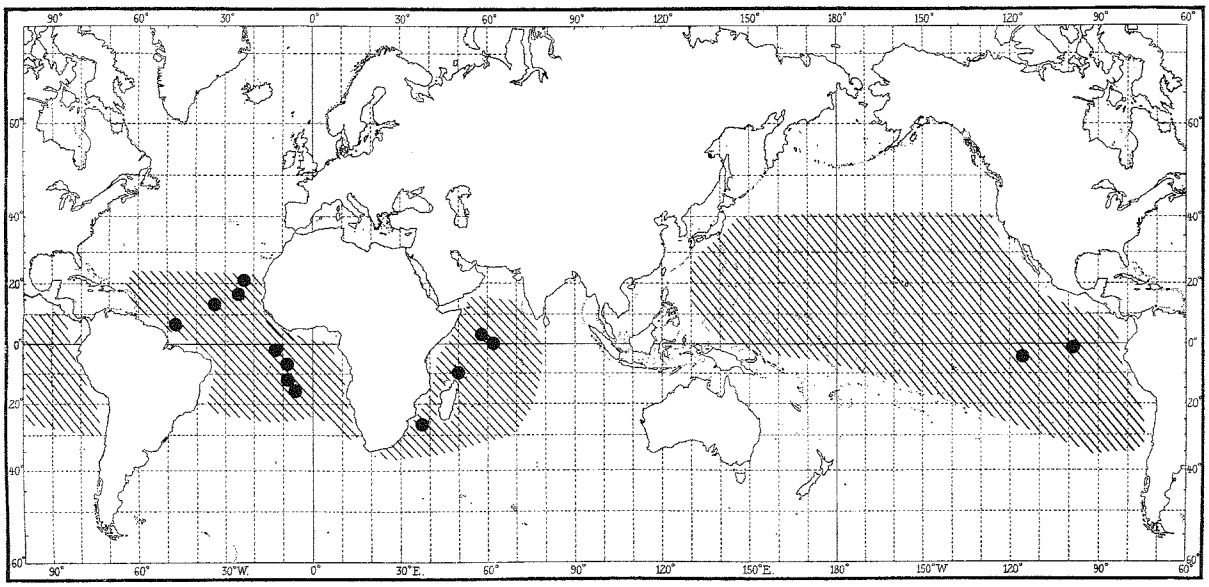


Fig. 14. Probable geographical distribution of *Sergia laminata*. Circles indicate "Dana" stations. Shaded areas without symbols are supported by literature data.

Vertical range: Meso- and bathypelagic species. "Dana" specimens were taken within the depth range 200-2000 m. Most specimens occur at 300-1000 m which is not so deep as was previously supposed (Vereshchaka 1994a).

Sergia gardineri species group

Diagnosis: Lens-less photophores present: 1 long continuous row close to central axis of scaphocerite; 1 long continuous row close to inner margin of Up exopod; hepatic tubercle prominent; postdorsal spine on VI abdominal somite present; ocular papilla well developed, 1/2-4/5 as long as wide; endopod of Mxp I with 3 segments; propodus in Mxp III divided into 3 subsegments; posterior branchial lobe above P III well developed, not lamellar; petasma with either LI or LT rudimentary or absent; clasping organ with 0-3 strong serrated bristles.

Species included: *S. bigemmea* (Burkenroad, 1940), *S. gardineri* (Kemp, 1913), *S. inequalis* (Burkenroad, 1940), *S. kensleyi* n. sp., *S. splendens* (Sund, 1920).

Key to species of the *Sergia gardineri* species group

1. A I with segment 1 longer than segment 2, male outer A I flagellum with tubercle overlapping segment 4 of flagellum, segment 3 of male A I outer flagellum with 0-1 serrated bristle on dorsal surface. LI of petasma absent or rudimentary, LT well developed 2
– A I with segment 1 subequal to segment 2, male outer A I flagellum with tubercle not overlapping segment 4 of flagellum, segment 3 of male A I outer flagellum with 2-3 serrated bristles on dorsal surface. LI of petasma well developed, LT reduced 4
2. Rostrum with additional dorsal tooth. Segment 3 of male A I outer flagellum with single, very strong, serrated bristle on dorsal surface. PV of petasma with few hooks. LC divided, LAc present, LA curved strongly ..... *Sergia gardineri*
– Rostrum without additional dorsal tooth. Segment 3 of male A I outer flagellum without serrated bristle on dorsal surface. PV of petasma without hooks. LC undivided, LAc absent, LA curved slightly 3
3. Ocular papilla about 3/4 as long as wide. Male outer A I flagellum with tubercle reaching end of segment 6 of flagellum. PV of petasma with tip sharp, LI absent ..... *Sergia splendens*
– Ocular papilla about 1/2 as long as wide. Male outer A I flagellum with tubercle reaching end of segment 5 of flagellum. PV

Table 4. Affinities and differences between species of the *Sergia gardineri* species group. a = acute, b = blunt, d = divided, r = rudimentary, u = undivided, w = well developed, + = present, – = absent.

Characters	*S. bigemmea*	*S. gardineri*	*S. inequalis*	*S. kensleyi* n. sp.	*S. splendens*
Rostrum	b	a	a	a	a
Additional dorsal tooth on rostrum	–	+	–	–	–
A I segment 1 relative to A I segment 2	=	<	=	<	<
Tubercle on male A I outer flagellum	w	w	r	w	w
No of segments overlapped by tubercle	4	6	4	5	6
Segment 4 of flagellum	u	u	d	u	u
No of serrated bristles in clasping organ	2	1	3	0	0
Distal tooth of scaphocerite overlapping blade	–	+	+	+	+
End of PV of petasma	a	b	b	b	a
Hooks on PV of petasma	–	+	–	–	–
LI of petasma	w	r	w	r	–
LT of petasma	r	w	r	w	w
LC of petasma	u	d	d	u	u

of petasma with tip not sharp, LI present.... .....*Sergia kensleyi* n. sp.

4. Rostrum with blunt tip. Penultimate photophore on scaphocerite similar to others, additional (to that in proximomedial corner) photophores along distolateral margin of Up endopod usually present. Tubercle on segment 3 of male A I outer flagellum well developed, segment 4 of flagellum with 2 serrated bristles on dorsal side. Distal tooth of scaphocerite not overlapping blade. PV of petasma with tip sharp and not bifid, LC undivided, LA curved ..... *Sergia bigemmea*

– Rostrum with acute tip. Penultimate photophore on scaphocerite more spaced and larger, than others, no additional (to that in proximomedial corner) photophores along distolateral margin of Up endopod. Tubercle on segment 3 of male A I outer flagellum rudimentary, segment 4 of flagellum with 3 serrated bristles in dorsal side. Distal tooth of scaphocerite overlapping blade. PV of petasma with tip not sharp and slightly bifid, LC divided, LA not curved ....*Sergia inequalis*

Sergia bigemmea (Burkenroad, 1940)

Figs. 15-17

Sergestes bigemmeus Burkenroad, 1940: 49.
Sergestes (Sergia) bigemmeus. – Yaldwyn 1957: 9.
Sergia bigemmea. – Omori 1974: 236. – Walters 1976: 819. – Krygier & Wasmer 1988: 50.

Material examined: "Dana" stations: 3570-2 (1m 8½); 3570-3 (1m 10½); 3570-5 (1f 10); 3570-6 (1f 8 & 1m 12); 3576-4 (1m 12½); 3576-5 (1f 9 & 2m 9-9½); 3577-1 (1m 12); 3577-6 (1f 13½); 3577-7 (2f 9-9½ & 2m 9½-12); 3579-1 (1f 12); 3580-2 (1m 14); 3582-1 (1f 13½ & 1m 14); 3585-8 (1m 9½); 3586-2 (1m 7½); 3586-4 (2f 6 & 2m 5½-7); 3587-10 (3m 7½-9); 3587-11 (4j 5-6); 3588-1 (1m 10); 3588-2 (1m 12); 3591-1 (1f 12½); 3591-3 (5j 5-7½); 3593-2 (2j 5½-6½); 3593-8 (3j 5-5½); 3602-1 (1m 14½); 3602-6 (1m 14½); 3624-1 (1m 14½); 3782-3 (1f 13½); 3784-6 (1m 14); 3784-7 (1f 9½); 3784-8 (1m 12); 3786-8 (1f 13); 3788-2 (1f 12).

Holotype of *Sergestes bigemmeus*, "Dana" St. 3570-6 (ZMUC CRU 1600).

Type locality: Off Tahiti, 14°01'S, 147°52'W.

Type material: Holotype of *Sergestes bigemmeus* (ZMUC, see above).

Diagnosis: Integument firm; rostrum blunt, without small additional dorsal tooth; ocular papilla 0.8 times as long as wide; cornea well pigmented, dark brown, considerably wider than eyestalk; A I peduncle with segment 1 equal to segment 2; segment 3 of outer A I flagellum in male with well developed tubercle not overlapping segment 4 of flagellum and segment 4 not subdivided, bearing 2 serrated bristles on dorsal surface; scaphocerite with distal tooth not overlapping blade; PV of petasma tapering into acute point, not bearing hooks; LI well developed; LT reduced, not reaching

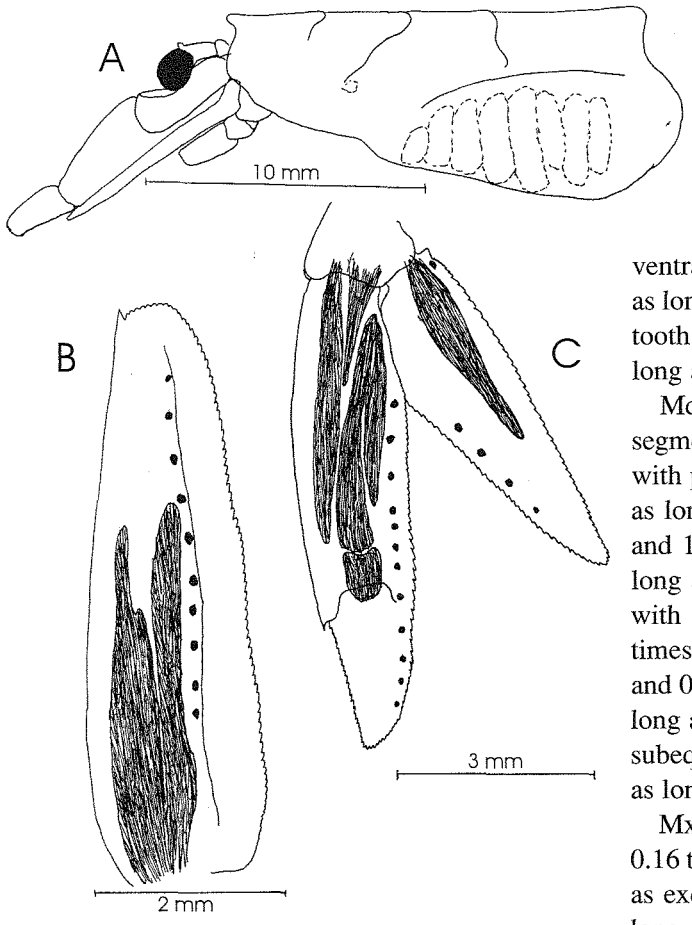


Fig. 15. *Sergia bigemmea*, male, "Dana" St. 3582-1, Cp length 14.1 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

end of PV; LC undivided; LAc developed; LA slightly curved in medial direction; small photophores in single row medial to inner muscle strips on scaphocerite and on Up exopod; few additional (to that in proximomedial corner) photophores along distolateral margin of Up endopod usually present.

Description: Cp 2.0 times as long as high and 0.38 times as long as abdomen (Fig. 15A). Abdomen with somite VI 1.4 times as long as high and 1.1 times as long as telson; telson 2.9 times as long as wide.

Eyestalk with ocular papilla 0.7 times as long as wide, cornea 0.9 times as long as wide, 0.7 times as long and 1.2 times as wide as eyestalk. A I peduncle 0.7 times as long as Cp, with segments 2 and 3 1.0 and 0.63 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle almost reaching end of segment 4 of flagellum; latter bearing 2 strong serrated bristles and few setae on dorsal surface and several setae on ventral surface (Fig. 16C). A II peduncle 0.4 times as long as scaphocerite; latter with prominent distal tooth not overlapping blade (Fig. 15B), 3.5 times as long as wide, 0.77 times as long as A I peduncle.

Md palp 0.29 times as long as Cp, with proximal segment 2.5 times as long as distal segment. Mx I with palp 2.2 times as long as wide and 0.06 times as long as Cp; endopod 1.7 times as long as wide and 1.4 times as long as palp; endite 1.4 times as long as wide and 0.8 times as long as palp. Mx II with exopod 2.2 times as long as wide and 0.30 times as long as Cp; palp 5.0 times as long as wide and 0.16 times as long as Cp; endopod 1.8 times as long as wide and 0.6 times as long as palp; endites subequal, 1.6 times as long as wide and 0.2 times as long as palp.

Mxp I with exopod 2.9 times as long as wide and 0.16 times as long as Cp; endopod 1.0 times as long as exopod; segments 2 and 3 1.1 and 0.8 times as long as segment 1, respectively; segment 2 incompletely subdivided at 0.7 length. Mxp II 0.8 times as long as Cp, with merus 1.1, carpus 0.9, propodus 1.0, and dactyl 0.5 times as long as ischium. Mxp III 1.2 times as long as Cp, with merus 1.1, carpus 0.9, propodus 0.8, and dactyl 0.7 times as long as ischium; dactyl incompletely divided into 6 subsegments.

P I 0.9 times as long as Cp, with merus 2.4, carpus 1.5, and propodus 2.6 times as long as ischium; propodus divided into 10 subsegments. P II 1.3 times as long as Cp, with merus 3.1, carpus 2.6, propodus 3.1, and dactyl 0.1 times as long as ischium; propodus divided into 11 subsegments. P III 1.6 times as long as Cp, with merus 2.4, carpus 2.0, propodus 2.3, and dactyl 0.1 times as long as ischium; propodus incompletely divided into 11 subsegments. P IV 1.1 times as long as Cp, with merus 1.2, carpus 0.9, and propodus 0.9 times as long as ischium. P V 0.6 times as long as Cp, with merus 1.1, carpus 0.9, and propodus 0.7 times as long as ischium.

Somite VIII with arthrobranch 0.11 times as long as Cp and 2.1 times as long as epipod. Somite IX with anterior pleurobranch 0.21 times as long as Cp

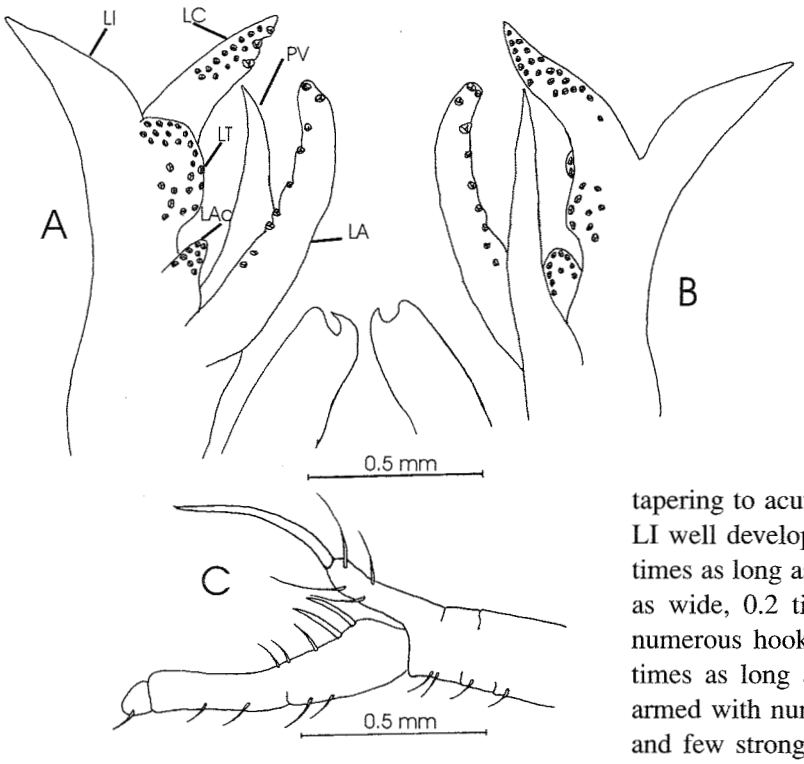


Fig. 16. *Sergia bigemmea*, male, "Dana" St. 3582-1, Cp length 14.1 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

and 3.9 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.26 times as long as Cp and 4.8 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.28 times as long as Cp and 4.1 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.29 times as long as Cp and 1.4 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.25 times as long as Cp and 1.2 times as long as posterior pleurobranch.

Pl I with basipod 0.31 times as long as Cp and exopod 2.1 times as long as basipod. Pl II with basipod 0.29 times as long as Cp; exopod 2.5 and endopod 1.3 times as long as basipod, respectively. Pl III with basipod 0.29 times as long as Cp; exopod 2.3 and endopod 1.3 times as long as basipod, respectively. Pl IV with basipod 0.29 times as long as Cp; exopod 2.1 and endopod 1.2 times as long as basipod, respectively. Pl V with basipod 0.25 times as long as Cp; exopod 2.1 and endopod 1.2 times as long as basipod, respectively.

Up with exopod 4.2 times as long as wide, 7.3 times as long as basipod and 0.6 times as long as Cp; endopod 3.3 times as long as wide and 0.7 times as long as exopod (Fig. 15C).

Petasma (Fig. 16A-B). PV long and narrow, tapering to acute point, 5.0 times as long as wide. LI well developed, 3.3 times as long as wide, 0.6 times as long as PV. LT reduced, 0.4 times as long as wide, 0.2 times as long as PV, covered with numerous hooks. LC slightly overlapping LI, 2.9 times as long as wide, 0.7 times as long as PV, armed with numerous smaller hooks in distal part and few stronger hooks on distolateral side. LAc developed, 1.1 times as long as wide and 0.2 times as long as PV, distally covered by several hooks. LA 4.4 times as long as wide and 1.0 times as long as PV, armed with row of smaller hooks along medial side and few stronger hooks near tip.

Photophores. Scaphocerite: continuous row of 8-12 small organs medial to inner strip of muscle from 1/4 to 0.9 of blade length. Up exopod: continuous row of 10-14 small photophores medial to inner strips of muscle from 1/4 to 0.9 exopod length. Up endopod: 1 photophore in proximomedial corner and few additional photophores along distolateral side, from 0.4 to 0.8 endopod length.

Remarks: Due to its rarity, this species has been mentioned by only few authors since the original description.

Sergia bigemmea differs from all species of the species group in (1) blunt rostrum, (2) presence of 2 teeth on dorsal side of segment 4 of male outer A I flagellum, (3) distal tooth on scaphocerite not overreaching blade, and (4) usual presence of additional photophores on Up endopod. Other differences and affinities between *S. bigemmea* and all other known species of the species group are shown in Table 4.

Geographical distribution (Fig. 17): West and Central tropical Pacific only: between 25°N and

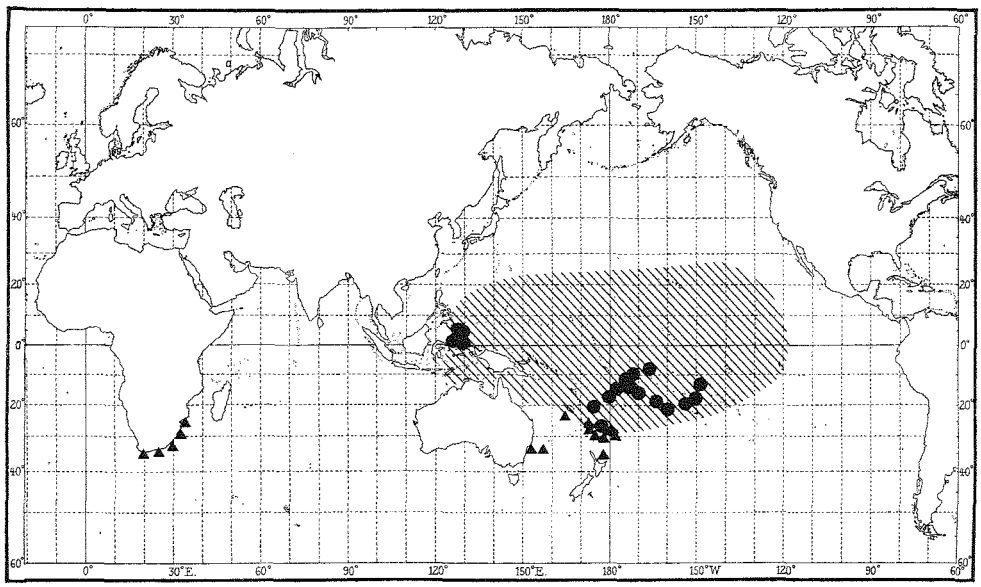


Fig. 17. Probable geographical distribution of *Sergia bigemmea* (circles) and *S. kensleyi* n. sp. (triangles). Circles and triangles indicate "Dana" stations). Shaded area without symbols is supported by literature data.

30°S, off New Guinea and tropical Pacific ("Dana"); Northeast Pacific (Krygier & Wasmer 1988), off Hawaii (Walters 1976).

S. bigemmea and *S. kensleyi* are parapatric, the former occurring in tropical waters of the Indian Ocean and Pacific, the latter living in the temperate waters of the Southern Hemisphere of the same oceans. *S. bigemmea* is sympatric with *S. gardineri* and *S. inequalis* and allopatric with *S. splendens*.

Vertical range: An interzonal species, migrating daily between the upper bathypelagic and the epi-/mesopelagic zones. "Dana" specimens were taken within the depth range 100-1700 m. Most specimens live at 100-300 m at night and at 1000-1300 m during the day.

Sergia gardineri (Kemp, 1913)

Figs. 18-20

Sergestes gardineri Kemp, 1913: 55, pl. 7, figs. 2-5. – Hansen 1919: 9, pl. 1, fig. 2a-c.
Sergestes (Sergia) gardineri. – Yaldwyn 1957: 9.
Sergia gardineri. – Walters 1976: 818. – Krygier & Wasmer 1988: 50.

Material examined: "Dana" stations: 3549-6 (1m 8½); 3556-1 (1f 6½ & 3m 7½-8½); 3556-2 (3f 4½-6); 3556-4 (1m 5); 3556-5 (3f 3½-5 & 2m 5-6½); 3556-6 (3f 5-7½ & 2m 5-5½); 3656-8 (1m 7); 3561-3 (1f 5½ & 1m 7); 3567-1 (1f 5); 3569-1 (1j 3½); 3585-9 (1m 5½); 3624-2 (2m 6½); 3624-8 (1f 7 & 2m 8-8½); 3624-9 (1f 7); 3625-4 (1f 6); 3626-2 (1f 7½); 3626-3 (1f 7); 3627-3 (1f 7); 3627-4 (2f 7-7½); 3637-2 (1f 6); 3653-7 (1f 8½); 3655-4 (1m 7); 3655-5 (1m 7½); 3656-3 (1f 7½); 3663-1 (2f 8-9); 3663-3 (1f 7½); 3676-6 (1f 7½); 3676-7 (1m 6); 3676-8 (1f 4 & 1m 6½); 3676-9 (7f 6½-8½ & 10m 5-7½); 3677-1 (1m 5½); 3677-2 (1f 6 & 3m 5-6); 3678-2 (5f 7-7½ & 9m 4½-7); 3678-3 (1f 6½ & 1m 6½); 3680-2 (3f 5½-6 & 1m 5½); 3680-3 (2f 5 & 1m 6); 3682-3 (3f 4½-5 & 2m 4-5); 3683-2 (2f 6 & 2m 5-6½); 3683-4 (1j 3); 3683-7 (1f 4½); 3686-3 (2m 6-6½); 3687 [sample number unknown] (2f 5-5½ & 1m 5½); 3687-2 (2m 5-7); 3688-2 (4f 4½-7½ & 1m 5); 3688-3 (3f 4-5 & 1m 4½); 3688-4 (3f 4½-5 & 3m 4½-5½); 3689-4 (3f 6-8½ & 3m 5-5½); 3689-8 (1f 7½); 3714-2 (2j 2½); 3714-7 (1m 5½); 3714-8 (1f 8½ & 1m 5); 3714-9 (2j 2-3); 3716-1 (1f 7); 3729-1 (1f 6½); 3729-2 (4f 4-5½ & 1m 6); 3729-3 (29j 2-2½); 3730-2 (1f 6½); 3730-3 (2f 6½-7½ & 1m 6); 3731-10 (1f 7½); 3731-12 (1m 6); 3740-3 (4f 6½-7 & 5m 6-7); 3745-3 (9f 4½-7½); 3746-2 (4f 4½-8½ & 1m 8); 3749-2 (2f 5-7½); 3749-3 (1f 5 & 1j 2½); 3751-1 (2m 5½); 3751-2 (1f 6½ & 3m 6); 3751-3 (2f 5½-6½ & 2m 5-6½); 3751-7 (1f 7 & 1m 6 & 1j 3); 3752-2 (1f 5); 3752-3 (1f 6 & 2m 5); 3768-2 (2m 4-7); 3782-2 (2f 4½-5 & 1m 4½); 3782-3 (2m 3½-4); 3784-1 (6f 4-7 & 3m 4-7); 3784-2 (1f 5½); 3784-3 (1f 5½ & 2m 4); 3784-7 (1m 5); 3788-2 (1f 5); 3789-9 (2m 4-7);

3792-2 (2f 6-6½); 3793-1 (1f 4 & 1m 3½); 3793-2 (2f 3½-6½); 3795-3 (2f 3½-4½); 3796-1 (1f 6 & 6m 5-7); 3796-2 (3f 4½-6½); 3797-3 (2f 4½-7 & 6m 4-6½); 3812-1 (1f 5 & 1m 5½); 3812-2 (6f 4-5 & 8m 4½-6½); 3812-3 (1f 5 & 2m 4-4½); 3813-2 (1f 5½); 3814-2 (2m 4½-6); 3817-1 (1f 6½); 3819-1 (1m 4½); 3824-6 (1f 8); 3828-9 (1m 5); 3838-1 (1f 7); 3841-2 (1f 7 & 1m 4); 3844-7 (3f 4-6); 3864-3-4 (1f 5); 3869-7 (1m 5); 3873-1 (1f 6 & 1m 5); 3873-2 (2f 5½ & 1m 5½); 3873-3 (7f 5½-7 & 1m 5); 3873-4 (2m 5); 3874-1 (2f 6-7½); 3874-3 (1f 6); 3874-4 (2f 6-6½); 3876-1 (2f 6-7 & 1m 6); 3887-3 (1f 4½); 3889-2 (1f 5½ & 1m 6½); 3889-3 (3f 4½-5½ & 2m 4½-5½); 3890-1 (2f 5-8 & 1m 6); 3890-2 (2f 3½-4); 3890-3 (1f 4 & 1m 4); 3891-1 (9f 3½-7 & 6m 4-6); 3891-2 (5f 4½-5½ & 4m 4½-6); 3891-3 (5f 4½-7½ & 3m 4-6); 3891-4 (5f 3-5½); 3892-1 (1f 5); 3892-2 (2f 7-8); 3893-3 (3f 4-4½ & 2m 4-6); 3893-8 (1f 4 & 2m 4-4½); 3894-2 (4f 3-7½ & 1m 4½); 3905-1 (1m 5½); 3905-2 (1f 8½); 3905-3 (1f 7 & 2m 5½-7); 3905-4 (1f 7 & 1m 5); 3906-3 (1m 5½); 3906-4 (2f 5½-7); 3907-1 (2m 6); 3907-2 (3f 6-8 & 2m 6); 3907-3 (4f 6½-8 & 1m 6); 3907-4 (11f 5-8½ & 16m 5-7½); 3909-1 (1m 7½); 3909-2 (1m 7); 3909-4 (1f 4 & 1m 6½); 3909-5 (1m 7); 3910-3 (1f 7); 3912-3 (1f 4 & 2m 5½-6½); 3914-3 (1f 3½ & 1m 6½); 3915-2 (1m 5½); 3915-3 (15f 4-6½ & 14m 4½-6); 3916-1 (1f 6); 3916-3 (3f 4-6); 3917-1 (1f 7½); 3917-2 (1f 6½ & 2m 5½-6½); 3917-4 (2f 6-6½); 3917-5 (11f 3½-5½ & 7m 3½-6½ & 8j 3); 3917-7 (2f 3½ & 1m 5); 3917-8 (4f 3-6½ & 7m 3½-6½); 3917-9 (6f 3½ & 8m 3½-5 & 7j 3); 3918-2 (7j 2½); 3920-7 (1f 6); 3920-8 (1f 6½ & 1m 6½); 3929-2 (1f 6½ & 1m 5½); 3929-3 (2f 6½-7 & 3m 4½-6½); 3933-2 (1m 4½); 3934-1 (4f 5-7 & 2m 4½-5½); 3934-2 (4f 4½-6½ & 6m 5½-6½); 3934-3 (2f 5-5½ & 12m 4-6½); 3934-4 (5f 4-6 & 8m 4½-6½); 3934-5 (1f 4); 3935-1 (8f 4-7 & 18m 4½-6); 3935-2 (7f 4½-7½ & 26m 4-6½); 3935-3 (4f 6-8 & 5m 4½-5½); 3937-1 (3f 6-6½ & 1m 6); 3937-2 (5f 6-7 & 7m 5½-6½); 3937-3 (3f 4-6 & 8m 5-6½ & 4j 3-3½); 3937-4 (5f 5½-7½ & 2m 4-6½); 3938-2 (1f 6); 3939-1 (6f 5-7 & 7m 4-6); 3939-2 (18f 5-7 & 20m 5-6½); 3939-3 (11f 5½-7½ & 9m 4½-6); 3941-1 (3f 4½-7& 1m 6); 3941-2 (26f 3½-7½ & 16m 3½-6); 3941-3 (46f 4-8 & 37m 4-6); 3941-4 (7f 4-6 & 4m 3½-6); 3943-2 (7f 4-7 & 5m 4-5½); 3943-3 (8f 4-6½ & 11m 4-6 & 2j 3½); 3943-4 (3f 5-7 & 5m 4½-5½); 3946-2 (14f 4-7½ & 6m 5½-6); 3949-1 (1m 6); 3949-2 (1f 4); 3949-3 (1m 4 & 1j 2½); 3952-1 (1f 5½); 3952-2 (1f 6½); 3952-3 (2f 7); 3957-2 (1j 3½); 3959-2 (1f 8½); 3969-4 (2m 5-5½); 3970-2 (1f 4 & 1m 4½ & 1j 2½); 3971-2 (1f 6½ & 1m 5½); 3971-4 (12f 4-6½ & 6m 4-6½ & 5j 3½).

"Galathea" station: 464 (1m 6½).

Type localities: Western Indian Ocean: S by E of Farquhar, 10°27′S, 51°17′E, 27 Sep. 1905 (3 different samples: 2 young, badly damaged; 3 males & 3 females, 15-24 mm; 1 female, 20 mm); NE of Madagascar, between Providence and Alphonse Islands, 8°16′S, 51°26′E, 6 Oct. 1905 (1 male, 17 mm); 5 miles off Desroches Atoll (1 male, 17 mm).

Type material: Probably syntype(s), not found at NHM, perhaps lost (not examined).

Diagnosis: Integument firm; rostrum acute, with small additional dorsal tooth; ocular papilla 0.8 times as long as wide; cornea well pigmented, dark brown, considerably wider than eyestalk; A I peduncle with segment 2 shorter than segment 1; segment 3 of outer A I flagellum in male with well-developed tubercle overlapping end of segment 6 of flagellum; segment 4 not subdivided, bearing very strong serrated bristle on dorsal surface; scaphocerite with strong distal tooth overlapping blade; PV of petasma with blunt point, bearing hooks; LI rudimentary, as inconspicuous heel at base of LT; LT not reduced, not reaching and of PV; LC divided at proximal part into 2 lobules; LAc rudimentary; LA strongly curved in medial direction; small photophores arranged in single row medial to inner muscle strips on scaphocerite and on Up exopod; no additional (to that in proximomedial corner) photophores along distolateral margin of Up endopod.

Description: Cp with rostrum acute at tip and bearing small additional dorsal tooth, 1.6 times as long as high and 0.34 times as long as abdomen (Fig. 18A). Abdomen with somite VI 1.5 times as long as high and 1.2 times as long as telson; telson 4.0 times as long as wide.

Eyestalk with ocular papilla 0.7 times as long as wide; cornea 0.9 times as long as wide, 0.8 times as long and 1.2 times as wide as eyestalk.

A I peduncle 0.8 times as long as Cp, with segments 2 and 3 0.63 and 0.67 times as long as segment 1, respectively; segment 4 of flagellum bearing extremely strong serrated bristle and several

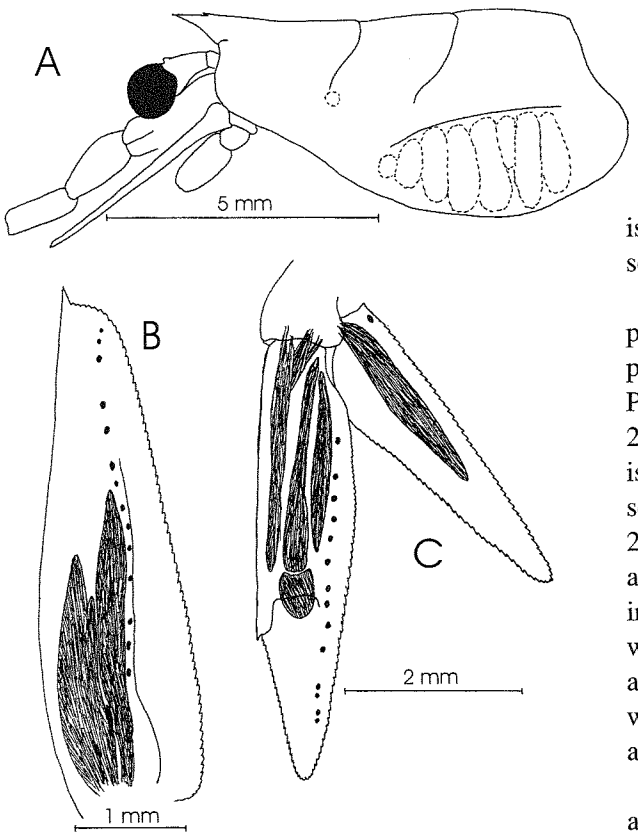


Fig. 18. *Sergia gardineri*, male, "Dana" St. 3905-3, Cp length 6.6 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

setae on dorsal and ventral surfaces (Fig. 19C). A II peduncle 0.4 times as long as scaphocerite; latter with strong distal tooth overreaching blade (Fig. 18B), 3.6 times as long as wide, 0.91 times as long as A I peduncle.

Md palp 0.32 times as long as Cp, with proximal segment 2.2 times as long as distal segment. Mx I with palp 2.0 times as long as wide and 0.07 times as long as Cp; endopod 1.6 times as long as wide and 1.6 times as long as palp; endite 1.4 times as long as wide and 0.9 times as long as palp. Mx II with exopod 3.0 times as long as wide and 0.34 times as long as Cp; palp 2.7 times as long as wide and 0.12 times as long as Cp; endopod 1.9 times as long as wide and 1.2 times as long as palp; endites subequal, 1.9 times as long as wide and 0.5 times as long as palp.

Mxp I with exopod 2.5 times as long as wide and 0.18 times as long as Cp; endopod 1.6 times as long as exopod; segments 2 and 3 0.7 and 1.0 times as long as segment 1, respectively. Mxp II 0.9 times as long as Cp, with merus 1.1, carpus 1.0, propodus 1.1, and dactyl 0.6 times as long as ischium. Mxp III 1.2 times as long as Cp, with merus 0.6, carpus 0.7, propodus 0.6, and dactyl 0.5 times as long as ischium; dactyl incompletely divided into 5 subsegments.

P I 1.0 times as long as Cp, with merus 1.9, carpus 1.1, and propodus 1.7 times as long as ischium; propodus incompletely divided into 7 subsegments. P II 1.4 times as long as Cp, with merus 2.4, carpus 2.1, propodus 2.4, and dactyl 0.2 times as long as ischium; propodus incompletely divided into 7 subsegments. P III 1.6 times as long as Cp, with merus 2.3, carpus 1.8, propodus 1.9, and dactyl 0.2 times as long as ischium; propodus incompletely divided into 9 subsegments. P IV 1.0 times as long as Cp, with merus 1.2, carpus 1.1, and propodus 1.0 times as long as ischium. P V 0.6 times as long as Cp, with merus 1.1, carpus 0.7, and propodus 0.7 times as long as ischium.

Somite VIII with arthrobranch 0.12 times as long as Cp and 2.5 times as long as epipod. Somite IX with anterior pleurobranch 0.19 times as long as Cp and 3.6 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.23 times as long as Cp and 4.8 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.28 times as long as Cp and 5.7 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.31 times as long as Cp and 2.2 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.29 times as long as Cp and 1.2 times as long as posterior pleurobranch.

Pl I with basipod 0.29 times as long as Cp and exopod 1.9 times as long as basipod. Pl II with basipod 0.31 times as long as Cp; exopod 2.1 and endopod 1.3 times as long as basipod, respectively. Pl III with basipod 0.31 times as long as Cp; exopod 2.0 and endopod 1.2 times as long as basipod, respectively. Pl IV with basipod 3.3 times as long as Cp; exopod 1.9 and endopod 1.2 times as long as basipod, respectively. Pl V with basipod 0.30 times as long as Cp; exopod 1.7 and endopod 1.0 times as long as basipod, respectively.

Up with exopod 4.8 times as long as wide, 6.0 times as long as basipod and 0.8 times as long as Cp; endopod 4.1 times as long as wide and 0.7 times as long as exopod (Fig. 18C).

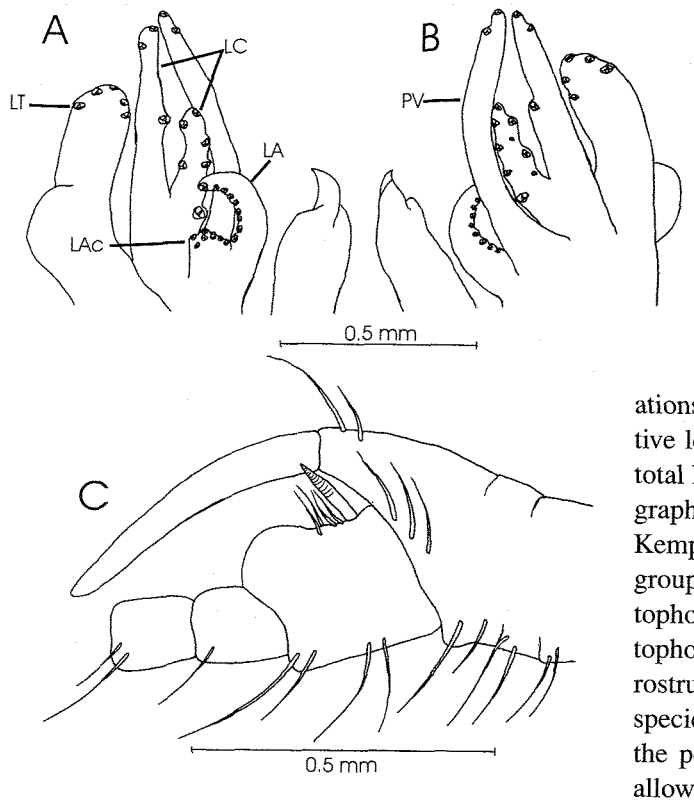


Fig. 19. *Sergia gardineri*, male, "Dana" St. 3905-3, Cp length 6.6 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

Petasma (Fig. 19A-B). PV long and narrow, with rounded apex, 5.4 times as long as wide, armed with few hooks near tip. LT slightly curved laterally, 2.3 times as long as wide, 0.7 times as long as PV, armed with several hooks around apex. Longer lobule of LC 5.8 times as long as wide, overlapping LT and not reaching end of PV, 2.2 times and 0.9 times as long as shorter lobule and PV, respectively, distally armed with few hooks; shorter lobule 3.1 times as long as wide, overlapping LA and not reaching end of LT, armed with few hooks. LAc reduced, as long as wide and 0.1 times as long as PV, covered by several hooks. LA 2.8 times as long as wide and 0.4 times as long as PV, strongly curved medially, armed with several smaller hooks along medial side.

Photophores. Scaphocerite: continuous row of 8-16 small organs medial to inner strip of muscle from 1/4 blade length almost to tip. Up exopod: continuous row of 7-15 small photophores medial to inner strips of muscle from 0.2 to 0.9 exopod length. Up endopod: 1 photophore in proximomedial corner.

Remarks: All "Dana" specimens correspond to the Kemp's (1913) original description. Slight variations in the form of the rostrum, in the comparative length of the smaller lobule of LC (0.2-0.8 of total length of the longer lobule) indicate only geographical variability and are not of species level. Kemp (1913) referred this species to the *robustus* group of species and reported the absence of photophores, which is not true: lens-less dermal photophores are numerous. The remarkable form of the rostrum makes preliminary identification of this species very easy, while the characteristic form of the petasma without a LI and with a divided LC allows rapid confirmation of species identity as *S. gardineri*. Due to this, no incorrect synonymy has appeared since the species was described.

S. gardineri is more similar to *S. splendens* and *S. kensleyi* n. sp. than to other species. Affinities and differences between *S. gardineri* and all other known species of the species group are presented in Table 4.

Geographical distribution (Fig. 20): Tropical and temperate areas of the Indian and Pacific Oceans.

Indian Ocean: Off South Africa and Madagascar ("Dana"), western part (Kemp 1913), northern and eastern part ("Dana" and "Galathea"; Hansen 1919).

Pacific Ocean: West Pacific ("Dana" stations). Off Australia and New Zealand; Central and East Pacific ("Dana"); off Hawaii (Walters 1976), western Central Pacific and off Japan (Krygier & Wasmer 1988).

Sergia gardineri and *S. splendens*, both living in the upper 500 m layer of the pelagic zone, both with diurnal vertical migrations and similar in other ecological features, are parapatric, with *S. gardineri* occurring in the Indian and Pacific Oceans, *S. splendens* living only in the Atlantic Ocean. *S. gardineri* is sympatric with other members of the species group.

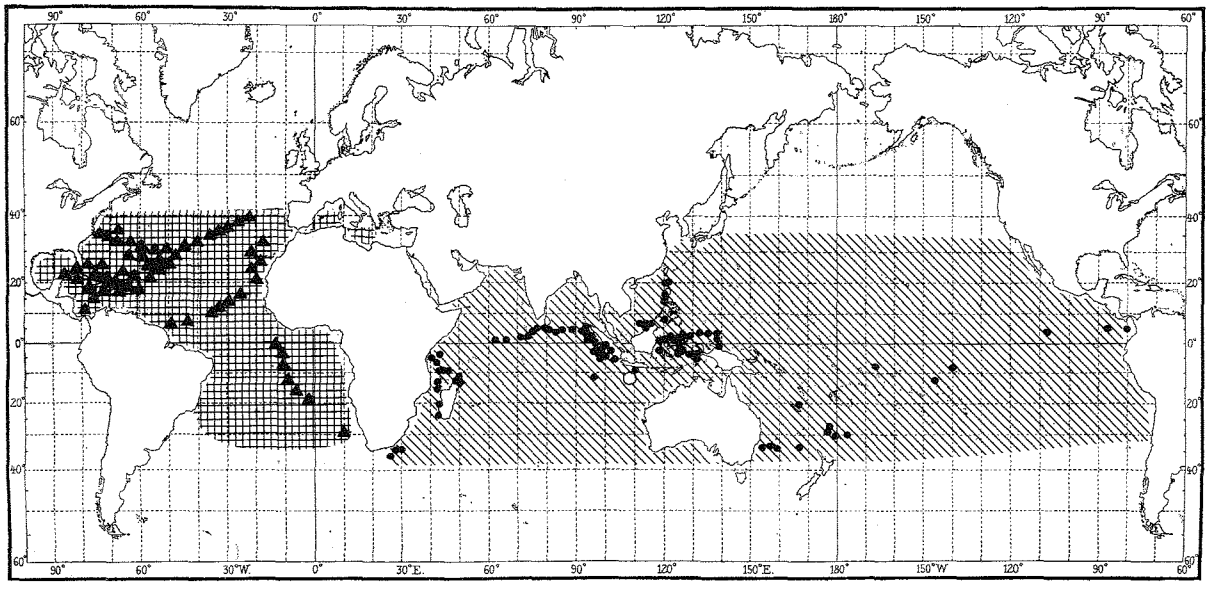


Fig. 20. Probable geographical distribution of *Sergia gardineri* (circles, hatching) and *Sergia splendens* (triangles, cross hatching). Black symbols indicate "Dana" stations, white symbol a "Galathea" station. Shaded areas without symbols are supported by literature data.

Vertical range: An interzonal species migrating diurnally between the mesopelagic and epipelagic zones. "Dana" specimens were taken within the depth range 20-2000 m. Most specimens live in the 100-300 m layer at night and 700-1000 m during the day.

Sergia inequalis (Burkenroad, 1940)

Figs. 21-23, Pl. 4C

Sergestes inequalis Burkenroad, 1940: 51.
Sergestes (Sergia) inequalis. – Yaldwyn 1957: 9.
Sergia inequalis. – Omori 1974: 236. – Walters 1976: 821. – Kensley 1981: 64, fig. 3. – Krygier & Wasmer 1988: 50.

Material examined: "Dana" stations: 3585-1 (1f 14); 3585-8 (3f 11-13 & 1m 11); 3586-4 (1f 6 & 2m 5-10); 3587-7 (1m 13½); 3587-11 (1f 7); 3676-1 (1f 9½); 3676-2 (1f 11); 3676-6 (1m 9½); 3676-9 (1f 11 & 1m 9½); 3678-1 (1f 14½); 3680-2 (1f 8½); 3681-1 (1m 10½); 3682-3 (1f 8½ & 2m 7½-8); 3683-7 (1f 5 & 1j 4½); 3687-3 (1f 7½); 3728-4 (1j 5); 3730-2 (2f 6½-8½ & 1m 10); 3734-3 (1f 6½); 3739-1 (2f 7-13); 3744-3 (3m 8½-11½); 3745-1 (1f 13½ & 1m 9½); 3745-3 (1m 10); 3749-2 (2f 5 & 3m 7-9); 3749-3 (1f 7 & 1m 5½); 3751-2 (1f 15 & 1m 9); 3751-3 (1f 5 & 1m 6); 3751-6 (4f 8½-13½ & 4m 10-12½); 3751-7 (1m 7); 3752-2 (4f 7-15); 3753-3 (1f 7½); 3759-13 (2j 4-4½); 3759-14 (1j 5); 3766-18 (1f 12); 3767-1 (3m 9½); 3767-2 (1f 6); 3767-3 (1m 9); 3767-4 (1f 11); 3767-5 (1m 12); 3768-1 (3f 10½-12 & 4m 9-12); 3768-2 (1m 12); 3768-4 (1f 12 & 2m 12-12½); 3768-6 (5f 5½-10 & 2m 8½-10½); 3773-1 (1f 5 & 3m 5½-10); 3773-3 (2f 5-5½ & 2m 4-4½); 3775-1 (2f 5-10); 3775-2 (2f 5-7½); 3782-3 (2f 5-6½); 3784-1 (1f 11); 3784-2 (1m 6½); 3784-8 (1f 13 & 1m 13); 3786-7 (1f 16); 3789-1 (1m 10); 3789-8 (1f 14½); 3792-2 (1f 7 & 1m 6½); 3793-1 (2f 5½); 3795-2 (1m 6); 3795-3 (1f 6); 3796-1 (1f 6½); 3796-2 (3f 4½-7 & 3m 5-8); 3797-3 (2f 5-7½); 3804-3 (1f 12); 3812-2 (5f 6-7½ & 3m 6-7); 3812-3 (1f 8½ & 3m 6½-9); 3814-1 (1m 8½); 3814-5 (1m 10); 3815-6 (1f 13 & 2m 11½-13); 3817-1 (1f 9½ & 1m 9); 3817-2 (1f 6); 3817-6 (4f 6½-10 & 1m 10); 3817-7 (1f 9 & 1m 8); 3828-10 (1f 13); 3840-5 (1f 4½); 3841-1 (1f 8); 3851-4 (1m 5); 3860-20 (2f 10½-11½); 3864 -1-2 (10f 7-14 & 3m 9-10½); 3864-4 (6f 5-10 & 4m 6-13); 3869-7 (1m 9); 3873-1 (1f 10½); 3873-2 (1f 11 & 2m 8½); 3873-3 (2f 7-9 & 1m 9½); 3874-3 (1m 7); 3876-1 (1f 12½); 3876-3 (1m 10); 3884-1 (1f 6½ & 1m 11); 3884-3 (2f 6½-7 & 1m 6 & 2j 4½); 3885-1 (1f 7 & 1m 6); 3886-1 (1f 7); 3887-1 (1f 9 & 2m 5-7½); 3888-3 (1f 5); 3890-3 (1f 7½); 3890-4 (1m 7); 3891-2 (1f 7); 3891-4 (2m 6½-7); 3893-8 (1m 7½); 3905-1 (1m 11½); 3906-4 (1m 13½);

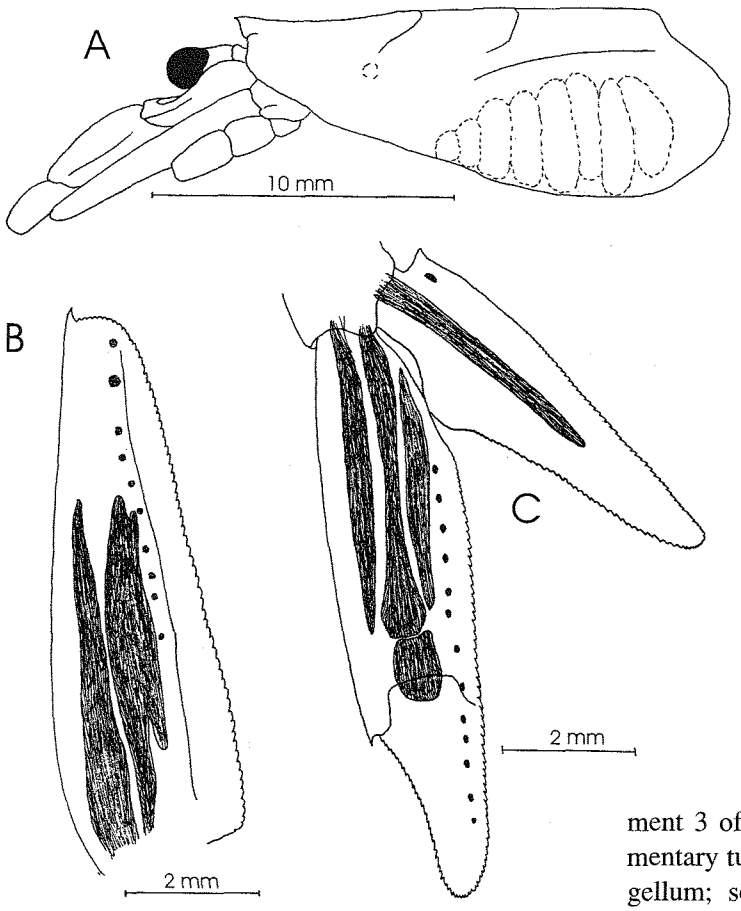


Fig. 21. *Sergia inequalis*, male, "Dana" St. 3906-4, Cp length 13.5 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

3913-3 (1m 13½); 3914-3 (1m 11); 3915-2 (1m 9½); 3915-3 (1m 11); 3916-1 (1m 9); 3916-3 (1f 8); 3917-5 (1f 9½); 3917-6 (2f 10-11); 3917-8 (2f 6-12 & 2m 7-9); 3917-9 (7f 5-6 & 2m 5½-8½); 3918-3 (1m 13); 3920-8 (1f 13); 3933-1 (1m 8½); 3934-4 (1m 11); 3934-5 (1f 11); 3935-3 (2f 10-12½ & 1m 11); 3935-4 (2f 7); 3937-2 (1f 11½); 3941-3 (2f 10-14).

"Galathea" stations: 408 (1f 14½); 441 (1f 11½); 464 (1m 9); 474 (1m 13).

Type locality: Western Pacific off New Guinea, 1°20′S, 138°42′E.

Type material: Holotype of *Sergestes inequalis*, "Dana" St. 3768 (was in ZMUC, lost, not examined, see Introduction).

Diagnosis: Integument firm; rostrum acute, without small additional dorsal tooth; ocular papilla 0.8 times as long as wide; cornea well pigmented, dark brown, considerably wider than eyestalk; A I peduncle with segment 1 as long as segment 2; segment 3 of outer A I flagellum in male with rudimentary tubercle reaching end of segment 6 of flagellum; segment 4 divided into 2 subsegments, proximal subsegment with 3 serrated bristles on dorsal surface; scaphocerite with strong distal tooth overlapping blade; PV of petasma not tapering into acute point, with slightly concave end, not bearing hooks; LI well developed; LT reduced; LC divided; LAc developed; LA not curved; small photophores in single row medial to inner muscle strips on scaphocerite and on Up exopod; no additional (to that in proximomedial corner) photophores along distolateral margin of Up endopod; penultimate photophore on scaphocerite more distanced from and larger than others.

Description: Cp 2.0 times as long as high and 0.40 times as long as abdomen (Fig. 21A). Abdomen with somite VI 1.4 times as long as high and 1.0 times as long as telson; telson 3.0 times as long as wide.

Eyestalk with ocular papilla 0.7 times as long as wide; cornea 1.1 times as long as wide, 0.9 times as long and 1.4 times as wide as eyestalk. A I peduncle 0.7 times as long as Cp, with segments 2 and 3 1.0 and 1.67 times as long as segment 1, respectively, segment 3 of outer A I flagellum in male with 2 long setae and curved rudimentary tubercle

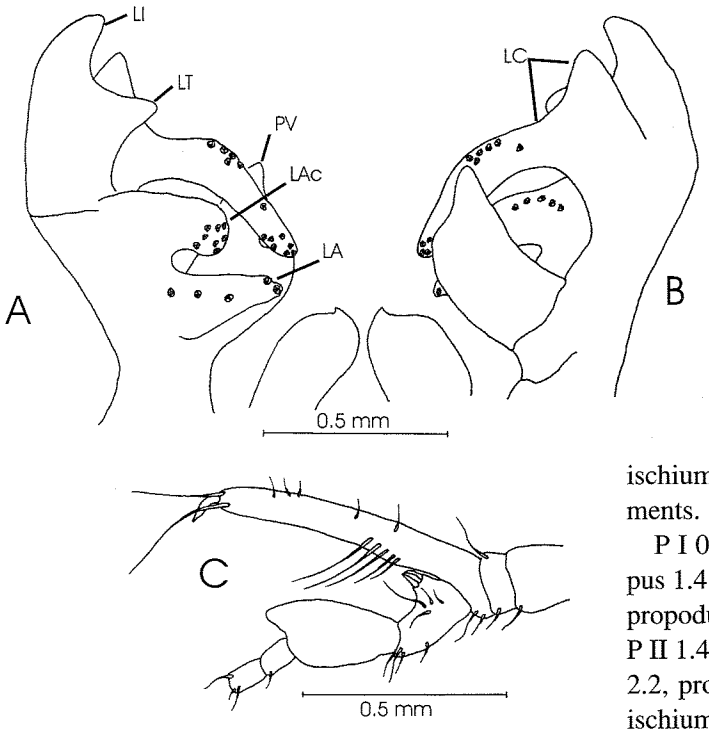


Fig. 22. *Sergia inequalis*, male, "Dana" St. 3906-4, Cp length 13.5 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

reaching end of segment 6 of flagellum; segment 4 divided into 2 subsegments, proximal subsegment with 3 strong serrated bristles and few setae on dorsal surface and several setae on ventral surface, distal segment with distodorsal extension (Fig. 22C). A II peduncle 0.5 times as long as scaphocerite; latter with prominent distal tooth overlapping blade (Fig. 21B), 3.2 times as long as wide, 0.77 times as long as A I peduncle.

Md palp 0.28 times as long as Cp, with proximal segment 2.2 times as long as distal one. Mx I with palp 2.8 times as long as wide and 0.06 times as long as Cp; endopod 1.8 times as long as wide and 1.5 times as long as palp; endite 1.4 times as long as wide and 0.9 times as long as palp. Mx II with exopod 2.8 times as long as wide and 0.30 times as long as Cp; palp 3.7 times as long as wide and 0.09 times as long as Cp; endopod 1.7 times as long as wide and 0.9 times as long as palp; endites subequal, 1.5 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 2.5 times as long as wide and 0.15 times as long as Cp; endopod 1.2 times as long as exopod, segments 2 and 3 1.5 and 1.3 times as long as segment 1, respectively. Mxp II 0.8 times as long as Cp, with merus 1.0, carpus 1.3, propodus 1.0, and dactyl 0.5 times as long as ischium. Mxp III 1.1 times as long as Cp, with merus 0.9, carpus 0.8, propodus 0.7, and dactyl 0.6 times as long as ischium; dactyl incompletely divided into 5 subsegments.

P I 0.9 times as long as Cp, with merus 2.4, carpus 1.4, and propodus 2.3 times as long as ischium; propodus incompletely divided into 6 subsegments. P II 1.4 times as long as Cp, with merus 2.6, carpus 2.2, propodus 2.4, and dactyl 0.1 times as long as ischium; merus regularly serrate on ventral margin; propodus incompletely divided into 5-6 subsegments. P III 1.5 times as long as Cp, with merus 2.5, carpus 2.1, propodus 2.1, and dactyl 0.1 times as long as ischium; propodus incompletely divided into 7 subsegments. P IV 1.1 times as long as Cp, with merus 1.1, carpus 0.9, and propodus 1.1 times as long as ischium. P V 0.6 times as long as Cp, with merus 1.0, carpus 0.7, and propodus 0.8 times as long as ischium.

Somite VIII with arthrobranch 0.13 times as long as Cp and 2.4 times as long as epipod. Somite IX with anterior pleurobranch 0.22 times as long as Cp and 4.0 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.25 times as long as Cp and 4.0 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.30 times as long as Cp and 4.2 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.34 times as long as Cp and 1.3 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.30 times as long as Cp and 1.2 times as long as posterior pleurobranch.

Pl I with basipod 0.28 times as long as Cp and exopod 1.8 times as long as basipod. Pl II with basipod 0.28 times as long as Cp; exopod 2.2 and endopod 1.3 times as long as basipod, respectively. Pl III with basipod 0.28 times as long as Cp; exopod 2.1 and endopod 1.1 times as long as basipod, respectively. Pl IV with basipod 0.27 times as long as Cp;

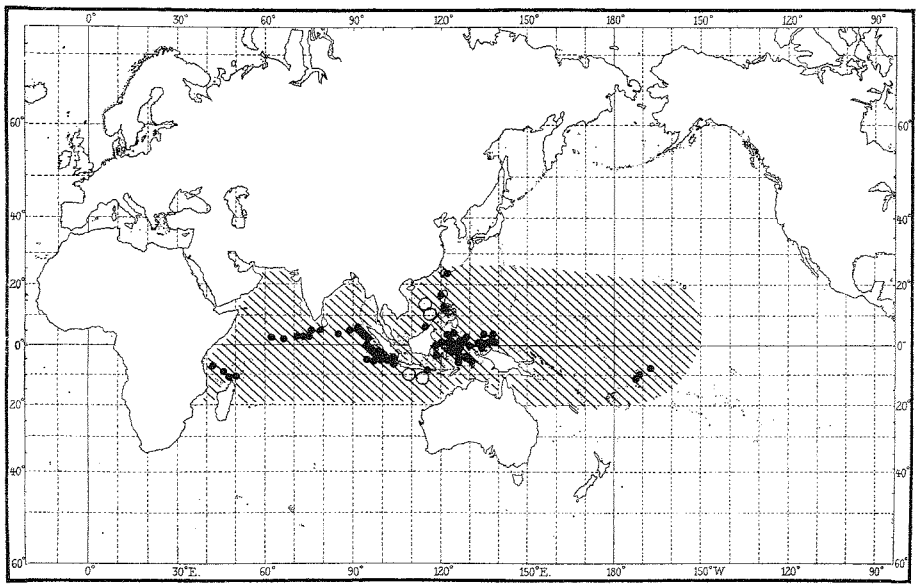


Fig. 23. Probable geographical distribution of *Sergia inequalis*. Black circles indicate "Dana" stations, white circles "Galathea" stations. Shaded areas without symbols are supported by literature data.

exopod 1.8 and endopod 1.0 times as long as basipod, respectively. Pl V with basipod 0.26 times as long as Cp; exopod 1.5 and endopod 0.9 times as long as basipod, respectively.

Up with exopod 4.4 times as long as wide, 6.7 times as long as basipod and 0.6 times as long as Cp; endopod 3.3 times as long as wide and 0.7 times as long as exopod (Fig. 21C).

Petasma (Fig. 22A-B; Pl. 4C). PV short, 2.1 times as long as wide. LI 1.8 times as long as wide, 0.5 times as long as PV. LT as heel at base of LI, 1.0 times as long as wide, 0.3 times as long as PV, armed with few hooks. LC with longer lobule 3.9 times as long as wide and 1.0 times as long as PV, armed with several hooks at middle and in distal part, directed dorsolaterally; shorter lobule 0.9 times as long as wide and 0.5 times as long as PV, overlapping LT, not reaching end of LI, directed distally, unarmed. LAc 1.6 times as long as wide and 0.5 times as long as PV, distally covered by several hooks. LA 1.9 times as long as wide and 0.7 times as long as PV, not curved, armed with row of hooks along dorsal margin and few hooks near tip; tip directed laterally.

Photophores. Scaphocerite: continuous row of 8-12 small organs medial to inner strip of muscle from 0.3-0.4 to 0.9-1.0 blade length. Up exopod: continuous row of 10-15 small photophores medial to inner strips of muscle from 1/4 to 0.9 exopod length. Up endopod: 1 photophore in proximomedial corner.

Remarks: Since Burkenroad's original description (1940), this species has been recorded only twice (Walters 1976, Kensley 1981), Kensley providing figures of the petasma. Due to the very specific form of the petasma, *S. inequalis* has been correctly identified, and no younger synonyms have appeared.

Sergia inequalis is apart from all other species of the species group. In addition to features noted in Table 4, it differs in (1) the presence of 3 serrated bristles on the dorsal side of segment 4of the male outer A I flagellum, (2) the blunt, often slightly bifid end of PV, and (3) having LA not curved.

Geographical distribution (Fig. 23): Tropical areas of Indian Ocean, West and Central Pacific, between 25°N and 15°S.

Indian Ocean: Off Madagascar ("Dana") and South Africa (Kensley 1981), off Seychelles Islands, Sri Lanka ("Dana"), Eastern Indian Ocean ("Dana" and "Galathea"), off Sunda Islands, Java Sea (Burkenroad 1940).

Pacific: West and Central South Pacific ("Dana"), off Hawaii (Walters 1976).

Sergia inequalis and *S. kensleyi* are parapatric, the former living in the tropical Pacific, the latter in temperate areas of the Southern Hemisphere of the Pacific and Indian Oceans. *S. inequalis* is sympatric with *S. gardineri* and *S. bigemmea* and allopatric with *S. splendens*.

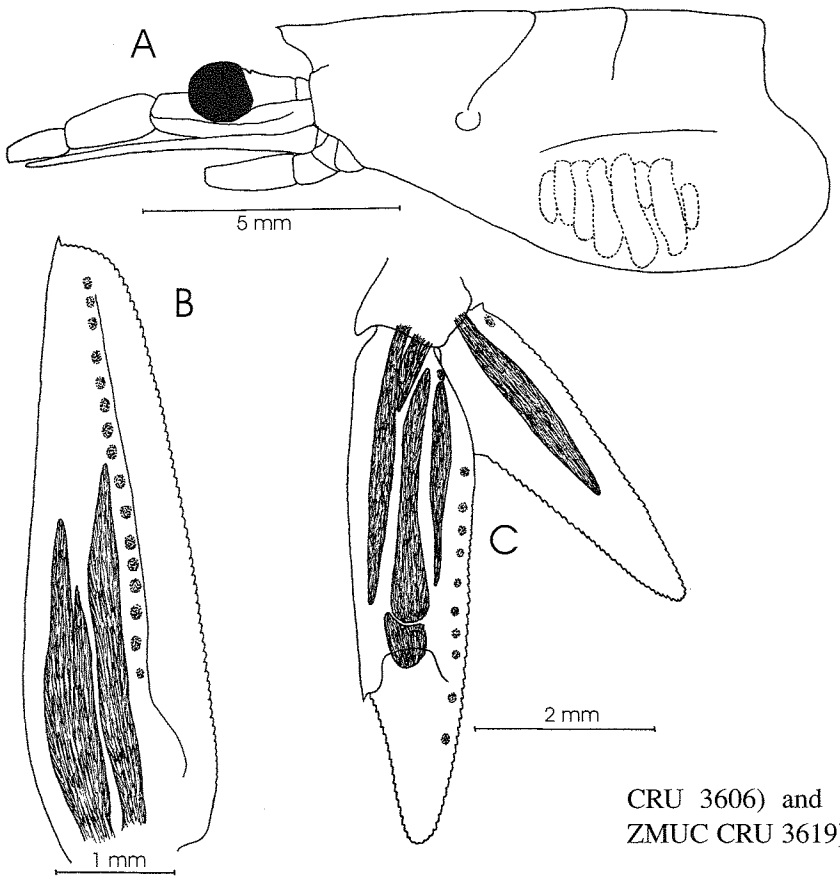


Fig. 24. *Sergia kensleyi* n. sp., holotype, male, "Dana" St. 3970-1, Cp length 8.3 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

Vertical range: An interzonal species, migrating daily between the meso- and epipelagic zones. "Dana" specimens were taken within the depth range 30-2000 m. Most specimens live at 100-300 m at night and at 1000-1300 m during the day.

Sergia kensleyi n. sp.

Figs. 17, 24-25; Pl. 4D

Material examined: "Dana" stations: 3613-6 (1m 10); 3621-2 (1m 7); 3622-1 (20f 4½-10 & 12m 4½-6½); 3623-4 (1f 5 & 4m 5-7); 3623-5 (6f 5½-6½ & 6m 5-7); 3624-3 (2m 4½-5½); 3626-4 (2m 5½-6½); 3627-3 (2m 7-8); 3627-7 (1m 7½); 3638-4 (1f 5 & 2m 5½-6); 3656-1 (1m 6½); 3656-3 (1m 6); 3663-2 (2m 7½-8); 3966-1 (1m 7½); 3966-3 (1f 7); 3969-4 (1f 8 & 1m 7½); 3970-1 (2f 7-8½ & 2m 8); 3970-2 (2f 7-7½ & 5m 7-7½); 3971-4 (2m 7-7½); 3975-9 (3f 7 & 2m 6½-7½).

Holotype: male (Cp length 8.3 mm, ZMUC CRU 3605), "Dana" St. 3970-1, 34°09′S, 27°38′E, sampled 28 Jan. 1930.

Paratypes: 1 male (Cp length 8.0 mm; ZMUC CRU 3606) and 1 female (Cp length 8.5 mm; ZMUC CRU 3619), same sample as holotype.

Type locality: Western Indian Ocean off Mozambique, 34°09′S, 27°38′E.

Type material: Holotype + 2 paratypes (ZMUC, see above).

Diagnosis: Integument firm; rostrum acute, without additional tooth; ocular papilla 0.5 times as long as wide; cornea well pigmented, dark brown, considerably wider than eyestalk; A I peduncle with segment 2 shorter than segment 1, segment 1 of outer A I flagellum in male with well developed tubercle reaching end of segment 5 of flagellum; segment 4 of flagellum not subdivided, lacking serrated bristles on dorsal surface; scaphocerite with distal tooth overlapping blade; PV of petasma not tapering into sharp point, without hooks; LI small; LT not reduced, not reaching end of LC; LC undivided; LAc absent; LA slightly curved in medial direction; small photophores in single row medial to inner muscle strips on scaphocerite and on Up exopod, no additional (to that in proximomedial corner) photophores along distolateral margin of Up endopod.

Description: Cp 1.6 times as long as high and

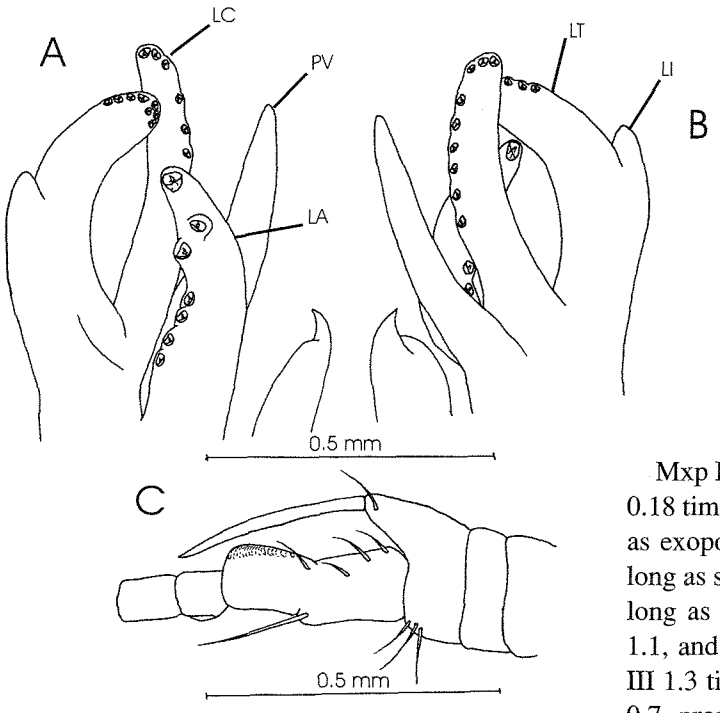


Fig. 25. *Sergia kensleyi* n. sp., holotype, male, "Dana" St. 3970-1, Cp length 8.3 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

0.36 times as long as abdomen (Fig. 24A). Abdomen with somite VI 1.6 times as long as high and 1.2 times as long as telson; telson 3.2 times as long as wide.

Cornea well pigmented, dark brown, 1.0 times as long as wide, 0.9 times as long and 1.7 times as wide as eyestalk. A I peduncle 0.7 times as long as Cp, with segments 2 and 3 0.56 and 0.48 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle just reaching end of segment 5 of flagellum, segment 4 of flagellum bearing few setae on dorsal surface and single longer setae on ventral surface (Fig. 25C). A II peduncle 0.4 times as long as scaphocerite; latter with distal tooth overreaching blade (Fig. 24B), 3.5 times as long as wide, 0.91 times as long as A I peduncle.

Md palp 0.36 times as long as Cp, with proximal segment 2.1 times as long as distal one. Mx I with palp 2.5 times as long as wide and 0.08 times as long as Cp; endopod 1.4 times as long as wide and 1.1 times as long as palp; endite 1.8 times as long as wide and 0.9 times as long as palp. Mx II with exopod 3.3 times as long as wide and 0.32 times as long as Cp; palp 3.2 times as long as wide and 0.13 times as long as Cp; endopod 1.6 times as long as wide and 1.0 times as long as palp; endites subequal, 1.6 times as long as wide and 0.5 times as long as palp.

Mxp I with exopod 2.4 times as long as wide and 0.18 times as long as Cp; endopod 1.3 times as long as exopod, segments 2 and 3 0.9 and 0.8 times as long as segment 1, respectively. Mxp II 0.9 times as long as Cp, with merus 1.2, carpus 1.0, propodus 1.1, and dactyl 0.5 times as long as ischium. Mxp III 1.3 times as long as Cp, with merus 0.7, carpus 0.7, propodus 0.6, and dactyl 0.5 times as long as ischium; dactyl incompletely divided into 3-4 subsegments.

P I 1.0 times as long as Cp, with merus 1.9, carpus 1.3, and propodus 1.8 times as long as ischium; propodus divided into 6 subsegments. P II 1.2 times as long as Cp, with merus 0.8, carpus 0.7, propodus 1.1, and dactyl 0.1 times as long as ischium; propodus divided into 7 subsegments. P III 1.6 times as long as Cp, with merus 2.6, carpus 2.0, propodus 2.3, and dactyl 0.2 times as long as ischium; propodus divided into 7 subsegments. P IV 1.1 times as long as Cp, with merus 1.4, carpus 1.0, and propodus 1.1 times as long as ischium. P V 0.6 times as long as Cp, with merus 0.9, carpus 0.7, and propodus 0.6 times as long as ischium.

Somite VIII with arthrobranch 0.11 times as long as Cp and 1.9 times as long as epipod. Somite IX with anterior pleurobranch 0.17 times as long as Cp and 4.7 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.21 times as long as Cp and 5.2 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.25 times as long as Cp and 5.2 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.28 times as long as Cp and 1.6 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.22 times as long as Cp and 1.7 times as long as posterior pleurobranch.

Pl I with basipod 0.31 times as long as Cp and

exopod 1.7 times as long as basipod. Pl II with basipod 0.31 times as long as Cp; exopod 1.9 and endopod 1.2 times as long as basipod, respectively. Pl III with basipod 0.31 times as long as Cp; exopod 1.9 and endopod 1.1 times as long as basipod, respectively. Pl IV with basipod 0.31 times as long as Cp; exopod 1.8 and endopod 1.1 times as long as basipod, respectively. Pl V with basipod 0.29 times as long as Cp; exopod 1.5 and endopod 0.9 times as long as basipod, respectively.

Up with exopod 4.4 times as long as wide, 4.2 times as long as basipod and 0.7 times as long as Cp; endopod 3.4 times as long as wide and 0.7 times as long as exopod (Fig. 24C).

Petasma (Fig. 25A-B; Pl. 4D). PV long and narrow, reaching end of LT, 4.7 times as long as wide. LI 1.0 times as long as wide and 1.1 times as long as PV. LT curved laterally, 2.4 times as long as wide, 0.5 times as long as PV, armed with several hooks near tip. LC long, overlapping LT and PV, 4.1 times as long as wide and 0.9 times as long as PV, bearing row of hooks along lateral margin and near tip. LA 3.2 times as long as wide and 0.9 times as long as PV, armed with few hooks along medial side and few stronger hooks near apex, latter slightly curved medially.

Photophores. Scaphocerite: continuous row of 15-17 organs medial to inner strip of muscle from 1/4 blade length to almost tip. Up exopod: continuous row of 8-11 photophores medial to inner strips of muscle from 1/4 to 0.8 exopod length and 1 additional photophore near inner margin at base. Up endopod: 1 photophore in proximomedial corner.

Remarks: *Sergia kensleyi* n. sp. is close to *S. gardineri* and *S. splendens* and differs from *S. bigemmea* and *S. inequalis* in having the tubercle of segment 3 of the male outer A I flagellum reaching the end of segment 6. Other affinities and differences between *S. kensleyi* and all other known species of the species group are shown in Table 4.

Etymology: The species is named after Dr. Brian Kensley, NMNH, Smithsonian Institution, in recognition of his important contributions to the present knowledge of sergestids.

Geographical distribution (Fig. 17): Temperate areas of the southwest Indian Ocean and the Southwest Pacific.

Indian Ocean: Off South Africa ("Dana").

Pacific: Off the southeast coast of Australia, north of New Zealand ("Dana").

This species seems to avoid tropical waters and occurs south of 25°S. It is very likely that the existence of two separate areas (Fig. 17) is rather the result of scanty sampling of the temperate waters of the South Central and East Indian Ocean than of real isolation. In respect to *S. inequalis* and *S. bigemmea*, *S. kensleyi* is parapatric, the first two species occurring in the tropical waters of the Pacific and Indian Oceans, *S. kensleyi* in the southern temperate areas of the same oceans. *S. kensleyi* is sympatric with *S. gardineri* and allopatric with *S. splendens*.

Vertical range: An interzonal species, migrating daily between the upper bathypelagic and epipelagic zones and taken within the depth range 30-1700 m. Most specimens live at 70-200 m at night and at 1000-1500 m during the day.

Sergia splendens (Sund, 1920)

Figs. 2A, 20, 26-27; Pls. 2D-E, 4B

Sergestes splendens Sund, 1920: 14, figs. 16-18. [Not Hansen, 1919, usually treated as nomen nudum.]

Sergestes richardi Hansen, 1920: 482 [new name proposed for *Sergestes splendens* Sund, 1920, by Hansen considered a junior homonym of *Sergestes splendens* Hansen, 1919]. – Dennell 1955: 400, figs. 3-4. – Synonymized with *Sergestes splendens* Sund by Yaldwyn (1957).

Sergestes crassus Hansen, 1922: 98, pl. 5, fig. 4 [2nd new name proposed for *Sergestes splendens* Sund, 1920, by Hansen considered a junior homonym of *Sergestes splendens* Hansen, 1919]; 1925: 23. – Gurney 1924: 94, fig. 32; 1942: 188, fig. 60. – Cecchini 1928: 43, fig. 4a. – Gurney & Lebour 1940: 24.

Sergestes (Sergia) splendens. – Yaldwyn 1957: 9. – Kensley 1971: 260, fig. 23; 1977: 18. – Crosnier & Forest 1973: 307.

Sergia splendens. – Omori 1974: 236. – Vereshchaka 1994a: 84, figs. 13-15, 26; 1995a: 1651.

Material examined (depths given for stations with trawls at different depths): "Dana" stations: 939, depth 170 m (6f 7-10 & 2m

8-8½); 941, depth 330 m (1f 9½); 946, depth 130 m (2f 3½-8½ & 2m 8-8½); 946, depth 330 m (2f 7½-9 & 1m 7½); 947, depth 330 m (8f 7-10½ & 8m 6½-9½); 952, depth 20 m (3f 3-9½ & 3m 4-5); 952, depth 100 m (1f 6½ & 3m 7-8); 952, depth 130 m (2f 5½-6½ & 2m 6-7); 1142-6 (1f 6 & 1m 6½); 1150-1 (1m 6½); 1152-1 (1f 11 & 2m 5½-7); 1156-5 (1m 6½); 1157-1 (1m 10); 1157-5 (1m 9½); 1160-2 (1f 11); 1162-1 (1m 9½); 1163-2 (1f 9 & 1m 9); 1165-2 (1m 8½); 1171-2 (1f 9); 1171-7 (1f 11½); 1174-1 (4m 9-10½); 1185-1 (1f 9); 1185-11 (3f 7-9 & 2m 7-7½); 1194-5 (1f 8½); 1198-2 (4f 7½-9½ & 2m 7-8); 1198-3 (10f 6½-9½ & 1m 9½); 1202-2 (1m 6½); 1214-3 (2m 6-8½); 1214-4 (6f 6-10 & 8m 5½-7½); 1215-4 (2f 8½-9½); 1216-1 (2f 7-9); 1217-2 (3m 5-8); 1217-3 (5f 5-9 & 8m 7½-8); 1217-4 (15f 5½-9 & 10m 5½-7½); 1217-5 (6f 4-7 & 2m 5½-6½); 1218-1 (2f 7-8); 1218-2 (1m 7½); 1218-3 (1f 7 & 1m 7½); 1218-4 (2m 4-4½); 1223-1 (1f 8½); 1223-2, depth 100 m (13f 4-8 & 13m 3½-7); 1223-2, depth 200 m (5f 4½-9 & 4m 4½-8); 1223-3 (12f 4-9 & 9m 4½-7); 1223-6 (8f 4-6½ & 3m 4½-7); 1225-2 (5f 8 & 1m 8); 1225-3 (5f 4½-7 & 6m 4-8½); 1225-4 (68f 3½-8 & 50m 4-6½); 1225-5 (1f 9); 1228-1 (1f 9½); 1230-1 (1f 8); 1230-2 (3f 4½-6 & 2m 7-8); 1230-3 (7f 4½-8½ & 8m 5-7); 1230-4 (7f 4½-9½ & 2m 6½-7); 1230-5 (2f 4½-5 & 1m 5); 1230-7 (6f 5-9½ & 11m 5-9); 1231-1 (18f 5½-10½ & 14m 5½-9); 1239-11 (3f 7-9 & 3m 7-8); 1241-1 (3f 8-9½ & 1m 9); 1241-2 (1m 6); 1242-8 (2f 5½); 1242-11 (1f 7); 1242-13 (1f 5½); 1242-14 (2f 4½-5½); 1242-15 (1f 5 & 1m 5); 1243-4 (7j 2½); 1245-1 (1f 7); 1245-4 (3f 6½-8 & 1m 5½); 1247-1 (2f 8-9½); 1250-1 (6f 7½-9½ & 2m 5-5½); 1250-2 (14f 3½-8 & 8m 5-7); 1250-3 (58f 3½-9½ & 31m 3½-8); 1256-1 (1m 6); 1256-2 (2f 3½-4 & 2m 4½); 1256-3 (4f 4-8½ & 2m 4-6½); 1256-4 (3f 4½-9 & 4m 4-7); 1260-2 (1f 4½); 1261-1 (1f 9); 1261-3 (1f 5½ & 2m 4½-8½); 1261-6 (7f 6-10½ & 3m 3½-9); 1261-8 (7f 6½-8½ & 1m 8); 1261-9 (3f 5-9 & 3m 5-8); 1266-6 (1m 6½); 1267-1 (1f 7 & 1m 7½); 1268-3 (5j 2½); 1269-1 (1f 9); 1269-2 (1f 4½); 1269-3 (2f 8 & 3m 4-7); 1269-5 (3f 5-6); 1269-6 (1m 5½); 1269-7 (2f 7½-10½ & 2m 6½); 1270-7 (1f 8½); 1274-1 (1f 4½); 1274-4 (1m 4); 1281-6 (1f 8); 1281-9 (1f 6½ & 1m 6); 1286-1 (1f 9½); 1286-2 (2f 8½-9½); 1289-1 (1m 5); 1289-3 (1f 8½); 1292-4 (1f 8½); 1292-5 (8f 4-8½ & 1m 6); 1293-4 (2f 3½-8½ & 2m 4-4½); 1320-1 (1f 9); 1320-3 (2m 7½-8); 1320-4 (1f 8 & 4m 8½-9½); 1321-1 (8f 2½-5 & 3m 4-4½); 1321-2 (2f 7-9½); 1322-1 (1f 6); 1322-9-27(1f 9½ & 2m 9); 1322-21 (1f 9½); 1322-35 (3f 5½-9½); 1323-6 (2m 8½-9); 1323-7 (1m 5); 1323-8 (2f 6½-10); 1326-5 (1f 9); 1330-1 (1f 9); 1332-1 (1f 10 & 3m 9-9½); 1332-13 (2f 9); 1332-15 (11f 3-10 & 6m 4-9); 1334-3 (3f 6-9½ & 10m 7½-9); 1335-1 (1f 10½); 1335-2 (2f 7½-9½); 1341-2 (1f 4½ & 1m 5); 1341-4 (34f 4½-10 & 14m 4½-7); 1341-5 (6f 6-8 & 5m 5-7); 1341-6 (2m 7-8½); 1342-1 (2f 5-8½ & 5m 6-9); 1342-6 (1f 7½); 1342-8 (65f 4-11 & 41m 4-9½); 1345-1 (1f 8 & 3m 7-8); 1352-2 (15f 3-4 & 5m 3½-5½); 1353-5 (1m 4½); 1355-1 (4f 5-9 & 5m 5½-6½); 1356-1 (1f 9½); 1356-2 (1f 6½); 1356-3 (5f 9½-10 & 5m 5½-9); 1356-4 (1f 7½ & 11m 5-6½); 1356-5 (3f 7½-11½); 1358-4 (1f 7); 1358-5 (1f 7); 1358-8 (2f 10); 1358-9 (1f 8 & 1m 9); 1358-10 (8f 5-10½ & 6m 5-9½); 1360-2 (1m 9); 1360-3 (4f 4½-8 & 1m 4); 1361-1 (1f 8); 1362-3 (4f 5½-9 & 5m 5½-7½); 1362-4 (3f 4½-5 & 1m 7½); 1362-5 (1f 8½); 1363-3 (2f 5-6 & 1m 9); 1363 [sample number unknown] (1m 7); 1366-1 (1m 9½); 1366-2 (1f 10 & 1m 9); 1367-1 (1f 10); 1367-2 (1m 9); 1367-4 (1m 9½); 1368-1 (1f 10); 1369-4 (1f 10½); 1370-4 (1f 10½); 1380-3 (3f 9); 1380-4 (1f 10½); 3959-1 (1m 8); 3981-4 (46f 6-11 & 39m 6-10); 3996-1 (1f 8½); 3996-3 (1m 5); 3996-8 (6f 7½-9 & 7m 8-9); 3996-9 (5f 6-9 & 3m 5-8); 3997-1 (1m 7); 3997-2 (3f 5-5½ & 2m 4-9 & 4j 3-3½); 3997-3 (69f 4-9½ & 35m 4-9); 3998-1 (1m 10); 3998-4 (3f 4-4½ & 2m 4½-5½); 3998-7 (3f 6-11½); 3998-9 (1f 9½ & 1m 9); 3999-2 (9f 5-10½ & 2m 7½-9); 3999-4 (2f 4-5 & 2m 5-5½); 4000-2 (1f 9½); 4000-3 (10f 5-9 & 4m 6-8); 4000-4 (4f 5½-9); 4000-9 (1f 8 & 2 m 7-9); 4000-10 (1f 7½).

Type localities: Central North Atlantic: 12 "Michael Sars" stations, about 29°N, 25°W.

Type material: Syntypes of *Sergestes splendens* Sund, 111 specimens in original material (55f & 51m & 5j). According to Dr. Endre Willassen, ZMUB, only 3 (ZMBN 14245, 14247, 14248, not examined) of the 12 samples are currently labeled as types, but the other 9 not so labeled should probably be considered syntypes also.

Diagnosis: Integument firm; rostrum acute, without additional tooth; ocular papilla 0.7 times as long as wide; cornea well pigmented, dark brown, considerably wider than eyestalk; A I peduncle with segment 2 shorter than segment 1; segment 3 of

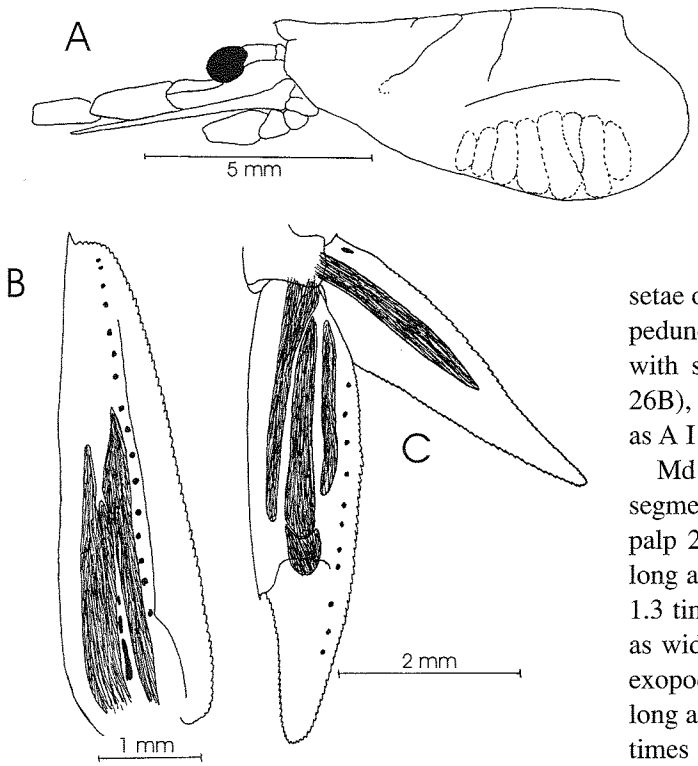


Fig. 26. *Sergia splendens*, male, "Dana" St. 1217-4, Cp length 7.3 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

outer A I flagellum in male with well developed tubercle reaching end of segment 6 of flagellum and segment 4 not subdivided, without serrated bristles on dorsal surface; scaphocerite with strong distal tooth overlapping blade; PV of petasma tapering into sharp point; LI absent; LT not reduced, almost reaching PV; LC reaching end of PV; LC undivided; LAc absent; LA slightly curved medially, small photophores arranged in single row medial to inner muscle strips on scaphocerite and on Up exopod; no additional (to that in proximo-medial corner) photophores along distolateral margin of Up endopod.

Description: Cp 1.7 times as long as high and 0.36 times as long as abdomen (Fig. 26A). Abdomen with somite VI 1.5 times as long as high and 1.2 times as long as telson; telson 3.9 times as long as wide.

Eyestalk with ocular papilla 0.6 times as long as wide; cornea 0.9 times as long as wide, 0.8 times as long and 1.3 times as wide as eyestalk.

A I peduncle 0.8 times as long as Cp, with segments 2 and 3 0.59 and 0.50 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle just reaching end of segment 6 of flagellum; segment 4 of flagellum with several setae on dorsal and ventral surfaces (Fig. 27C). A II peduncle 0.4 times as long as scaphocerite; latter with strong distal tooth overreaching blade (Fig. 26B), 3.5 times as long as wide, 0.83 times as long as A I peduncle.

Md palp 0.32 times as long as Cp, with proximal segment 2.2 times as long as distal one. Mx I with palp 2.2 times as long as wide and 0.08 times as long as Cp; endopod 1.3 times as long as wide and 1.3 times as long as palp; endite 1.6 times as long as wide and 1.0 times as long as palp. Mx II with exopod 2.9 times as long as wide and 0.31 times as long as Cp; palp 3.8 times as long as wide and 0.11 times as long as Cp; endopod 1.6 times as long as wide and 1.1 times as long as palp; endites subequal, 1.8 times as long as wide and 0.6 times as long as palp.

Mxp I with exopod 2.3 times as long as wide and 0.18 times as long as Cp; endopod 1.2 times as long as exopod; segments 2 and 3 0.9 and 1.2 times as long as segment 1, respectively. Mxp II 0.8 times as long as Cp, with merus 1.2, carpus 1.0, propodus 1.1, and dactyl 0.4 times as long as ischium. Mxp III 1.2 times as long as Cp, with merus 0.7, carpus 0.8, propodus 0.6, and dactyl 0.5 times as long as ischium; dactyl divided into 5 subsegments.

P I 1.0 times as long as Cp, with merus 2.2, carpus 1.3, and propodus 2.0 times as long as ischium, propodus divided into 5 subsegments. P II 1.4 times as long as Cp, with merus 2.7, carpus 2.2, propodus 2.5, and dactyl 0.2 times as long as ischium; propodus divided into 7 subsegments. P III 1.7 times as long as Cp, with merus 2.9, carpus 2.2, propodus 2.5, and dactyl 0.3 times as long as ischium; propodus incompletely divided into 7-8 subsegments. P IV 1.1 times as long as Cp, with merus 1.5, carpus 1.1, and propodus 1.2 times as long as ischium. P V 0.6 times as long as Cp, with merus 1.2, carpus 0.8, and propodus 0.8 times as long as ischium.

Somite VIII with arthrobranch 0.13 times as long as Cp and 2.2 times as long as epipod. Somite IX with anterior pleurobranch 0.21 times as long as Cp and 4.0 times as long as posterior pleurobranch.

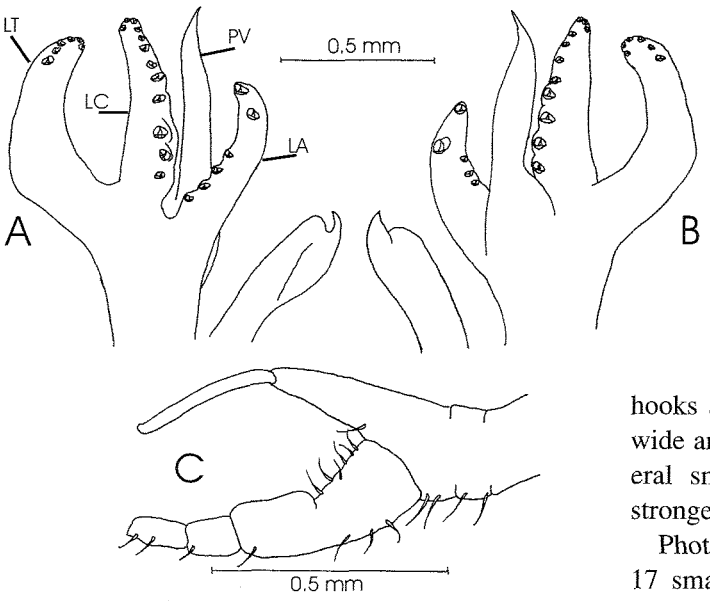


Fig. 27. *Sergia splendens*, male, "Dana" St. 1217-4, Cp length 7.3 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

Somite X with anterior pleurobranch 0.23 times as long as Cp and 3.6 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.20 times as long as Cp and 3.9 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.29 times as long as Cp and 1.8 times as long as posterior pleurobranch. Somite XIII with anterior pleurobranch 0.24 times as long as Cp and 1.3 times as long as posterior pleurobranch.

Pl I with basipod 0.28 times as long as Cp and exopod 2.0 times as long as basipod. Pl II with basipod 0.30 times as long as Cp, exopod 2.0 and endopod 1.2 times as long as basipod, respectively. Pl III with basipod 0.30 times as long as Cp, exopod 1.9 and endopod 1.2 times as long as basipod, respectively. Pl IV with basipod 0.30 times as long as Cp, exopod 1.8 and endopod 1.1 times as long as basipod, respectively. Pl V with basipod 0.29 times as long as Cp, exopod 1.5 and endopod 1.0 times as long as basipod, respectively.

Up with exopod 4.3 times as long as wide, 6.5 times as long as basipod and 0.7 times as long as Cp; endopod 3.9 times as long as wide and 0.7 times as long as exopod (Fig. 26C).

Petasma (Figs. 2A, 27A-B, Pl. 4B). PV long and narrow, overlapping LT, 3.5 times as long as wide. LT curved laterally, 2.5 times as long as wide, 0.7 times as long as PV, armed with several hooks near tip. LC long, overlapping LT, 3.0 times as long as wide and 0.8 times as long as PV, bearing stronger hooks along lateral side. LA 2.9 times as long as wide and 0.7 times as long as PV, armed with several smaller hooks along medial side and few stronger hooks near apex.

Photophores. Scaphocerite: continuous row of 7-17 small organs medial to inner strip of muscle from 1/4 blade length almost to tip. Up exopod: continuous row of 5-16 small photophores medial to inner strips of muscle from 0.2 to 0.9 of exopod length. Up endopod: 1 photophore in proximomedial corner.

Remarks: Colour variations of freshly caught shrimps are shown in Pl. 2D-E.

Most of the "Dana" specimens agree with Sund's (1920) original description. The species varies greatly in the number of photophores and even in the structure of the petasma. The number of photophores was shown (Vereshchaka 1994a) to vary individually even within populations from the same location. For instance, in the samples of "Dana" St. 1217, 23 mature females [42 females in Vereshchaka 1994a: 86 is an error] and 22 mature males of similar lengths were examined, and from 8 to 15 (average 11) photophores in females and from 5 to 13 (average 10) photophores in males were counted in their outer Up rami. I found numerous "Dana" specimens with the usual form of the LC, very rarely specimens with small basal lobule of LC as in the closely related species *S. gardineri*, and few transitional forms with LC proximally thickened (see fig. 13 in Vereshchaka 1994a) that looked very similar to *S. splendens* Sund (1920), for which Hansen (1922) proposed the [2nd!, thus unnecessary] new replacement name *Sergestes crassus* Hansen, since his own *S. splendens* was from 1919 and thus described first. As indicated in the synonymy, Hansen (1920), in the paper with the promised "formal description" of his own *S. splendens*, had already proposed *S. richardi* Hansen,

1920 as a replacement name for the species described by Sund, but seems to have forgotten he had done so, as he does not mention it at all. More recent authors have mostly ignored Hansen's replacement names and followed Barnard (1946), who proposed that *S. splendens* Hansen, 1920, be renamed *Sergestes talismani* Barnard, 1946. This useage is also followed here.

Sergia splendens is more similar to *S. gardineri* and *S. kensleyi* n. sp. than to other species of the group. Affinities and differences between S. *splendens* and all other known species of the species group are shown in Table 4.

Geographical distribution (Fig. 20): Atlantic Ocean only: almost everywhere in the tropical and temperate North Atlantic ("Dana"), from the Caribbean to the Mediterranean (Hansen 1922, Vereshchaka 1994a), South Atlantic as far as 38°S, near South Africa ("Dana"; Hansen 1925). Never in the Indian Ocean (Kensley 1971), where it is replaced by the closely related *S. gardineri.*

Sergia splendens and *S. gardineri* are parapatric. The same type of distribution is characteristic for *S. splendens* and *S. kensleyi* n. sp., both being also very close ecologically: *S. splendens* occurs in the Atlantic, *S. kensleyi* is found in the southwestern Indian Ocean and in the southwest Pacific. In respect to all other species of the species group, *S. splendens* is allopatric.

Vertical range: An interzonal species, with diurnal migrations between the meso- and epipelagic zones. "Dana" specimens were taken within the depth range 20-2000 m. Most specimens live at 100-300 m at night and at 700-1000 m during the daytime. These data agree with the results of Foxton (1970) and Vereshchaka (1994a), who respectively reported this species from 100-400 m and 200-500 m at night and from deeper than 800 and 500 m, respectively, during the day.

Sergia phorca species group

Diagnosis: Lens-less photophores usually present: 2 rows on scaphocerite (1 long continuous row close to central axis and 1 oblique proximal row), at least 1 triangular group in distal part of Up exopod; hepatic tubercle blunt; postdorsal spine on abdominal somite VI long; ocular papilla small, 1/4-1/3 as long as wide; A I with segment 1 of peduncle longer than segment 2, clasping organ with 6-8 serrated bristles; endopod of Mxp I with 3 segments; posterior branchial lobe above P III well developed, not lamellar; petasma with 1 or more lobes divided.

Species included: *Sergia bisulcata* (Wood-Mason *in* Wood-Mason & Alcock, 1891), *S. burukovskii* n. sp., *S. filicta* (Burkenroad, 1940), *S. grandis* (Sund, 1920), *S. maxima* (Burkenroad, 1940), *S. phorca* (Faxon, 1893), *S. plumea* (Illig, 1927), *S. potens* (Burkenroad, 1940), *S. wolffi* Vereshchaka, 1994.

Key to species of the *Sergia phorca* species group

1. Rostrum acute, uni- or bidentate. Photophores, if visible, forming 2 groups on scaphocerite (longitudinal and oblique) and at least 1 distal group on Up exopod. Propodus of Mxp III usually with 3 subsegments. Basal lobule of LC, if present, not directed proximally 2
– Rostrum blunt. Photophores, if visible, forming single proximal spot on scaphocerite and single proximal spot on Up exopod. Propodus of Mxp III with 4 subsegments. Basal lobule of LC directed proxmally 8
2. Photophores fused and forming 2 strips on scaphocerite. Segment 4 of male A I flagellum with 7-9 dorsal serrated bristles. Propodus of P I with 8 subsegments. LI of petasma divided, LC undivided .. *Sergia maxima*
– Photophores mostly discrete on scaphocerite. Segment 4 of male A I flagellum with 4-6 dorsal serrated bristles. Propodus of P I with number of subsegments not equal to 8. LI of petasma undivided, LC divided 3
3. Male A I outer flagellum with segment 3 bearing reduced tubercle and overlapped by few longer setae and with segment 4 bearing 2-3 dorsal serrated bristles; propodi in Mxp III, P I, and P III with 4, 9, and 12 subsegments, respectively ..... *Sergia filicta*
– Male A I outer flagellum with segment 3 bearing well developed tubercle not overlapped by few longer setae and with segment 4 bearing 4-6 dorsal serrated bristles; propodi in Mxp III, P I, and P III with 3, 10-

13, and 9-10/13-14 subsegments, respectively 4

4. Rostrum usually bidentate. LT of petasma divided, LAc present. ..... *Sergia potens*
– Rostrum usually unidentate. LT of petasma undivided, LAc absent 5
5. Photophores not visible on scaphocerite. Propodi of P II and P III with 13 subsegments. LC overlapping other lobes and processes of petasma; basal lobule of LC directed distolaterally; LA strongly curved at 3/4 of length ..... *Sergia wolffi*
– Longitudinal and oblique groups of photophores visible on scaphocerite. Propodi of P II and P III with 10-12 and 9-10 subsegments, respectively. LC not overlapping other lobes and processes of petasma; basal lobule of LC directed laterally or proximolaterally; LA curved evenly throughout or straight 6
6. Tubercle on segment 3 of male outer A I flagellum not overlapping segment 4. Scaphocerite less than 4 times as long as wide; propodi of P II and P III with 11 and 9 subsegments, respectively. Posterior branchial lobe on somite XII not hidden under anterior lobe. LC with distal lobule straight and proximal lobule directed laterally; LA not curved ..... *Sergia grandis*
– Tubercle on segment 3 of male outer A I flagellum overlapping segment 4. Scaphocerite more than 4 times as long as wide; propodi of P II and P III with 10/12 and 10 subsegments, respectively. Posterior branchial lobe on somite XII hidden under anterior lobe. LC with distal lobule curved and proximal lobule directed proximolaterally; LA curved 7
7. Propodus of P II with 10 subsegments. LA reaching 0.7-1.0 of PV.. *Sergia phorca*, n. comb.
– Propodus of P II with 12 subsegments. LA reaching 0.3-0.5 of PV.. *Sergia burukovskii* n. sp.
8. Photophores visible on scaphocerite and Up exopod. Tubercle on segment 3 of male outer A I flagellum not overlapping segment 4. Propodi of Mxp III, P II, and P III with 5-6, 9, and 13 subsegments, respectively. LI overlapping and distal lobule of LC not overlapping other lobes and processes of petasma; LA straight, reaching 0.8-1.0 of PV ..... *Sergia bisulcata*
– Photophores not visible on scaphocerite and Up exopod. Tubercle on segment 3 of male outer A I flagellum overlapping segment 4. Propodi of Mxp III, P II, and P III with 7, 12, and 11 subsegments, respectively. LI not overlapping and distal lobule of LC overlapping other lobes and processes of petasma; LA curved, reaching 0.4-0.6 of PV ..... *Sergia plumea*, n. comb.

Sergia bisulcata (Wood-Mason *in* Wood-Mason & Alcock, 1891)

Figs. 2B, 28-30

Sergestes bisulcatus Wood-Mason *in* Wood-Mason & Alcock, 1891a: 190; 1891b: 353. – Ortmann 1893: 114, fig. 2. – Faxon 1895: 210, pl. 52. – Hansen 1896: 949; 1919: 11, pl. 1, fig. 3a-d. – Alcock 1901: 49. [Non Stebbing 1905.]
Sergia bisulcata. – Ortmann 1893: 37. – Walters 1976: 823. – Krygier & Wasmer 1988: 50.
Sergestes (Sergia) bisulcatus. – Yaldwyn 1957: 9.

Material examined (? = identification uncertain): "Dana" stations: 3678-4 (1f 19); 3683-1 (2f 14½-25 & 1m 14½); 3683-2 (3m 12½-26½); 3683-7 (2j 6½-8½); 3684-2 (1m 14); 3685-1 (1f 13); 3585-8 (1f 19 & 1m 22); 3686-8 (2j 9-11); 3687-1 (1j 10); 3689-6 (2f 20-22½); 3689-7 (7f 9½-14); 3690-2 (1f 14½); 3713-2 (1f 12½); 3714-6 (1f 21½); 3716-3 (1f 20 & 1m 19); 3730-1 (1m 12 & 1j 11½); 3731-6 (1f 11½); 3731-8 (1m 18); 3731-10 (1m 21); 3737-1 (1f 16 & 2m 14½-18½); 3751-6 (1f 12); 3751-7 (1f 25 & 1m 20½); 3752-1 (1f 13); 3753-1 (1m 21); 3766-18 (1f 26); 3767-6 (1m 17½); 3768-2 (1f 11); 3768-3 (1f 12 & 1m 11½); 3782-1 (1f 28 & 1m 19); 3821-1 (1f 15); ? 3824-4 (1f 14); 3828-5 (1f 15 & 3m 13½-16½); 3828-9 (1m 21); 3869-5 (1f 12); 3869-6 (1f 18); ? 3907-1 (1f 12); ? 3915-2 (1f 10½); ? 3916-2 (1f 16).

Type localities: Indian Ocean: Bay of Bengal, "Investigator" St. 100, 16°55′41″N, 83°21′18″E, 840 fms and Arabian Sea, Laccadive Sea, off Goa coast, "Investigator" St. 105, 15°02′N, 72°34′E, 740 fms.

Type material: Syntypes (1 female from "Investigator" St. 100 + 1 male from St. 105, not examined), were in Indian Museum, Calcutta. Dr. P.

Table 5. Affinities and differences between species of the *Sergia phorca* species group. a = acute, b = blunt, d = divided, ph = photophore(s), r = rudimentary, Sc = scaphocerite, ss = subsegments, u = undivided, w = well developed, + = present, – = absent.

Characters	*S. bisulcata*	*S. burukovskii* n. sp.	*S. filicta*	*S. grandis*	*S. maxima*	*S. phorca*	*S. plumea*	*S. potens*	*S. wolffi*
Rostrum	b	a	a	a	a	a	b	a	a
Additional dorsal tooth on rostrum	–	–	–	–	+	–	–	+	–
Tubercle on male A I outer flagellum	w	w	r	w	w	w	w	w	w
Tubercle overlapping segment 4 of flagellum	+	+	–	–	+	+	+	+	+
No of serrated bristles in clasping organ	5–6	4–5	2–3	4–5	7–9	4–5	5	5–6	5–6
Posterior lobe of somite XI hidden	–	+	+	–	–	+	–	–	–
LI of petasma	u	u	u	u	d	u	u	u	u
LT of petasma	u	u	u	u	u	u	u	d	u
LC of petasma	d	d	d	d	u	d	d	d	d
LI overlapping other lobes and processes	+	–	–	–	–	–	–	+	–
LC overlapping other lobes and processes	–	–	+	–	+	–	+	–	+
LAc of petasma	–	–	–	–	–	–	–	+	–
LA of petasma curved	–	+	+	–	+	+	+	+	+
Basal ph on Sc	+	–	–	–	–	–	–	–	+ or –
Oblique ph row on Sc	–	+	+	+	+	+	–	+	–
Longitudinal ph row on Sc	–	+	+	+	+	+	–	+	–
Distal ph on Up exopod	–	+	+	+	+	+	–	+	–
Proximal ph on Up exopod	+	+ or –	–	+ or –	–	+	–	–	–
No of ss in Mxp III propodus	4	3	4	3	3	3	4	3	3
No of ss in Mxp III dactylus	5–6	7	7	6–7	7	9	7	7	7
No of ss in P I propodus	9–10	10	9	10	8	13	9	10–12	10
No of ss in P II propodus	9	12	10	11	12	10	12	13	13
No of ss in P III propodus	13	10	12	9	12	10	11	14	13

Mukhopadhyay, ZSI, New Alipore, has kindly informed me (in litt.) that the (damaged) male from St. 105 in the Arabian Sea is now in the National Collections of the Zoological Survey of India, Regn. No. 6070/9. The female is not mentioned and may have been lost.

Diagnosis: Integument firm, rostrum blunt; cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with well developed tubercle not reaching segment 4 of flagellum, without terminal setae overlapping tubercle; segment 4 of flagellum bearing 5-6 serrated bristles on dorsal surface; posterior branchial lobe on somite XII not hidden under anterior lobe; LI entire, greatly overlapping other lobes and processes; LT entire; LC divided, with distal lobule slightly curved, not overlapping other lobes and processes and with proximal lobule directed proximally; LAc absent; LA not curved, reaching 0.8-1.0 of PV length. 1 large proximal photophore medial to inner muscle strip on scaphocerite and 1 medium-sized proximal organ close to inner margin of Up exopod.

Description: Cp 2.3 times as long as high and 0.43 times as long as abdomen (Fig. 28A). Abdomen with somite VI 1.6 times as long as high and 1.1 times as long as telson; telson 3.2 times as long as wide.

Ocular papilla 0.3 times as long as wide; cornea well pigmented, dark brown, 1.0 times as long as wide, 0.4 times as long and 1.4 times as wide as eyestalk. A I peduncle 0.6 times as long as Cp, with segments 2 and 3 0.77 and 0.63 times as long as

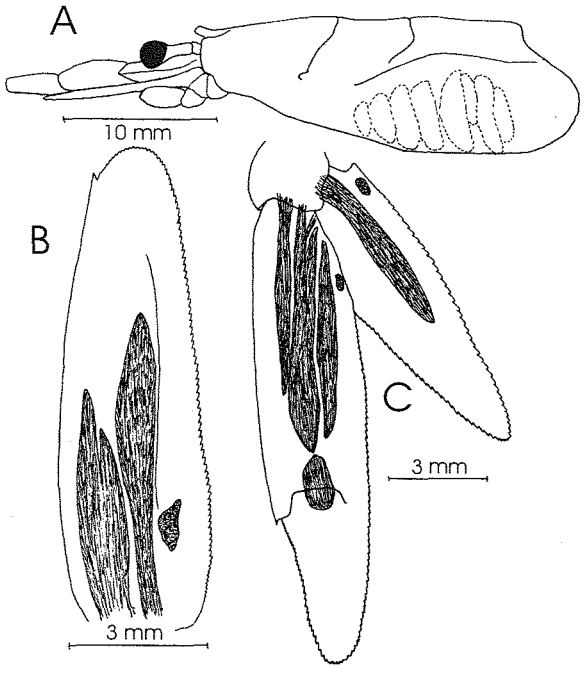


Fig. 28. *Sergia bisulcata*, male, "Dana" St. 3683-2, Cp length 23.6 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle not reduced, not overlapping end of segment 4 of flagellum, without long setae overlapping tubercle; segment 4 bearing 5-6 serrated bristles on dorsal surface (Figs. 2B, 29C). A II peduncle 0.4 times as long as scaphocerite; latter 3.4 times as long as wide (Fig. 28B), 0.83 times as long as A I peduncle.

Md palp 0.31 times as long as Cp, with proximal segment 2.1 times as long as distal one. Mx I with palp 2.7 times as long as wide and 0.06 times as long as Cp; endopod 1.6 times as long as wide and 1.4 times as long as palp; endite 1.9 times as long as wide and 1.0 times as long as palp. Mx II with exopod 3.1 times as long as wide and 0.30 times as long as Cp; palp 3.6 times as long as wide and 0.10 times as long as Cp; endopod 1.9 times as long as wide and 1.1 times as long as palp; endites subequal, 1.9 times as long as wide and 0.5 times as long as palp.

Mxp I with exopod 3.5 times as long as wide and 0.18 times as long as Cp; endopod 1.0 times as long as exopod, segments 2 and 3 1.1 times as long as segment 1. Mxp II 0.8 times as long as Cp, with merus 1.1, carpus 0.9, propodus 1.1, and dactyl 0.5 times as long as ischium. Mxp III 1.4 times as long as Cp, with merus 1.0, carpus 1.1, propodus 1.0, and dactyl 0.8 times as long as ischium; propodus and dactyl incompletely divided into 4 and 5-6 subsegments, respectively.

P I 1.0 times as long as Cp, with merus 2.5, carpus 1.4, and propodus 2.8 times as long as ischium; propodus incompletely divided into 9-10 subsegments. P II 1.2 times as long as Cp, with merus 2.5, carpus 1.9, propodus 2.2, and dactyl 0.1 times as long as ischium; propodus incompletely divided into 9 subsegments. P III 1.5 times as long as Cp, with merus 2.4, carpus 2.0, propodus 2.3, and dactyl 0.1 times as long as ischium; propodus divided into 13 subsegments. P IV 1.0 times as long as Cp, with merus 1.7, carpus and propodus 1.0 times as long as ischium. P V 0.7 times as long as Cp, with merus 1.1, carpus 0.8 and propodus 0.7 times as long as ischium.

Somite VIII with arthrobranch 0.12 times as long as Cp and 2.2 times as long as epipod. Somite IX with anterior pleurobranch 0.19 times as long as Cp and 6.2 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.24 times as long as Cp and 6.7 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.29 times as long as Cp and 6.0 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.27 times as long as Cp and 1.5 times as long as posterior pleurobranch, posterior lobe not hidden under anterior lobe. Somite XIII with anterior pleurobranch 0.25 times as long as Cp and 1.4 times as long as posterior pleurobranch.

Pl I with basipod 0.31 times as long as Cp and exopod 2.2 times as long as basipod. Pl II with basipod 0.28 times as long as Cp; exopod 2.8 and endopod 1.5 times as long as basipod, respectively. Pl III with basipod 0.26 times as long as Cp; exopod 2.7 and endopod 1.5 times as long as basipod, respectively. Pl IV with basipod 0.26 times as long as Cp; exopod 2.4 and endopod 1.3 times as long as basipod, respectively. Pl V with basipod 0.23 times as long as Cp; exopod 2.0 and endopod 1.1 times as long as basipod, respectively.

Up with exopod 4.5 times as long as wide, 6.2 times as long as basipod and 0.6 times as long as Cp; endopod 3.5 times as long as wide and 0.7 times as long as exopod (Fig. 28C).

Petasma (Fig. 29A-B). PV long and narrow, 4.1 times as long as wide, tip not curved. LI long, 5.7 times as long as wide and 0.7 times as long as PV. LT slender, not reaching end of LC, 2.8 times as

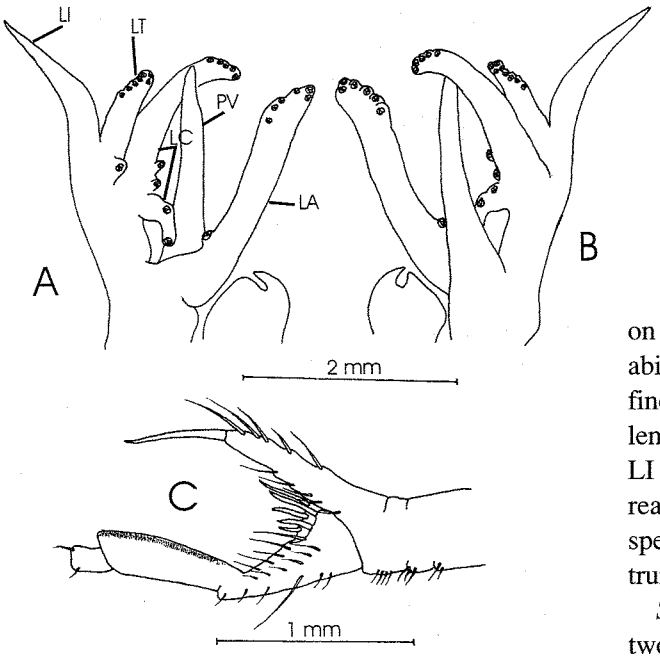


Fig. 29. *Sergia bisulcata*, male, "Dana" St. 3683-2, Cp length 23.6 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

long as wide and 0.4 times as long as PV, armed with several small hooks on distomedial side. LC with distal lobule overlapping LT, 3.1 times as long as wide and 0.7 times as long as PV, armed with several small hooks on distomedial side and near apex, tip directed laterally; proximal lobule 2.0 times as long as wide and 0.2 times as long as PV, armed with few small hooks, tip directed proximally. LA straight, suborthogonal, 4.4 times as long as wide and 1.1 times as long as PV, armed with few proximomedial and several small distal hooks.

Photophores. Scaphocerite: 1 large proximal photophore medial to inner strip of muscle at about of 0.2 blade length. Up exopod: 1 medium-sized proximal photophore close to inner margin at about 0.2 exopod length. Up endopod: 1 photophore in proximomedial corner.

Remarks: Wood-Mason (*in* Wood-Mason & Alcock 1891a) indicated the close alliance of *S. bisulcata* to *S. robusta* (as *Sergestes robustus*) and *S. japonica* (as *Sergestes mollis*). Stebbing (1905) criticised Wood-Mason's original description of the species as being somewhat contradictory and not detailed enough. Indeed, Faxon (1895) synonymized his *Sergestes phorcus* with *S. bisulcatus*. Later, Alcock (1901) published a more detailed description of *S. bisulcata* (as *Sergestes bisulcatus*) that showed the two species to be distinct. Studies on the "Dana" specimens have shown little variability in *S. bisulcata,* which mainly concerns the fine structure of the petasma; the comparative lengths of the lobes and processes vary slightly, but LI always overlaps other lobes and LA nearly reaches the end of PV. In contrast to the other species of the species group, the form of the rostrum remains almost constant, with the tip blunt.

Sergia bisulcata is close to *S. plumea* and the two differ from all other species of the species group in having (1) rostrum blunt, and (2) basal lobule of LC directed proximally.

Sergia bisulcata differs from all other species of the species group in having (1) P II propodus with 9 subsegments, and (2) 1 proximal photophore on scaphocerite. Other affinities and differences between *S. bisulcata* and all other known species of the species group are shown in Table 5.

Geographical distribution (Fig. 30): Tropical waters of the Indian and Pacific Oceans.

Indian Ocean: Bay of Bengal, Arabian Sea, Andaman Sea ("Dana"; Alcock 1901), Indo-West Pacific ("Dana"; Hansen 1919).

Pacific: Off Hawaii (Walters 1976).

Stebbing's (1905) record of this species from off South Africa is doubtful, as it does not describe the petasma and is not accompanied by any figure for this species. *S. bisulcata* occurs in a single area. It is parapatric to *S. potens*, *S. phorca*, *S. filicta*, which live either in the eastern tropical Pacific or South of 10°S, while *S. bisulcata* occurs in the Indian Ocean, Central and Western Pacific north of 10°S. *S. bisulcata* is sympatric with *S. maxima* and *S. plumea* and allopatric to all other species of the species group.

Vertical range: An interzonal species, migrating daily between the meso-/upper bathypelagic and upper mesopelagic zones. "Dana" specimens were taken within the depth range 100-2000 m. Most specimens live at 200-300 m at night and at 700-1300 m during the day.

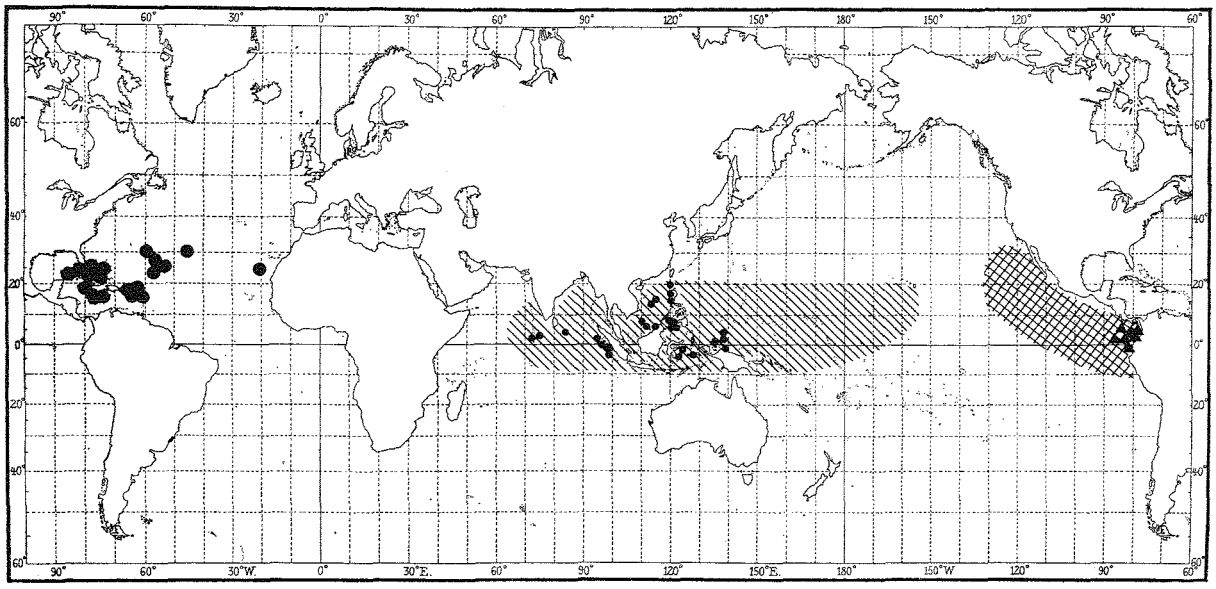


Fig. 30. Probable geographical distribution of *Sergia bisulcata* (small circles, hatching), *S. filicta* (triangles, cross hatching), and *S. wolffi* (large circles). Symbols indicate "Dana" stations. Shaded areas without symbols are supported by literature data.

Sergia burukovskii n. sp.

Figs. 31-33

Sergestes (Sergia) grandis Kensley, 1971 (part): 249, fig. 17. – Crosnier & Forest 1973 (part): 331, figs. 113-116.

Material examined: "Dana" stations: 3975-1 (1m 18½); 3979-1 (2m 23-28 & 11j 5-10); 3980-1 (1f 19 & 1m 25-26½); 3981-1 (2f 21-25).
Holotype: male (Cp length 26.6 mm, ZMUC CRU 3607), "Dana" St. 3980-1, 1000 mw, sampled 17.02.1930.

Paratypes: 1 female (Cp length 19.1 mm, ZMUC CRU 3608), "Dana" St. 3980-1 (same data as holotype) and 1 male (Cp length 28.1 mm, ZMUC CRU 3609), "Dana" St. 3979-1, 1000 mw, 27°10′S, 08°59′E, sampled 15.02.1930.

Type locality: South Atlantic, 23°26′S, 03° 56′E.

Type material: Holotype + 2 paratypes (ZMUC, see above).

Diagnosis: Integument firm, rostrum acute; cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with well developed tubercle overlapping segment 4 of flagellum, without terminal setae overlapping tubercle; segment 4 of flagellum bearing 4-5 serrated bristles on dorsal surface; posterior branchial lobe on somite XII hidden under anterior lobe; LI entire, not overlapping other lobes and processes; LT entire; LC divided, with distal lobule straight, not overlapping other lobes and processes and proximal lobule directed proximolaterally; LAc absent; LA evenly curved medially, reaching 0.3-0.5 PV length. Photophores in 2 rows on scaphocerite medial to inner strip of muscle (5-9 longitudinal organs and 2-6 oblique organs) and in 2 series on Up exopod, 2-7 in triangular figure distal to apical muscle strip and 1-4 proximal ones in continuous row medial to inner muscle strip.

Description: Cp 1.9 times as long as high and 0.43 times as long as abdomen (Fig. 31A). Abdomen with somite VI 1.5 times as long as high and 1.1 times as long as telson, telson 4.2 times as long as wide.

Ocular papilla 0.3 times as long as wide; cornea well pigmented, dark brown, 1.0 times as long as wide, 0.7 times as long and 1.5 times as wide as eyestalk. A I peduncle 0.6 times as long as Cp, with segments 2 and 3 0.83 and 0.71 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle overlapping segment 4 of flagellum; segment 4 bearing 5-6 serrated bristles and several setae on dorsal surface (Fig. 32C).

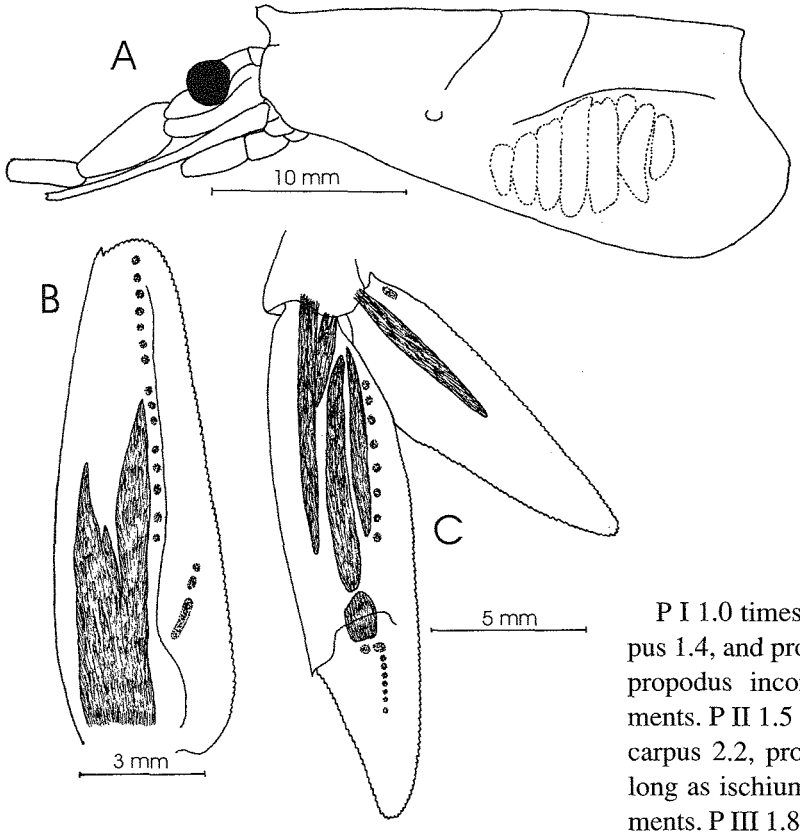


Fig. 31. *Sergia burukovskii* n. sp., holotype, male, "Dana" St. 3980-1, Cp length 26.6 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

A II peduncle 0.5 times as long as scaphocerite; latter 3.0 times as long as wide (Fig. 31B), 0.77 times as long as A I peduncle.

Md palp 0.34 times as long as Cp, with proximal segment 2.4 times as long as distal one. Mx I with palp 2.0 times as long as wide and 0.06 times as long as Cp; endopod 1.7 times as long as wide and 1.5 times as long as palp; endite 1.6 times as long as wide and 1.0 times as long as palp. Mx II with exopod 3.3 times as long as wide and 0.30 times as long as Cp; palp 4.4 times as long as wide and 0.12 times as long as Cp; endopod 2.0 times as long as wide and 1.0 times as long as palp; endites subequal, 2.1 times as long as wide and 0.5 times as long as palp.

Mxp I with exopod 3.4 times as long as wide and 0.20 times as long as Cp endopod 0.9 times as long as exopod, segments 2 and 3 1.2 and 1.3 times as long as segment 1, respectively. Mxp II 0.9 times as long as Cp, with merus 1.0, carpus 0.8, propodus 0.9, and dactyl 0.4 times as long as ischium. Mxp III 1.3 times as long as Cp, with merus, carpus and propodus 0.9, dactyl 0.7 times as long as ischium; propodus and dactyl incompletely divided into 3 and 7 subsegments, respectively.

P I 1.0 times as long as Cp, with merus 2.6, carpus 1.4, and propodus 2.7 times as long as ischium; propodus incompletely divided into 10 subsegments. P II 1.5 times as long as Cp, with merus 2.7, carpus 2.2, propodus 2.7, and dactyl 0.1 times as long as ischium; propodus divided into 12 subsegments. P III 1.8 times as long as Cp, with merus 3.2, carpus 2.7, propodus 3.0, and dactyl 0.2 times as long as ischium; propodus divided into 10 subsegments. P IV 1.1 times as long as Cp, with merus 1.3, carpus and propodus 1.0 times as long as ischium. P V 0.7 times as long as Cp, with merus 1.0, carpus 0.9 and propodus 0.7 times as long as ischium.

Somite VIII with arthrobranch 0.12 times as long as Cp and 1.5 times as long as epipod. Somite IX with anterior pleurobranch 0.18 times as long as Cp and 3.3 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.22 times as long as Cp and 3.5 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.26 times as long as Cp and 3.3 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.25 times as long as Cp and 1.5 times as long as posterior pleurobranch, posterior lobe hidden under anterior lobe. Somite XIII with anterior pleurobranch 0.21 times as long as Cp and 1.3 times as long as posterior pleurobranch.

Pl I with basipod 0.30 times as long as Cp and exopod 2.2 times as long as basipod. Pl II with basipod 0.29 times as long as Cp; exopod 2.4 and endopod 1.3 times as long as basipod, respectively. Pl III with basipod 0.29 times as long as Cp; exopod 2.3 and endopod 1.2 times as long as basipod, respec-

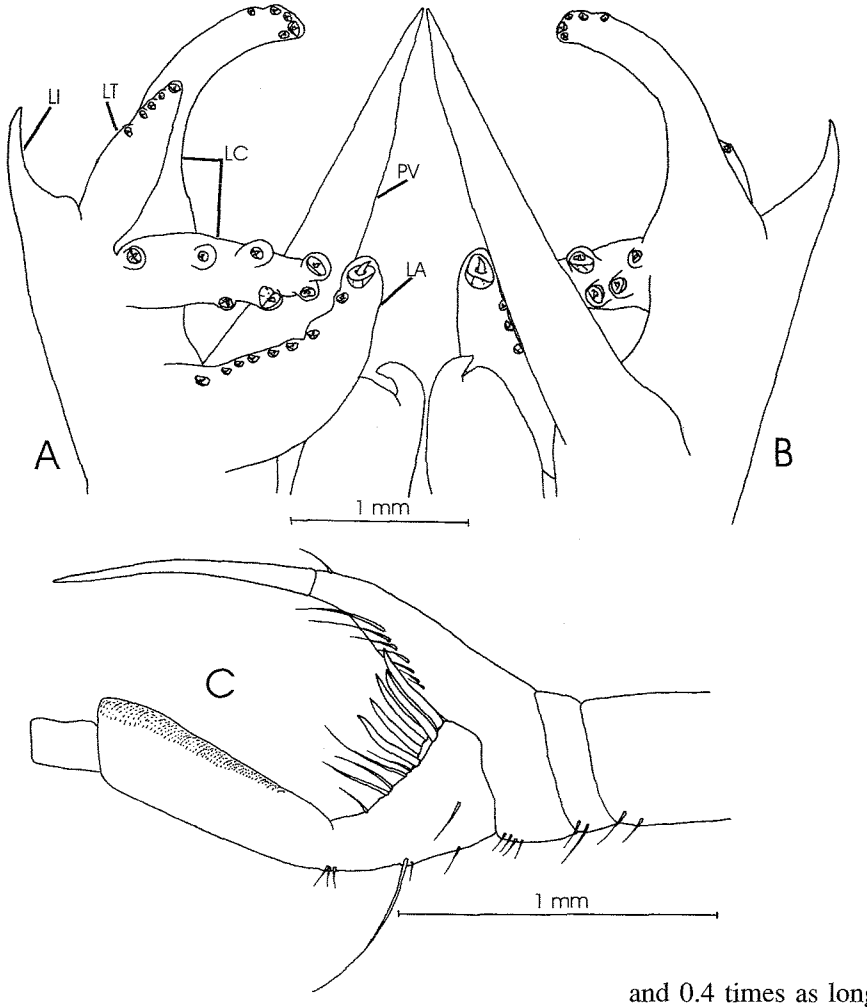


Fig. 32. *Sergia burukovskii* n. sp., holotype, male, "Dana" St. 3980-1, Cp length 26.6 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

tively. Pl IV with basipod 0.29 times as long as Cp; exopod 2.1 and endopod 1.2 times as long as basipod, respectively. Pl V with basipod 0.24 times as long as Cp; exopod 2.0 and endopod 1.1 times as long as basipod, respectively.

Up with exopod 4.1 times as long as wide, 6.2 times as long as basipod and 0.6 times as long as Cp; endopod 3.1 times as long as wide and 0.6 times as long as exopod (Fig. 31C).

Petasma (Fig. 32A-B). PV long and narrow, 4.0 times as long as wide, tip straight. LI well developed, not reaching end of PV, 2.2 times as long as wide and 0.3 times as long as PV. LT slender, overlapping LI and not reaching end of LC, 2.7 times as long as wide and 0.4 times as long as PV, armed with several small hooks on distomedial margin. LC with distal lobule reaching end of PV and greatly overlapping LI and LT, 2.1 times as long as wide and 0.5 times as long as PV, armed with several hooks near apex, slightly curved, tip directed distolaterally; proximal lobule 2.7 times as long as wide and 0.4 times as long as PV, covered with several large hook-bearing papillae. LA short, 2.1 times as long as wide and 0.5 times as long as PV, armed with numerous smaller hooks along medial side and single very strong apical hook.

Photophores. Scaphocerite: photophores arranged in 2 rows medial to inner strip of muscle, (1) longitudinal row of 12-19 organs from 0.4-0.5 to 0.9-1.0 blade length and (2) oblique row of 2-6 organs from 0.2-0.3 to 0.3-0.4 blade length. Up exopod: photophores arranged in 2 series, (1) 4-10 photophores in triangular figure distal to apical muscle strip and (2) 4-11 proximal organs in continuous row medial to inner muscle strip from 0.1-0.2 to 0.4-0.5 exopod length. Up endopod: 1 photophore in proximomedial corner.

Remarks: *Sergia burukovskii* n. sp. varies in the form of the rostrum (sometimes inconspicuously bidentate), number of photophores and their character (those in the oblique group on the scaphocerite may be almost fused), form of the lobes and processes of the petasma (LI may sometimes have

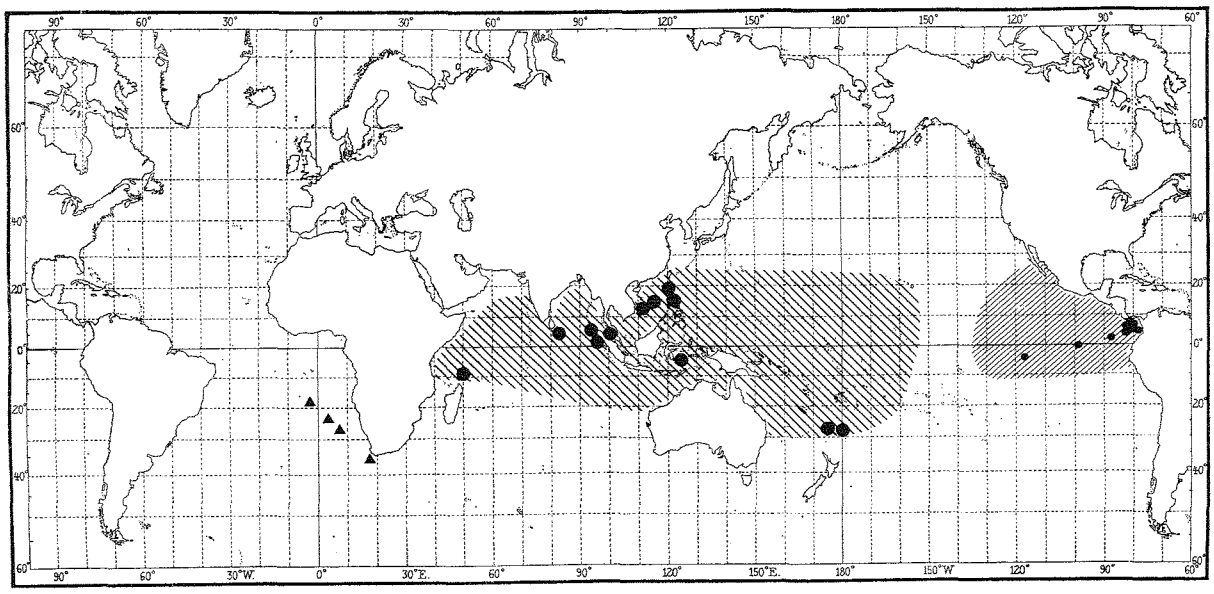


Fig. 33. Probable geographical distribution of *Sergia burukovskii* n. sp. (triangles), *S. maxima* (large circles, coarse hatching), and *S. phorca* (small circles, fine hatching). Symbols indicate "Dana" stations. Shaded areas without symbols are supported by literature data.

inconspicuous basal lobular extension, proximal lobule of LC may be less armed than described, apical hook on LA may be smaller and LA more curved than figured). However, most photophores are always discrete, and LA reaches about 1/2 PV length).

Sergia burukovskii is most closely related to *S. phorca,* differing only in the subsegmentation of Mxp III - P II and in the form of LA. Although subsegmentation is not always certain and complete, I consider both species distinct because LA reaches 0.3-0.5 PV in *S. burukovskii* and 0.7-1.0 in *S. phorca*. Thus, no overlapping is found in this character among all the "Dana" specimens. Within the species group, *Sergia burukovskii* possesses the highest number of photophores on the scaphocerite and Up exopod. Other affinities and differences between *S. burukovskii* and all other species of the species group are shown in Table 5.

Etymology: This species is named after Prof. R. N. Burukovski, Kaliningrad University, who has devoted his life to studies on shrimps.

Geographical distribution (Fig. 33): Southeast Atlantic Ocean and Southwest Indian Oceans: Off South Africa ("Dana"; Kensley 1971 and Crosnier & Forest 1973, both as *S. grandis*).

This species is nearly parapatric to *S. grandis* and is sympatric with *S. potens;* and allopatric to all other species of the species group.

Vertical range: An interzonal species, migrating daily between the upper bathypelagic and mesopelagic zones. "Dana" specimens were taken within the depth range 300-1000 m. All specimens occur at 300 m at night and at 1000 m during the day.

Sergia filicta (Burkenroad, 1940)

Figs. 30, 34-35

Sergestes filictum Burkenroad, 1940: 52.
Sergestes (Sergia) filictum. – Yaldwyn 1957: 9.
Sergia filicta. – Krygier & Wasmer 1988: 50.

Material examined: "Dana" stations: 1203-1 (29f 10-18½ & 16m 11-16½); 1203-2 (1f 18½); 1203-10 (2f 17-18 & 1m 17); 1203-13 (2f 17-19 & 2m 18-19); 1203-14 (15f 10-18 & 10m 10-17); 1203-16 (11f 10-18 & 7m 12-14½); 1205-2 (11f 10½-23 & 8m 9-13½); 1206-7 (10f 11-16½ & 6m 10-16½); 1208-1 (13f 10-18 & 15m 8-17); 1208-4 (6f 11-18 & 7m 12-16); 1208-13 (1m 16); 1209-1 (4f 12-22½ & 3m 11-14½); 3548-1 (2m 14-15); 3548-2 (1f 13); 3548-3 (3f 15½-21 & 4m 13½-14); 3549-4 (3f 16-17½ & 1m 14); 3549-6 (6f 12-16½ & 2m 15-16); 3550-1 (3f 15½-18½ & 1m 14);

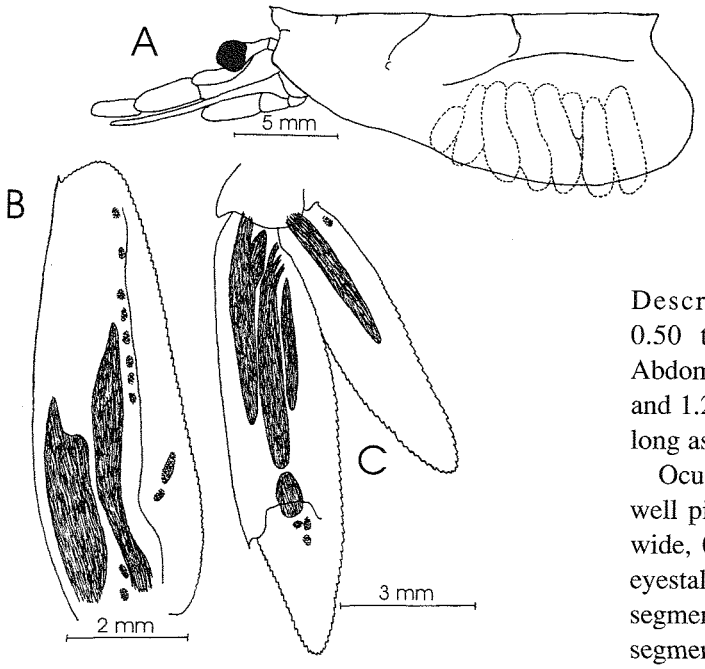


Fig. 34. *Sergia filicta*, male, "Dana" St. 1203-13, Cp length 18.9 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

3550-3 (1f 7½); 3550-6 (2f 16-17½ & 1m 14); 3550-8 (5f 8-9½ & 2m 10½-18½); 3556-1 (1f 13½); 3556-2 (1f 12).

Holotype of *Sergestes filictum* (ZMUC CRU 1603, "Dana" St. 3549-4).

Type locality: Gulf of Panama, 7°16′N, 78° 30′W.

Type material: Holotype (ZMUC, see above).

Diagnosis: Integument firm, rostrum acute; cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with rudimentary tubercle not reaching segment 4 of flagellum, with few terminal setae overlapping tubercle; segment 4 of flagellum bearing 2-3 serrated bristles on dorsal surface; posterior branchial lobe on somite XII hidden under anterior lobe; LI undivided, not overlapping other lobes and processes; LT entire; LC divided, with distal lobule slightly curved and much overlapping other lobes and processes and with proximal lobule directed proximolaterally; LAc absent; LA not curved, reaching 0.7-0.9 PV length. Photophores in 2 rows on scaphocerite medial to inner strip of muscle (6-10 organs in longitudinal row and 2-4 organs in oblique row) and in single series on Up exopod, 2-5 in triangular figure distal to apical muscle strip.

Description: Cp 2.1 times as long as high and 0.50 times as long as abdomen (Fig. 34A). Abdomen with somite VI 1.7 times as long as high and 1.2 times as long as telson; telson 3.2 times as long as wide.

Ocular papilla 0.3 times as long as wide; cornea well pigmented, dark brown, 0.9 times as long as wide, 0.9 times as long and 1.6 times as wide as eyestalk. A I peduncle 0.5 times as long as Cp, with segments 2 and 3 0.67 and 0.56 times as long as segment 1, respectively; segment 3 of outer A I flagellum in male with tubercle reduced, not reaching end of segment 4 of flagellum, with 3 long setae overlapping tubercle; segment 4 bearing 2-3 serrated bristles on dorsal surface (Fig. 35C). A II peduncle 0.5 times as long as scaphocerite; latter 3.0 times as long as wide (Fig. 34B), 0.83 times as long as A I peduncle.

Md palp 0.28 times as long as Cp, with proximal segment 2.1 times as long as distal one. Mx I with palp 2.4 times as long as wide and 0.05 times as long as Cp; endopod 1.8 times as long as wide and 1.6 times as long as palp; endite 1.6 times as long as wide and 1.0 times as long as palp. Mx II with exopod 2.8 times as long as wide and 0.33 times as long as Cp; palp 3.1 times as long as wide and 0.09 times as long as Cp; endopod 1.9 times as long as wide and 0.9 times as long as palp; endites subequal, 1.5 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 3.3 times as long as wide and 0.16 times as long as Cp; endopod 1.0 times as long as exopod, segments 2 and 3 1.5 and 1.2 times as long as segment 1, respectively. Mxp II 0.7 times as long as Cp, with merus 1.1, carpus 0.9, propodus 1.0, and dactyl 0.4 times as long as ischium. Mxp III 1.3 times as long as Cp, with merus, carpus, and propodus 0.9, dactyl 0.8 times as long as ischium; propodus and dactyl incompletely divided into 4 and 7 subsegments, respectively.

P I 0.9 times as long as Cp, with merus 2.1, carpus 1.2, and propodus 2.4 times as long as ischium; propodus divided into 9 subsegments. P II 1.4 times

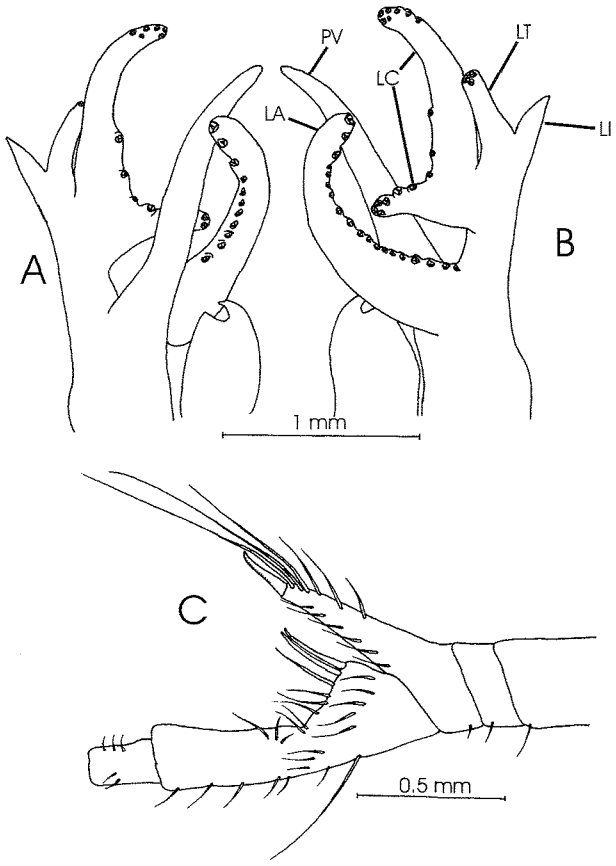


Fig. 35. *Sergia filicta*, male, "Dana" St. 1203-13, Cp length 18.9 mm. – A, caudal view of petasma. – B, oral view of petasma. – C, male outer A I flagellum.

as long as Cp, with merus 2.4, carpus 2.1, propodus 2.7, and dactyl 0.1 times as long as ischium; propodus divided into 10 subsegments. P III 1.7 times as long as Cp, with merus 2.5, carpus 2.1, propodus 2.5, and dactyl 0.1 times as long as ischium; propodus divided into 12 subsegments. P IV 1.2 times as long as Cp, with merus 1.4, carpus 1.0, and propodus 1.1 times as long as ischium. P V 0.7 times as long as Cp, with merus 1.1, carpus 0.8 and propodus 0.6 times as long as ischium.

Somite VIII with arthrobranch 0.17 times as long as Cp and 4.6 times as long as epipod. Somite IX with anterior pleurobranch 0.28 times as long as Cp and 6.3 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.29 times as long as Cp and 6.7 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.34 times as long as Cp and 7.4 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.36 times as long as Cp and 1.4 times as long as posterior pleurobranch, posterior lobe hidden under anterior lobe. Somite XIII with anterior pleurobranch 0.32 times as long as Cp and 1.1 times as long as posterior pleurobranch. All pleurobranchs very voluminous.

Pl I with basipod 0.30 times as long as Cp and exopod 2.2 times as long as basipod. Pl II with basipod 0.26 times as long as Cp; exopod 3.0 and endopod 1.5 times as long as basipod, respectively. Pl III with basipod 0.26 times as long as Cp; exopod 2.3 and endopod 1.4 times as long as basipod, respectively. Pl IV with basipod 0.26 times as long as Cp; exopod 2.1 and endopod 1.3 times as long as basipod, respectively. Pl V with basipod 0.22 times as long as Cp; exopod 2.0 and endopod 1.2 times as long as basipod, respectively.

Up with exopod 4.1 times as long as wide, 6.3 times as long as basipod and 0.6 times as long as Cp; endopod 3.4 times as long as wide and 0.7 times as long as exopod (Fig. 34C).

Petasma (Fig. 35A-B). PV long and narrow, 4.4 times as long as wide, tip slightly curved, directed laterally. LI small, not reaching end of PV, 2.3 times as long as wide and 0.2 times as long as PV. LT slender, overlapping LI and not reaching end of LC, 2.1 times as long as wide and 0.3 times as long as PV, armed with few small apical hooks. LC with distal lobule 4.2 times as long as wide and 0.7 times as long as PV, armed with several small hooks on distomedial side and near apex, tip directed distolaterally; proximal lobule 1.7 times as long as wide and 0.2 times as long as PV, armed with several small hooks in distal half. LA voluminous, 3.1 times as long as wide and 0.8 times as long as PV, armed with numerous smaller hooks along medial side.

Photophores. Scaphocerite: photophores arranged in 2 rows medial to inner strip of muscle, (1) longitudinal row of 6-10 organs from 0.4-0.5 to 0.8-0.9 blade length and (2) oblique row of 2-4 (often fused) organs from 0.2 to 0.3 blade length; 1-2 additional organs sometimes present near base, between inner and outer muscle strips. Up exopod: single group of 2-5 photophores in triangular figure distal to apical muscle strip. Up endopod: 1 photophore in proximomedial corner.

Remarks: Since Burkenroad's original description (1940), no morphological paper has included this species. As do all species of the species group, *S. filicta* varies in the form of the rostrum, minor pro-

portions of the appendages, the position of the photophores, and in the fine structure of the petasma. A few additional photophores may be found at the base of the scaphocerite in some "Dana" specimens of this species. The relative length of LI and LT as well as the form of LA may also vary, but the relative length of LA remains always about 3/4 of the PV length, with the distal lobe of LC far overlapping all other lobes and processes.

Sergia filicta is close to *S. phorca, S. grandis, S. potens, S. maxima, S. wolffi,* and *S. burukovskii.* It differs from *S. bisulcata* and *S. plumea* in having (1) male outer A I flagellum with segment 3 bearing a reduced tubercle overlapped by a few longer setae and (2) segment 4 armed with 2-3 dorsal serrated bristles. Affinities and differences between *S. filicta* and all other species of the species group are shown in Table 5.

Geographical distribution (Fig. 30): Eastern Pacific Ocean only: Gulf of Panama ("Dana"; Burkenroad 1940), off Galapagos Islands ("Dana"), off California (Krygier & Wasmer 1988).

The distribution of *S. filicta* is limited to a single small area, most of which is sympatric with that of *S. phorca. S. filicta* is parapatric with *S. potens, S. maxima,* and *S. bisulcata,* which live in the temperate or tropical Central and West Pacific. *S. filicta* is allopatric to *S. grandis, S. wolffi,* and *S. burukovskii.*

Vertical range: An interzonal species, migrating daily between the meso-/upper bathypelagic and upper mesopelagic zones. "Dana" specimens were taken within the depth range 100-1300 m. Most specimens live at 200-300 m at night and 700-1300 m during the day.

Sergia grandis (Sund, 1920)

Figs. 36-38, Pl. 3D-E

Sergestes grandis Sund, 1920: 16, figs. 22-26. – Hansen 1922: 92, pl. 5, fig. 3. – Holthuis 1952b: 87. – Dennell 1955: 403, fig. 5.

Sergestes (Sergia) grandis. – Yaldwyn 1957: 9. – Kensley 1971 (part): 249, fig. 17; 1972: 30, fig. 13. – Crosnier & Forest 1973 (part): 331, figs. 113-116.

Sergia grandis. – Omori 1974: 236. – Vereshchaka 1994a: 82, figs. 10-12, 26; 1995a: 1651.

Material examined: "Dana" stations (depths given for stations with trawls at different depths): 941, depth 330 m (2f 12-17½ & 1m 14½); 947, depth 330 m (1f 12); 1142-10 (1m 23); 1163-2 (1f 21); 1165-2 (1m 18); 1177-1 (1m 18½); 1178-1 (1f 20½); 1183-6 (1f 24½); 1185-1 (3f 12½-15); 1185-11 (1f 19); 1188-2 (2f 14½-22 & 1m 18); 1202-2 (4f 8-9½); 1214-3 (3f 9½-11); 1215-5 (2f 17½-23); 1216-1 (2f 18½-22½ & 1m 20); 1217-4 (2f 10½-20); 1217-5 (3f 13½-22½ & 1m 19); 1218-1 (2f 9-12); 1223-1 (2f 14-19½ & 3m 13½-18½); 1223-2 (4f 8-10 & 3m 9½-10); 1223-6 (10f 6½-9); 1225-2 (3f 9½-14 & 2m 10½-13); 1225-3 (25f 6½-9); 1225-4 (5j 3-4½); 1228-1 (2f 9-28); 1230-2 (2f 9½-11); 1230-3 (4f 7½-22 & 4m 10-20); 1230-4 (4f 8½-12½ & 3j 6½-7½); 1230-5 (3j 7-8); 1231-1 (20f 8½-20½ & 7m 8½-12½); 1239-1 (3f 9-13 & 3m 9½-12); 1239-3 (1f 19½ & 1m 20); 1239-15 (1f 22); 1240-1 (1f 14); 1241-8 (2f 7½-13); 1242-1 (1f 10); 1242-6 (2f 9-13 & 2m 18-21); 1242-8 (1f 17); 1242-11 (1f 10); 1242-13 (1f 11); 1242-14 (1f 10); 1243-2 (1f 13); 1243-3 (4f 8-10½); 1245-3 (5j 7½-9½); 1247-1 (1m 23); 1250-1 (1f 16 & 1m 15½); 1261-3 (1f 8); 1261-6 (1f 20½); 1266-1 (2f 7-11 & 1m 20½); 1266-6 (1f 17 & 1m 20); 1268-1 (1f 20½); 1269-7 (1f 24); 1270-6 (1f 21½); 1276-1 (1f 21½); 1278-1 (1m 17); 1279-1 (2f 21½-24); 1281-6 (1m 21); 1281-8 (1m 18); 1287-2 (1f 8½); 1288-1 (1m 16); 1289-3 (1f 22); 1294-3 (1f 19½); 1322-3 (1f 11½); 1322-8 (1f 8½); 1322-32 (1m 19); 1323-7 (1f 12½); 1326-5 (1m 19½); 1327-1 (2f 14-21); 1328-6 (1f 21½); 1334-1 (2m 15½-21); 1335-2 (1j 8); 1336-2 (1f 20½); 1337-5 (4f 11-19½ & 1m 22½); 1339-1 (1f 15½ & 1m 19); 1341-2 (1m 16); 1342-1 (1f 20); 1342-6 (2f 12½-14½ & 3m 11½-15); 1353-5 (2f 17½-20 & 3m 16-21); 1356-1 (1f 13½ & 1m 11½); 1356-2 (1f 17); 1358-1 (1m 15½); 1358-8 (1f 20½); 1361-1 (2m 14½-19); 1363-1 (1f 22½ & 1m 25); 1365-1 (1f 19); 1366-1 (1f 19 & 1m 17½); 1368-1 (1m 21½); 1369-2 (1m 19½); 1370-2 (1f 19½); 1371-1 (1m 18); 3997-2 (1f 10½); 3998-1 (1m 28); 3998-2 (1m 22); 3999-1 (2f 29-30); 4000-2 (1f 16); 4000-6 (1f 24).

Type localities: North Atlantic: 4 "Michael Sars" stations: off West Africa, St. 34, 28°42′N, 14°16′W, 400 mw (ZBMN 14836) and St. 49, 29°2′N, 25°3′W, 3000 mw (ZBMN 14837); and central North Atlantic, St. 51 and 52, ca. 31°20′N, 31°36′W (ZBMN 14838-14840; 4000, 100 and 1200 mw, resp.).

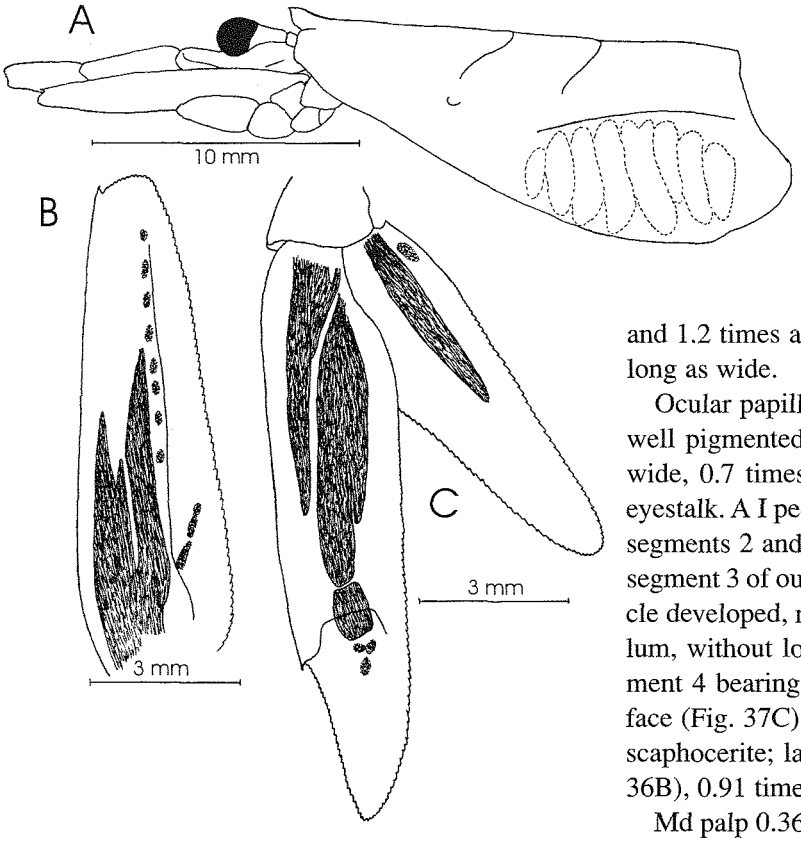


Fig. 36. *Sergia grandis*, male, "Dana" St. 1230-3, Cp length 20.2 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

Type material: Syntypes of *Sergestes grandis* (5f & 1m) (ZMBN 14836-14840, not examined).

Diagnosis: Integument firm, rostrum acute; cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with well developed tubercle not overlapping segment 4 of flagellum, without terminal setae overlapping tubercle; segment 4 of flagellum bearing 4-5 serrated bristles on dorsal surface; posterior branchial lobe on somite XII not hidden under anterior lobe; LI undivided, not overlapping other lobes and processes; LT undivided;, LC divided, with distal lobule straight and not overlapping other lobes and processes and proximal lobule directed laterally; LAc absent, LA straight, reaching 0.2-0.5 of PV length. Photophores in 2 series on scaphocerite medial to inner strip of muscle (5-9 organs in longitudinal row and 2-6 organs in oblique row) and in a single series on Up exopod; 2-5 in triangular figure distal to apical muscle strip.

Description: Cp 2.1 times as long as high and 0.42 times as long as abdomen (Fig. 36A). Abdomen with somite VI 1.5 times as long as high and 1.2 times as long as telson; telson 2.8 times as long as wide.

Ocular papilla 0.3 times as long as wide; cornea well pigmented, dark brown, 1.1 times as long as wide, 0.7 times as long and 1.4 times as wide as eyestalk. A I peduncle 0.6 times as long as Cp, with segments 2 and 3 0.71 times as long as segment 1, segment 3 of outer A I flagellum in male with tubercle developed, not overlapping segment 4 of flagellum, without long setae overlapping tubercle; segment 4 bearing 4-5 serrated bristles on dorsal surface (Fig. 37C). A II peduncle 0.5 times as long as scaphocerite; latter 3.5 times as long as wide (Fig. 36B), 0.91 times as long as A I peduncle.

Md palp 0.36 times as long as Cp, with proximal segment 2.3 times as long as distal one. Mx I with palp 1.9 times as long as wide and 0.06 times as long as Cp; endopod 2.0 times as long as wide and 1.7 times as long as palp, endite 1.5 times as long as wide and 1.0 times as long as palp. Mx II with exopod 3.1 times as long as wide and 0.30 times as long as Cp; palp 4.0 times as long as wide and 0.12 times as long as Cp; endopod 2.1 times as long as wide and 0.9 times as long as palp; endites subequal, 1.5 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 3.9 times as long as wide and 0.20 times as long as Cp; endopod 0.9 times as long as exopod, segments 2 and 3 1.5 times as long as segment 1. Mxp II 0.9 times as long as Cp, with merus 1.0, carpus 0.9, propodus 1.0, and dactyl 0.4 times as long as ischium. Mxp III 1.5 times as long as Cp, with merus 0.9, carpus 0.8, propodus 0.8, and dactyl 0.7 times as long as ischium; propodus and dactyl incompletely divided into 3 and 6-7 subsegments, respectively.

P I 1.1 times as long as Cp, with merus 2.5, carpus 1.3, and propodus 2.5 times as long as ischium; propodus incompletely divided into 10 subsegments. P II 1.6 times as long as Cp, with merus 2.8, carpus 2.4, propodus 2.9, and dactyl 0.2 times as long as ischium; propodus divided into 11 subseg-

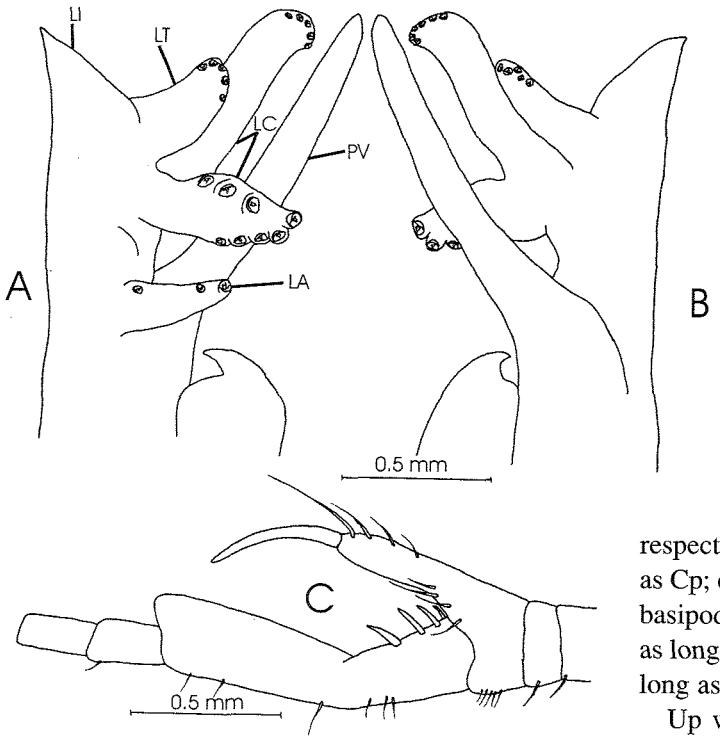


Fig. 37. *Sergia grandis*, male, "Dana" St. 1230-3, Cp length 20.2 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

ments. P III 1.9 times as long as Cp, with merus 3.1, carpus 2.7, propodus 2.8, and dactyl 0.2 times as long as ischium; propodus divided into 9 subsegments. P IV 1.2 times as long as Cp, with merus 1.6, carpus 1.1, and propodus 1.2 times as long as ischium. P V 0.7 times as long as Cp, with merus 1.2, carpus 0.9 and propodus 0.7 times as long as ischium.

Somite VIII with arthrobranch 0.13 times as long as Cp and 1.5 times as long as epipod. Somite IX with anterior pleurobranch 0.20 times as long as Cp and 2.7 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.25 times as long as Cp and 3.3 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.27 times as long as Cp and 3.0 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.27 times as long as Cp and 1.3 times as long as posterior pleurobranch, posterior lobe not hidden under anterior lobe. Somite XIII with anterior pleurobranch 0.24 times as long as Cp and 1.3 times as long as posterior pleurobranch.

Pl I with basipod 0.33 times as long as Cp and exopod 2.3 times as long as basipod. Pl II with basipod 0.29 times as long as Cp; exopod 2.6 and endopod 1.5 times as long as basipod, respectively. Pl III with basipod 0.29 times as long as Cp; exopod 2.7 and endopod 1.7 times as long as basipod, respectively. Pl IV with basipod 0.29 times as long as Cp; exopod 2.2 and endopod 1.2 times as long as basipod, respectively. Pl V with basipod 0.26 times as long as Cp; exopod 2.0 and endopod 1.2 times as long as basipod, respectively.

Up with exopod 4.6 times as long as wide, 5.7 times as long as basipod and 0.7 times as long as Cp; endopod 3.3 times as long as wide and 0.7 times as long as exopod (Fig. 36C).

Petasma (Fig. 37A-B). PV long and narrow, 4.3 times as long as wide, tip not curved. LI very thick, almost reaching end of PV, 1.4 times as long as wide and 0.3 times as long as PV. LT slender, almost reaching end of LI and not reaching end of LC, 1.5 times as long as wide and 0.2 times as long as PV, armed with few small apical hooks. LC with distal lobule overlapping LI and LT and reaching end of PV, 2.8 times as long as wide and 0.4 times as long as PV, armed with several small hooks near apex, not curved, tip directed distolaterally; proximal lobule 1.6 times as long as wide and 0.2 times as long as PV, armed with several strong hooks in distal half. LA very short, in average 1.9 times as long as wide and 0.2 times as long as PV, armed with few smaller hooks on medial side.

Photophores. Scaphocerite: photophores arranged in 2 rows medial to inner strip of muscle, (1) longitudinal row of 6-10 organs from 0.3-0.4 to 0.8-0.9 blade length and (2) oblique row of 2-4 (often fused) organs from 0.2 to 0.3 blade length. Up exopod: single group of 2-5 photophores in triangular figure distal to apical muscle strip. Up endopod: 1 photophore in proximomedial corner.

Remarks: Variations of colour in life are shown in Pl. 3D-E.

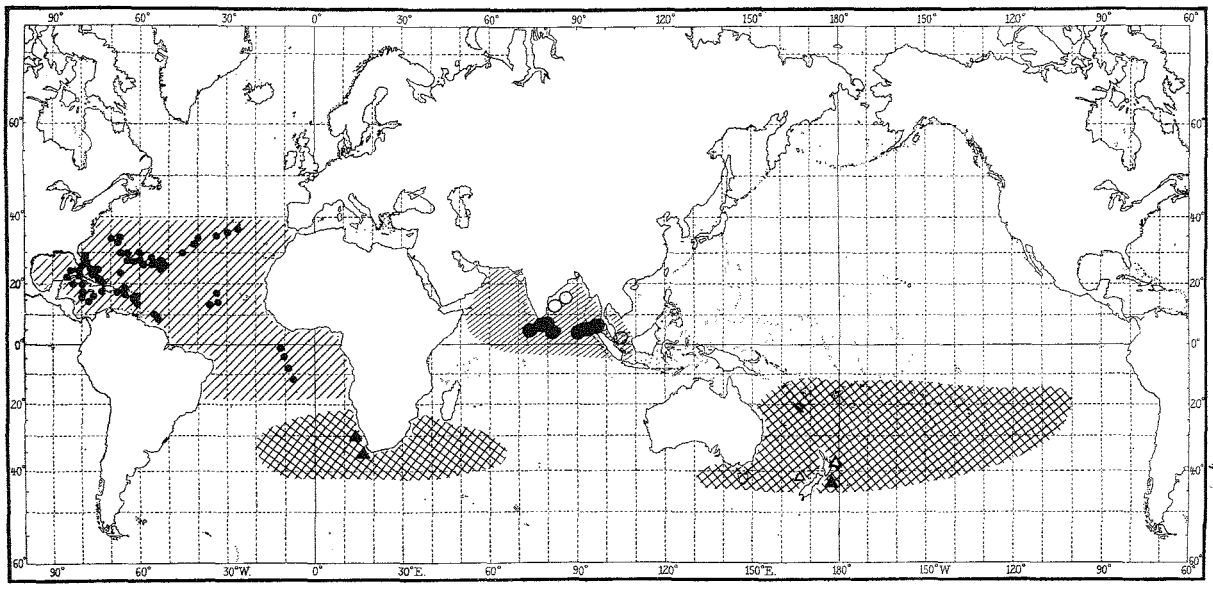


Fig. 38. Probable geographical distribution of *Sergia grandis* (small circles, coarse hatching), *S. plumea* (large circles, fine hatching) and *S. potens* (triangles, cross hatching). Black symbols indicate "Dana" stations, white symbols "Galathea" stations. Shaded areas without symbols are supported by literature data.

This species was noted by many authors to be very close to its Pacific vicariant, *S. phorca*. Although the distinctness of the two species was beyond any doubt for most authors, it was very difficult to express how they could be distinguished, more so as both show great morphological variability. As shown by Crosnier & Forest (1973), the position of the photophores varies geographically. Individual variation even within the same locality was shown (Vereshchaka 1994a) to concern not only the photophore position but also other characters believed to be distinguishing: the form of the scaphocerite, P IV, Up, PV, the hook of the PU (Sund 1920); the form of the LC (Hansen 1922); and the form of the rostrum, LT, PU, and eyes (Crosnier & Forest 1973). In my previous paper, the figure of the petasma of *S. grandis* was accidentally replaced by the figure of the petasma of *S. potens* (Vereshchaka 1994a, fig. 10E); the visibility of the posterior branchial lobe on somite XII (character 2, op. cit., p. 83) also needs correction: the posterior branchial lobe is not covered by the anterior lobe in *S. grandis* and at least half covered by it (not always completely covered) in *S. phorca*; the form of the distal photophore group on Up exopod (character 3, op. cit., p. 83) has proved on more extensive "Dana II" material not to be universal.

Sergia grandis is closer to *S. phorca, S. potens, S. filicta, S. maxima, S. wolffi,* and *S. burukovskii* n. sp. than to *S. bisulcata* and *S. plumea*. Affinities and differences between *S. grandis* and all other known species of the species group are shown in Table 5.

Geographical distribution (Fig. 38): Atlantic Ocean only: Caribbean Sea, West and Central Atlantic, near Cape Verde Islands (Hansen 1922, Vereshchaka 1994a), Central Atlantic ("Dana"; Crosnier & Forest 1973).

Records of this species from around South Africa (Hansen 1925, Kensley 1971, Crosnier & Forest 1973) seem to refer to a very similar species, *S. burukovskii* n. sp. *Sergia grandis* is parapatric to *S. potens* and *S. burukovskii*, which occur mainly in the southern temperate Atlantic (*S. potens* also in the Pacific). *S. grandis* is sympatric with *S. wolffi* and allopatric to all other members of the species group.

Vertical range: An interzonal species, migrating daily between the meso-/upper bathypelagic and the upper mesopelagic zones. The "Dana" specimens were taken within the depth range 30-2300 m. Most specimens live at 200-500 m at night and at 800-1500 m during the day.

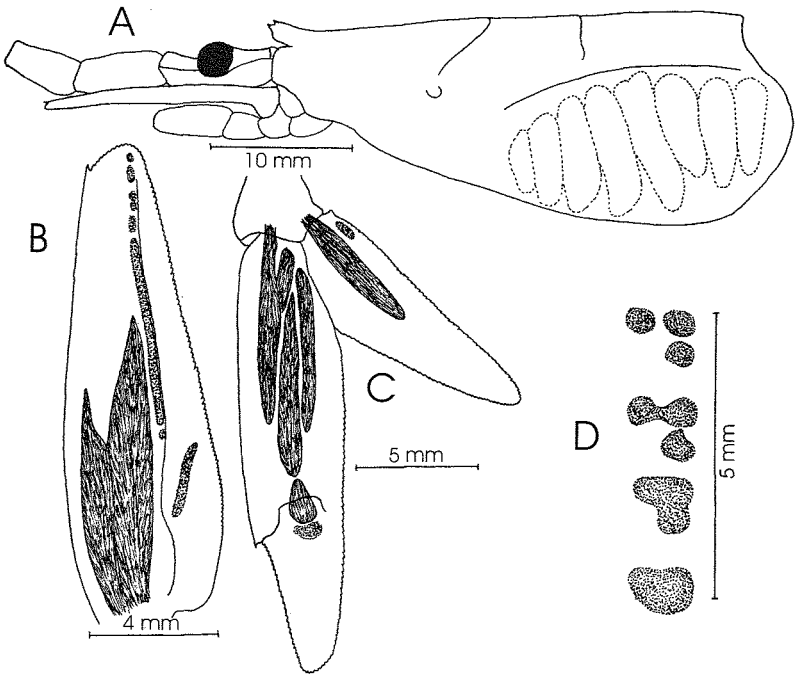


Fig. 39. *Sergia maxima*, male, "Dana" St. 3688-4, Cp length 35.4 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up. – D, ontogenetic transformation of distal photophores on Up exopod, "Dana" St. 3869-5, 3828-1, 3625-1, 3909-4.

***Sergia maxima* (Burkenroad, 1940)**

Figs. 33, 39-40

Sergestes maximus Burkenroad, 1940: 47.
Sergestes (Sergia) maximus. – Yaldwyn 1957: 9.
Sergia maxima. – Walters 1976: 823. – Krygier & Wasmer 1988: 50. – Vereshchaka 1995a: 1651.

Material examined: "Dana" stations: 3623-1 (1f 22); 3625-1 (1m 16½); 3683-1 (1f 32); 3688-4 (1m 35½); 3712-1 (1m 16); 3714-6 (1m 21½); 3716-3 (1m 28½); 3828-1 (1f 12); 3869-5 (1j 11); 3902-1 (1f 13½); 3909-3 (2m 37-41; the latter male is the largest known sergestid specimen!); 3909-4 (1m 31½).

Type locality: Western Indian Ocean, 11°18′S, 50°03′E.

Type material: Holotype ("Dana" St. 3933-1, ZMUC, lost, see Introduction).

Diagnosis: Integument firm; rostrum usually acute, bidentate; cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with well developed tubercle overlapping segment 4 of flagellum, without terminal setae overlapping tubercle; segment 4 of flagellum bearing 7-9 serrated bristles on dorsal surface; posterior branchial lobe on somite XII not hidden under anterior lobe; LI divided, not overlapping other lobes and processes; LT entire; LC entire, overlapping other lobes and processes; LAc absent; LA evenly curved medially, reaching 0.4-0.6 of PV. Photophores in 2 rows on scaphocerite medial to inner strip of muscle, single large spot distal to apical muscle band on Up exopod.

Description: Cp 2.0 times as long as high and 0.45 times as long as abdomen (Fig. 39A). Abdomen with somite VI 1.7 times as long as high and 1.0 times as long as telson; telson 3.3 times as long as wide.

Ocular papilla inconspicuous, 0.3 times as long as wide; cornea well pigmented, dark brown, 0.9 times as long as wide, 0.8 times as long and 1.5 times as wide as eyestalk. A I peduncle 0.6 times as long as Cp, with segments 2 and 3 0.77 and 0.71 times as long as segment 1, respectively, segment 1 of outer A I flagellum in male with tubercle overlapping segment 5 of flagellum, segment 4 bearing 7-9 serrated bristles and few stout setae on dorsal surface (Fig. 40C). A II peduncle 0.5 times as long as scaphocerite; latter 3.4 times as long as wide (Fig. 39B), 0.83 times as long as A I peduncle.

Md palp 0.33 times as long as Cp, with proximal segment 2.4 times as long as distal. Mx I with palp 2.1 times as long as wide and 0.06 times as long as Cp; endopod 2.0 times as long as wide and 1.6 times as long as palp; endite 1.9 times as long as

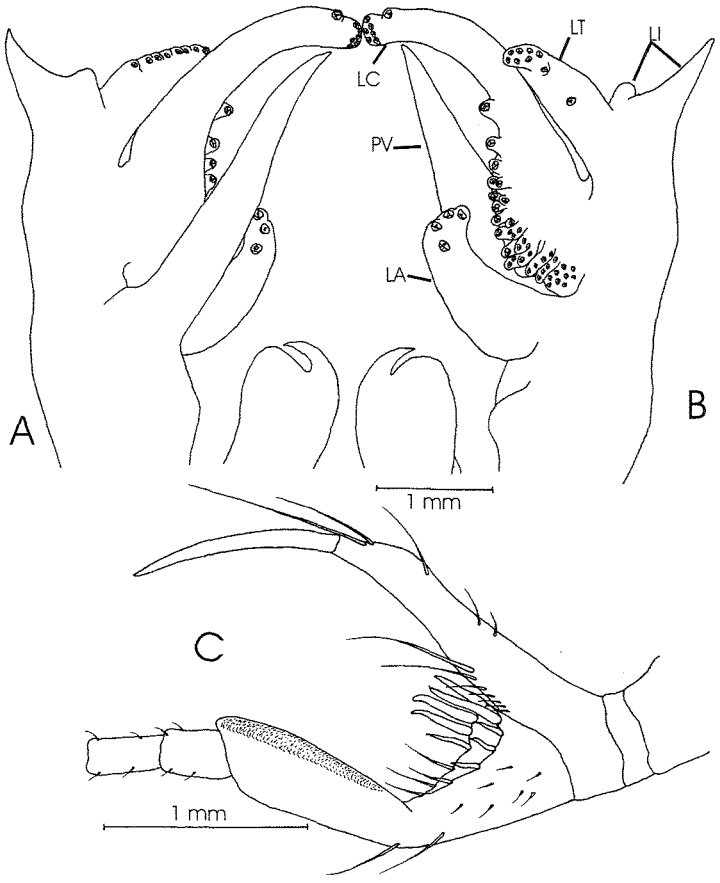


Fig. 40. *Sergia maxima*, male, "Dana" St. 3688-4, Cp length 35.4 mm. – A, caudal view of petasma. – B, oral view of petasma. – C, male outer A I flagellum.

wide and 0.9 times as long as palp. Mx II with exopod 3.2 times as long as wide and 0.29 times as long as Cp; palp 3.7 times as long as wide and 0.11 times as long as Cp; endopod 2.2 times as long as wide and 1.0 times as long as palp; endites subequal, 1.8 times as long as wide and 0.4 times as long as palp.

Mxp I with exopod 3.8 times as long as wide and 0.17 times as long as Cp; endopod 1.0 times as long as exopod, segments 2 and 3 1.3 and 1.2 times as long as segment 1, respectively. Mxp II 0.9 times as long as Cp, with merus 0.9, carpus 0.7, propodus 0.9, and dactyl 0.4 times as long as ischium. Mxp III 1.6 times as long as Cp, with merus 0.8, carpus 0.9, propodus and dactyl 0.8 times as long as ischium; propodus and dactyl divided into 3 and 7 subsegments, respectively.

P I 1.1 times as long as Cp, with merus 2.8, carpus 1.6, and propodus 3.1 times as long as ischium; propodus divided into 8 subsegments. P II 1.6 times as long as Cp, with merus 3.1, carpus 2.6, propodus 3.1, and dactyl 0.1 times as long as ischium; propodus divided into 12 subsegments. P III 1.9 times as long as Cp, with merus 3.4, carpus 3.1, propodus 3.2, and dactyl 0.1 times as long as ischium; propodus divided into 12 subsegments. P IV 1.2 times as long as Cp, with merus 1.6, carpus 1.2, and propodus 1.3 times as long as ischium. P V 0.6 times as long as Cp, with merus 1.7, carpus 1.5 and propodus 1.2 times as long as ischium.

Somite VIII with arthrobranch 0.14 times as long as Cp and 2.6 times as long as epipod. Somite IX with anterior pleurobranch 0.22 times as long as Cp and 4.2 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.26 times as long as Cp and 4.1 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.28 times as long as Cp and 3.0 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.31 times as long as Cp and 1.4 times as long as posterior pleurobranch, posterior lobe not hidden under anterior lobe. Somite XIII with anterior pleurobranch 0.25 times as long as Cp and 1.2 times as long as posterior pleurobranch.

Pl I with basipod 0.30 times as long as Cp and exopod 2.2 times as long as basipod. Pl II with basipod 0.28 times as long as Cp; exopod 2.6 and endopod 1.3 times as long as basipod, respectively. Pl III with basipod 0.28 times as long as Cp; exopod 2.1 and endopod 1.2 times as long as basipod, respec-

tively. Pl IV with basipod 0.27 times as long as Cp; exopod 1.9 and endopod 1.1 times as long as basipod, respectively. Pl V with basipod 0.24 times as long as Cp; exopod 2.0 and endopod 1.1 times as long as basipod, respectively.

Up with exopod 4.4 times as long as wide, 5.8 times as long as basipod and 0.6 times as long as Cp; endopod 3.2 times as long as wide and 0.6 times as long as exopod (Fig. 39C).

Petasma (Fig. 40A-B). PV slender, 4.9 times as long as wide, tip not curved. LI well developed, with medial lobule overlapping LT, 1.9 times as long as wide and 0.3 times as long as PV; lateral lobule small, as long as wide, 0.1 times as long as PV. LT not reaching end of LI and LC, 2.4 times as long as wide and 0.4 times as long as PV, armed with several small hooks in distal part. LC 3.1 times as long as wide and 0.9 times as long as PV, bearing numerous papillae with hooks on proximolateral side and several hooks near apex, curved, tip directed laterally. LA short, 2.1 times as long as wide and 0.5 times as long as PV, armed with several hooks near apex.

Photophores. Scaphocerite: photophores arranged in 2 rows medial to inner band of muscle, (1) longitudinal row distally split into 2-7 discrete organs from 0.3-0.4 to 0.9-1.0 blade length and (2) oblique row from 0.2 to 0.3-0.4 blade length. Up exopod: 1 large organ distal to apical muscle strip. Up endopod: 1 photophore in proximomedial corner.

Remarks: All "Dana" specimens agree with Burkenroad's (1940) original description. They vary in the form of the rostrum, which may be unidentate and even blunt (2 examined specimens). Insignificant variations were found in the petasma: the lateral lobule of LI may be more or less prominent, LC may sometimes have a rudimentary proximal lobule, especially in young specimens. The unique continuous band of the photophores is derived from the rows of discrete photophores, usual for the species group. In the longitudinal band on the scaphocerite, there may be one to a few discrete organs not fused yet. The origin of the large distal spot on the Up exopod is also accounted for by the fusion of previously discrete photophores; this is seen in the series of transitional cases found in the youngest specimens (Fig. 39D). Thus, the unique characters of this species (undivided LC and band photophores) undoubtedly derive from those that are common for the species group.

Sergia maxima is closest to *S. phorca, S. grandis, S. potens, S. filicta, S. wolffi,* and *S. burukovskii* n. sp. It differs from these and all other species of the group in (1) clasping organ with 7-9 serrated bristles, (2) P I propodus with 8 subsegments, (3) LI divided, (4) LC entire, (5) scaphocerite with bands of photophores. Other affinities and differences between *S. maxima* and all other species of the species group are shown in Table 5.

Geographical distribution (Fig. 33): Tropical areas of the Indian and Pacific Oceans.
Indo-West Pacific: Central and northern part, off Sri Lanka, off Sumatra ("Dana").

Pacific: Western and central parts, off the Philippines, north of New Zealand ("Dana"), off Hawaii (Walters 1976).

Sergia maxima is parapatric to *S. phorca* and *S. filicta*, which live in the eastern tropical Pacific,while *S. maxima* occurs in the central and western tropical Pacific. *S. maxima* is allopatric to *S. grandis, S. wolffi,* and *S. burukovskii* and sympatric with all other species of the species group.

Vertical range: An interzonal species, migrating daily between the upper bathypelagic and mesopelagic zones. "Dana" specimens were taken within the depth range 300-2000 m. Most specimens live at 300-700 m at night and 1000-2000 m during the day.

Sergia phorca (Faxon, 1893), n. comb.

Figs. 33, 41-42; Pl. 3C

Sergestes phorcus Faxon, 1893: 217. – Illig 1914: 354 (part); 1927: 289 (part), figs. 18-25. – Hansen 1919: 5 (part); 1922: 97. – Sund 1920: 16. – Boone 1930: 121. – Burkenroad 1937: 323, figs. 6-7.

Sergestes bisulcatus. - Faxon 1895: 210, pl. 52, fig. 1a-h [not Wood-Mason *in* Wood-Mason & Alcock, 1891a].

Sergestes (Sergia) phorcus. – Yaldwyn 1957: 9.

Material examined: "Dana" stations: 1203-1 (1f 21 & 1m 23½); 1203-2 (2f 22-24½); 1203-10 (3f 17½-25 & 3m 19½-22½); 1203-17 (1f 20 & 3m 21-22); 1205-2 (1f 19 & 2m 19-19½); 1205-3 (4f 13-20½ & 2m 20-23½); 1206-2 (1f 23); 1206-7 (1f 18½ & 1m 19½); 1206-8 (1m 25); 1208-4 (2m 20-25); 1208-13 (1f 20½); 1209-1 (1f 10 & 1m 29);

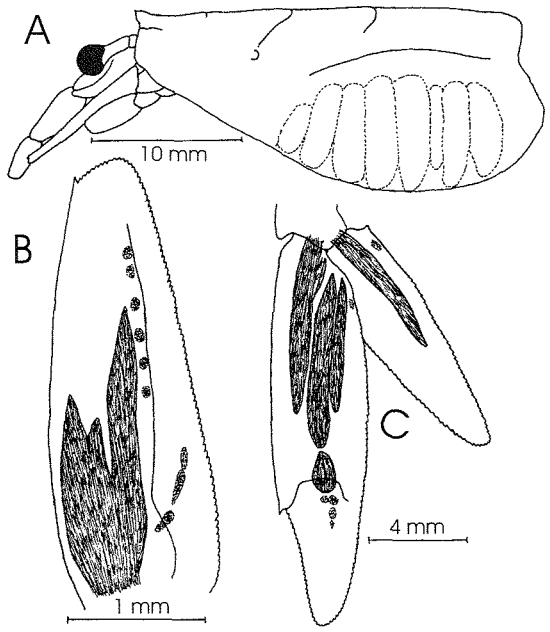


Fig. 41. *Sergia phorca*, male, "Dana" St. 3550-1, Cp length 30.6 mm. – A, lateral view of Cp. – B, scaphocerite. – C, Up.

3548-2 (2f 16-21 & 1m 14); 3549-4 (2f 22½ & 1m 15 & 1j 11); 3549-5 (1m 17); 3549-6 (1f 18½ & 1m 21); 3550-1 (2f 16½-24 & 2m 27-30½); 3550-8 (1f 21½ & 1m 21); 3556-1 (1f 29 & 1m 29½); 3556-4 (2f 26½-28½ & 2m 25-26); 3558-1 (1j 11½); 3558-5 (3f 17½-23½); 3558-6 (1f 14 & 1m 12); 3561-4 (1m 27); 3561-6 (3m 24-27).

"Galathea" station: 726 (1m 20½).

Type localities: Eastern Pacific Ocean: Gulf of Panama; Galapagos; and Gulf of California (see Faxon 1893 for details).

Type material: Six syntypes of *Sergestes phorcus*, all collected by "Albatross": Gulf of Panama (MCZ 4667, 1 male, St. 3382, 1793 fms; MCZ 4668, 2 females, St. 3388, 1168 fms); Galapagos (MCZ 4669, 1 female, St. 3401, 395 fms), none examined. - Gulf of Panama (Depository?, 1 female, St. 3386, 242 fms). - Gulf of California (Depository?, 1 female, St. 3437, 628 fms) (none examined).

Diagnosis: Integument firm, rostrum acute; cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with well developed tubercle overlapping segment 4 of flagellum, without terminal setae overlapping tubercle; segment 4 of flagellum bearing 4-5 serrated bristles on dorsal surface; posterior branchial lobe on somite XII hidden under anterior lobe; LI undivided, not overlapping other lobes and processes; LT undivided; LC divided, with distal lobule not curved and not overlapping other lobes and processes and proximal lobule directed proximolaterally; LAc absent; LA evenly curved in medial direction, reaching 0.7-1.0 PV length. Photophores in 2 rows on scaphocerite medial to inner strip of muscle (5-9 organs in longitudinal row and 2-6 organs in oblique row) and in 2 series on Up exopod; 2-7 in triangular figure distal to apical muscle strip and 1-4 proximal ones in continuous row medial to inner muscle strip.

Description: Cp 2.0 times as long as high and 0.50 times as long as abdomen (Fig. 41A). Abdomen with somite VI 1.7 times as long as high and 1.1 times as long as telson; telson 3.3 times as long as wide.

Ocular papilla 0.3 times as long as wide; cornea well pigmented, dark brown, 1.1 times as long as wide, 0.6 times as long and 1.4 times as wide as eyestalk. A I peduncle 0.5 times as long as Cp, with segments 2 and 3 0.71 and 0.63 times as long as segment 1, respectively, segment 3 of outer A I flagellum in male with tubercle overlapping segment 4 of flagellum, segment 4 bearing 4-5 serrated bristles and several setae on dorsal surface (Fig. 42C). A II peduncle 0.6 times as long as scaphocerite; latter 3.0 times as long as wide (Fig. 41B), 0.77 times as long as A I peduncle.

Md palp 0.28 times as long as Cp, with proximal segment 2.2 times as long as distal one. Mx I with palp 1.9 times as long as wide and 0.05 times as long as Cp; endopod 2.1 times as long as wide and 1.8 times as long as palp; endite 1.5 times as long as wide and 0.9 times as long as palp. Mx II with exopod 3.0 times as long as wide and 0.32 times as long as Cp; palp 3.0 times as long as wide and 0.09 times as long as Cp; endopod 2.2 times as long as wide and 1.1 times as long as palp; endites subequal, 1.4 times as long as wide and 0.5 times as long as palp.

Mxp I with exopod 3.6 times as long as wide and 0.16 times as long as Cp; endopod 1.1 times as long as exopod; segments 2 and 3 1.3 and 1.1 times as long as segment 1, respectively. Mxp II 0.7 times as long as Cp, with merus 1.2, carpus 0.9, propodus 1.0, and dactyl 0.5 times as long as ischium. Mxp III 1.2 times as long as Cp, with merus 0.9, carpus 1.0, propodus 0.9, and dactyl 0.8 times as long as

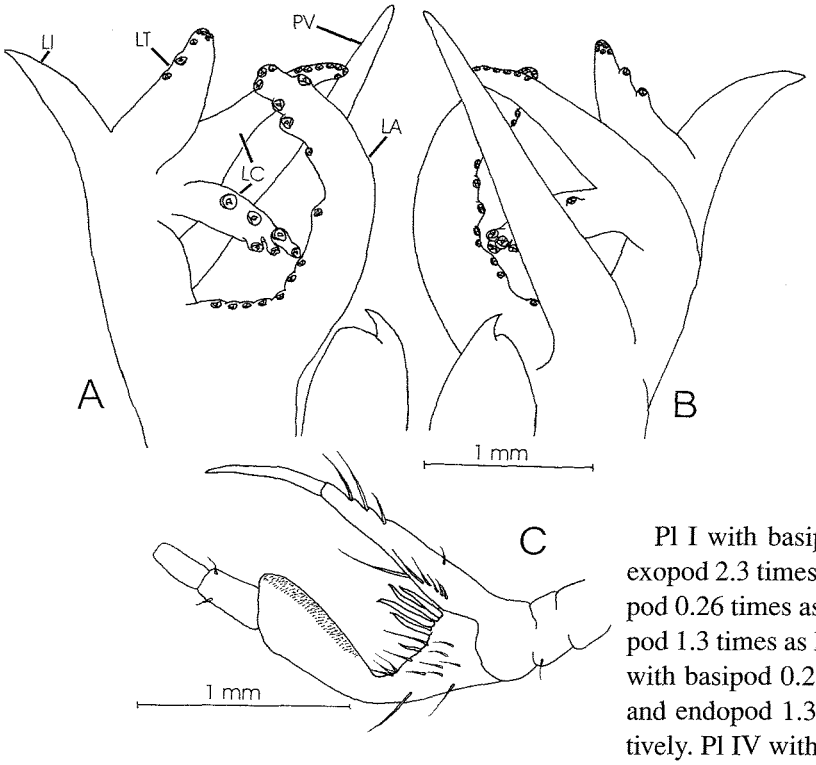


Fig. 42. *Sergia phorca*, male, "Dana" St. 3550-1, Cp length 30.6 mm. – A, oral view of petasma. – B, caudal view of petasma. – C, male outer A I flagellum.

ischium; propodus and dactyl divided into 3 and 9 subsegments, respectively.

P I 0.9 times as long as Cp, with merus 3.2, carpus 1.9, and propodus 3.6 times as long as ischium, propodus divided into 13 subsegments. P II 1.3 times as long as Cp, with merus 2.3, carpus 2.1, propodus 2.6, and dactyl 0.1 times as long as ischium; propodus divided into 10 subsegments. P III 1.6 times as long as Cp, with merus 2.4, carpus 2.3, propodus 2.7, and dactyl 0.1 times as long as ischium; propodus divided into 10 subsegments. P IV 1.1 times as long as Cp, with merus 1.2, carpus 0.9, and propodus 1.0 times as long as ischium. P V 0.6 times as long as Cp, with merus 1.2, carpus 0.9 and propodus 0.7 times as long as ischium.

Somite VIII with arthrobranch 0.20 times as long as Cp and 4.4 times as long as epipod. Somite IX with anterior pleurobranch 0.25 times as long as Cp and 7.1 times as long as posterior pleurobranch. Somite X with anterior pleurobranch 0.29 times as long as Cp and 5.9 times as long as posterior pleurobranch. Somite XI with anterior pleurobranch 0.31 times as long as Cp and 5.3 times as long as posterior pleurobranch. Somite XII with anterior pleurobranch 0.36 times as long as Cp and 1.3 times as long as posterior pleurobranch, posterior lobe hidden under anterior lobe. Somite XIII with anterior pleurobranch 0.32 times as long as Cp and 1.1 times as long as posterior pleurobranch.

Pl I with basipod 0.28 times as long as Cp and exopod 2.3 times as long as basipod. Pl II with basipod 0.26 times as long as Cp; exopod 2.5 and endopod 1.3 times as long as basipod, respectively. Pl III with basipod 0.26 times as long as Cp; exopod 2.3 and endopod 1.3 times as long as basipod, respectively. Pl IV with basipod 0.24 times as long as Cp; exopod 2.4 and endopod 1.2 times as long as basipod, respectively. Pl V with basipod 0.27 times as long as Cp; exopod 2.1 and endopod 1.1 times as long as basipod, respectively.

Up with exopod 4.3 times as long as wide, 7.0 times as long as basipod and 0.5 times as long as Cp; endopod 3.7 times as long as wide and 0.6 times as long as exopod (Fig. 41C).

Petasma (Fig. 42A-B). PV long and narrow, 4.9 times as long as wide, tip not curved. LI well developed, not reaching end of PV, 2.3 times as long as wide and 0.3 times as long as PV. LT slender, reaching end of LI and LC, 2.2 times as long as wide and 0.4 times as long as PV, armed with few small hooks on distomedial margin. LC with distal lobule 3.0 times as long as wide and 0.4 times as long as PV, armed with several small hooks on distomedial side, not curved, tip directed distolaterally; proximal lobule 2.4 times as long as wide and 0.3 times as long as PV, armed with several medium-sized hooks in distal half. LA voluminous, 3.9 times as long as wide and 0.6 times as long as PV, armed with numerous smaller hooks along medial side and several stronger hooks near apex.

Photophores. Scaphocerite: photophores arranged in 2 rows medial to inner strip of muscle: (1) longitudinal row of 5-9 organs from 0.3-0.4 to 0.8-0.9 blade length and (2) oblique row of 2-6 (often partially fused) organs from 0.1 to 0.3 blade length. Up

exopod: photophores arranged in 2 series: (1) 2-7 photophores in triangular figure distal to apical muscle strip, and (2) 1-4 proximal organs in continuous row medial to inner muscle strip from 0.1-0.2 to 0.4-0.5 exopod length. Up endopod: 1 photophore in proximomedial corner.

Remarks: Colour in life is shown in Pl. 3C.

Sergia phorca varies in proportions of the lobes of the petasma and in the number of photophores. The length of LA varies individually, but always remains in the range 0.6-1.0 PV length. The proximal set of photophores on the Up exopod may consist of only 1-3 organs or (very rarely) be absent. The proximal set of photophores on the Up exopod may be reduced to 3 organs in triangular figure or even (rarely) to 2 organs; in the latter case the 2 photophores are arranged obliquely.

Sergestes phorcus was first described by Faxon (1893) and later (1895) treated by the same author as a synonym of *Sergestes bisulcatus* Wood-Mason *in* Wood-Mason & Alcock, 1891. After the publication of a more detailed description of the latter species (Alcock 1901), both species appeared beyond any doubt to be distinct, so the former must retain the original specific name *phorcus*. The synonymy of *S. phorcus* and *S. bisulcatus* was accepted by Hansen (1896). However, later Hansen (1919) introduced the special study of the pars media of the petasma and, after examination of both species, re-established *S. phorcus*. After examination of the Monaco collections, Hansen (1922) found the species identified by him in 1919 as *S. phorcus* to be different from that described by Sund (1920) as *S. grandis*. Hansen also illustrated the petasma of *S. grandis* and compared this with the petasma of *S. phorcus* drawn by Dr. Waldo Schmitt (unpublished, drawing is kept in the Library for Crustacea, ZMUC) and synonymized *S. bisulcatus* Stebbing, 1905 and *S. grandis* Sund. The first figure of the petasma of *S. phorcus* was provided by Burkenroad (1937).

Sergia phorca is rarely present in the pelagic collections. This as well as its comparatively narrow range of distribution may explain why it has been mentioned by only few authors, mainly in the first half of the 1900s.

Sergia phorca differs from all other species of the species group in having (1) Mxp III dactylus with 9 subsegments and (2) P I propodus with 13 subsegments. Other differences and affinities between *S. phorca* and all other known species of the species group are shown in Table 5.

Geographical distribution (Fig. 33): Eastern Pacific only: Gulf of Panama, off Galapagos Islands ("Dana"; Faxon 1893; Burkenroad 1937), Equatorial East Pacific ("Dana"), Lower California, Gulf of California (Burkenroad 1937).

The distribution of *S. phorca* is very limited. The species is sympatric with *S. filicta* and parapatric to *S. potens*, *S. maxima*, and *S. bisulcata,* with *S. potens* occurring in the temperate or tropical Central and West Pacific and *S. bisulcata* in the eastern part of this ocean. *S. phorca* is allopatric to *S. grandis*, *S. wolffi*, and *S. burukovskii* n. sp.

Vertical range: An interzonal species, migrating daily between the meso-/upper bathypelagic and the upper mesopelagic zones. "Dana" specimens were taken within the depth range 200-1300 m. Most specimens occur at 200-400 m at night and at 800-1300 m during the day.

Sergia plumea (Illig, 1927), n. comb.

Figs. 38, 43-44

Sergestes plumeus Illig, 1927: 295, figs. 30-32.
Sergestes (Sergia) plumeus. – Yaldwyn 1957: 9.

Material examined: "Dana" stations: 3902-1 (1f 16½); 3903-1 (1f 13½); 3904-3 (1f 13½ & 1m 18); 3909-1 (1f 6 & 1m 13); 3909-2 (2m 17-19); 3909-3 (1m 16); 3909-4 (2f 11 & 2m 12-13); 3912-1 (1m 11½); 3913-1 (1f 10 & 4m 11-18½); 3914-2 (2f 10-11½).

"Galathea" stations: 298 (1m 17); 299 (1m 14); 351 (2m 11½-12½).

Type locality: Indian Ocean off Ras Hafun, "Valdivia" St. 268, 9°6′N, 53°41′E, caught at 1500 m.

Type material: Holotype (Berlin: ZMB 20889, 1 female, not examined).

Diagnosis: Rostrum blunt, cornea considerably wider than eyestalk; segment 3 of outer A I flagellum in male with well developed tubercle overlapping segment 4 of flagellum, without terminal setae overlapping tubercle; 4 segment of flagellum bearing 5 serrated bristles on dorsal surface; posterior