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A NEW PELAGIC SHRIMP OF THE GENUS *SERGIA* (DECAPODA, SERGESTIDAE) FROM THE ATLANTIC OCEAN

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ABSTRACT

The oceanic sergestid shrimp *Sergia robusta* (Smith, 1882), originally described on material collected off the East coast of U.S., was subsequently reported from the whole Atlantic Ocean, including the Mediterranean Sea. Specimens collected off West Africa south of the Canary Current are characterized by a smaller size and have the clasping organ of the male antennula different from specimens collected in the Northern hemisphere and in the Mediterranean Sea. Other minor differences are also observed in the armature of petasma lobes. The constancy of the shape of the clasping organ with absence of intermediate forms suggests the existence of two species: *S. robusta,* restricted to the North Atlantic gyre (Gulf Stream, Canary Current, North Equatorial Current) and the whole Mediterranean Sea, and *S. manningorum,* new species herein described, recorded from northern Namibia to Gulf of Guinea and Senegal. The two species seem to occur sympatrically in the Cape Verde Frontal Zone.

Pelagic shrimps of the genus *Sergia* Stimpson, 1860, are found in all the oceans, and several species seem to have a very large geographic distribution (Pérez Farfante and Kensley, 1997). Their general morphology is rather homogeneous and in some cases only the anatomy of body parts involved in reproduction, namely male petasma and lower antennular flagellum, allow sure identification of closely related species (Vereshchaka, 1994). Moreover, taxonomy of sergestid shrimps is confused by the existence of different species names used in the past century for larval stages (mastigopus) and early juveniles (Bate, 1888). Synonymy can seldom be verified due to difficulties in rearing the larval stages of these pelagic shrimps under laboratory conditions. Careful examination of material collected in the world oceans could result in the recognition of taxonomically cryptic species, *sensu* Knowlton (1986), inside a taxon previously considered with a world-wide distribution, as in the case of the pelagic shrimp *Pasiphaea sivado* recently studied by Hayashi (1999).

Sergia robusta (Smith, 1882) was first described from the Western Atlantic (off Martha's Vineyard, Massachusetts, U.S.A.) and subsequently reported also in the Eastern Atlantic, from off Ireland (Kemp, 1910) to Angola (Crosnier and Forest, 1973), including the whole Mediterranean (Băcescu and Mayer, 1961). The species is not recorded off the Atlantic coasts of South America, and according to Crosnier and Forest (1973) the scattered records of *S. robusta* outside the Atlantic are most probably the consequence of misidentifications with *S. bisulcata* (Wood-Mason, 1891).

Hansen (1896) described *Sergestes mediterraneus* on material collected in the Mediterranean Sea, but later the same Hansen (1922) synonymized it with *Sergestes robustus* Smith, 1882.

Casanova (1977) in his doctoral thesis, after examination of large collections made in the Western Mediterranean and off the Atlantic coasts of Morocco and Mauritania, confirmed the identity of the Mediterranean and the temperate North Atlantic specimens. At the same time he was the first to notice (p. 179, fig. 50) the remarkable size differences between the Atlantic and Mediterranean specimens examined by him and those collected off tropical West Africa by Crosnier and Forest (1973).

Through the kindness of Dr. Raymond B. Manning, we could examine the large collection of *S. robusta* gathered during the cruise made in 1970 by the R/V *Trident* in the Western Mediterranean, to study the diel vertical migrations of pelagic organisms (Froglia and Giannini, 1982). It included 1,195 males ranging in size between 7.1 and 18.1 mm CL

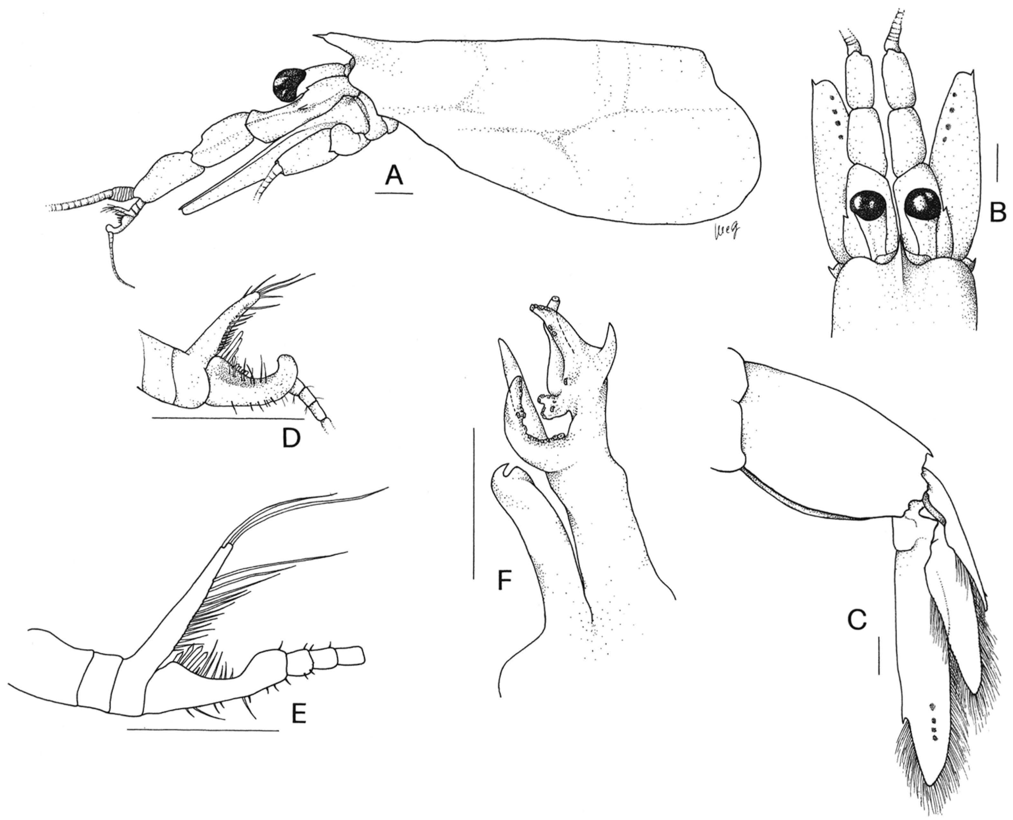

Fig. 1. *Sergia manningorum* sp. nov., male paratype, CL 7 mm: A, cephalothorax, side view; B, same dorsal view; C, sixth abdominal somite and telson; D, clasping organ; F, petasma, side view. E, *Sergia robusta,* male, CL 14 mm, Western Mediterranean, clasping organ. Scale bars = 1 mm.

and 1,300 females ranging in size from 6.2 to 20.2 mm CL. Other material of *S. robusta* was collected during the fishery investigations carried out by our institute (IRPEM) in the Southern Adriatic: 129 males in the size range 7.5–17.0 mm CL, 115 females in the size range 7.0–17.7 mm CL (Froglia and Giannini, 1984), and around Sicily: 63 males in the size range 6.1–17.2 mm CL, 73 females in the size range 6.1–18.5 mm CL (unpublished). Subsequently, during a visit to the U.S. National Museum of Natural History, Smithsonian Institution (USNM), we could compare our Mediterranean material with samples, identified as *S. robusta,* collected off tropical West Africa and with specimens collected off the U.S. East coast, including the type of *Sergestes robustus.*

Years later we had the opportunity to examine, at the Muséum national d'Histoire naturelle, Paris, France (MNHN) and the Instituto de Ciencias del Mar, Barcelona, Spain (ICM), part of the material reported by Crosnier and Forest (1973) and by Macpherson (1983), and we became definitely convinced that *Sergia robusta,* as presently understood, actually includes two species, thriving in different Atlantic water masses, and recognizable by few, but constant characters.

The species living off tropical West Africa is considered new and herein described.

Sergia manningorum, new species
Figs. 1–3

Sergestes (*Sergia*) *robustus:* Crosnier and Forest, 1973: 327, figs. 111 d–i, 112 c–d.
Sergia robusta: Macpherson, 1983: 70.

Material Examined.—Type material: **off Congo:** 11°23′S 10°55′E, 190–200 m, 4 June 1971, R/V *Atlantis II,* Cruise 60, sta. RHB2281, Holotype: ♂ CL 9.1 mm, Paratypes: 4 ♂♂ CL 7.0–9.6 mm. All type material has been returned to the USNM (Holotype: USNM 291188, Paratypes: USNM 291189–291190. Other specimens: **Namibia:** 19°33′S 11°32′E, 0–100 m, 21 September 1980, IKMT, 2 ♂♂ (ICM630/1991); 17°48′S 10°58′E, 0–100 m, 22 Sep-

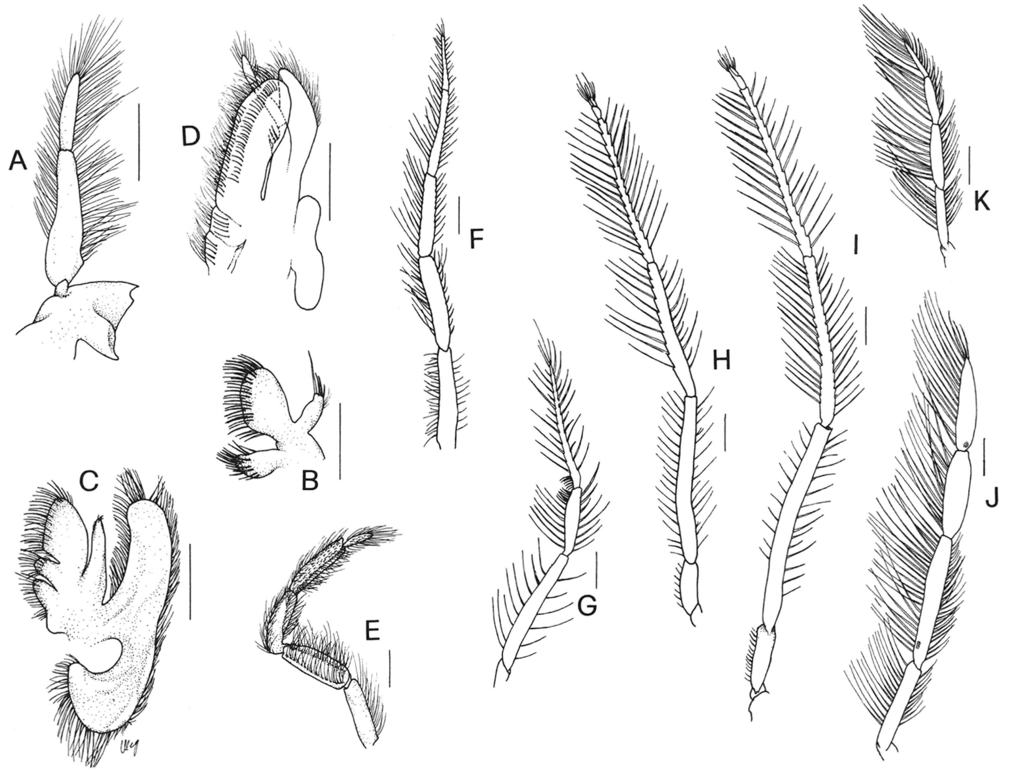

Fig. 2. *Sergia manningorum* sp. nov., male paratype, CL 7 mm, mouth parts and pereiopods: A, mandible; B, first maxilla; C, second maxilla; D, first maxilliped; E, second maxilliped; F, third maxilliped; G, first pereiopod; H, second pereiopod; I, third pereiopod; J, fourth pereiopod; K, fifth pereiopod. Scale bars = 1 mm.

tember 1980, IKMT, 1 ♂, 1 ♀ (ICM631/1991); 19°30′S 11°31′E, 0–100 m, 14 September 1980, IKMT, 1 ♂, 1 ♀ (ICM633/1991); 17°30′S 11°18′E, 0–100 m, 15 September 1980, IKMT, 1 ♂, 2 ♀♀ (ICM632/1991). **Congo:** 15°35′S 8°35′E, 0–750 m, 9 March 1961, IKMT, Leg. A. Crosnier, 1 ♂, 2 ♀♀ (MNHN–Na10241); 12°51′S 8°15′E, 3 June 1971, R/V *Atlantis II,* Cruise 60, sta. RHB2279, 3 ♂♂, 2 ♀ (USNM 164964); 11°10′S 11°15′E, 0–725 m, 4 March 1961, Grand Schmidt, Leg. A. Crosnier, 1 ♂, 1 ♀ (MNHN–Na10260); 9°18′S 11°10′E, 0–130 m, 3 March 1961, night, Grand Schmidt, Leg. A. Crosnier, 1 ♂, 2 ♀♀ (MNHN–Na10258); 9°14′S 10°02′E, 0–725 m, 2 March 1961, Grand Schmidt, Leg. A. Crosnier, 2 ♂♂ (MNHN–Na10256); 6°12′S 9°06′E, 0–725 m, 25 February 1961, morning, IKMT, Leg. A. Crosnier, 2 ♂♂, 2 ♀♀ (MNHN–Na10264); 5°30′S 10°10′E, 0–725 m, 24 February 1961, night, IKMT, Leg. A. Crosnier, 2 ♂♂ (MNHN–Na10262); 5°02′S 11°17′E, 595–605 m, 18 March 1967, sunrise, bottom trawl, Leg. A. Crosnier, 11 ♂♂, 5 ♀♀ (MNHN–Na10226). **Gabon:** 2°00′S 8°46.5′E, 455–610 m, 4 September 1963, R/V *Geronimo,* sta. 206, 1 ♂ (USNM); 2°37′S 8°58′E, 500–570 m, 17 April 1980, trawl, Leg. B. Seret, 7 ♀♀ (MNHN–Na3795). **Senegal:** 15°19′N 17°16′W, 355 m, 27 May 1974, Leg. P. Cayre, 2 ♂♂ (MNHN-Na3882). **Cape Verde Islands:** 16°42′N 19°11′W, 480–500 m, 13 November 1970, R/V *Atlantis II,* Cruise 59, sta. RHB2052, IKMT 10′, 31 ♂♂, 25 ♀♀ (USNM 291191); 19°30′N 18°17′W, 580–620 m, 12 November 1970, R/V *Atlantis II,* Cruise 59, sta. RHB2047, IKMT 10′, 2 ♂♂ (USNM 163435).

Description.—Carapace with integument thin and smooth, rostrum triangular directed slightly upward, with small tooth behind pointed apex, carapace grooves and carinae hardly visible, except for posterior cervical sulcus that does not reach dorsal margin, and branchiocardic and hepatic carinae (Fig. 1A).

Tergites and pleurae of abdominal segments with smooth surface and rounded, only sixth segment with acute tooth at dorsal posterior edge. Telson 0.7–0.8 times length of sixth abdominal somite and half length of outer uropod, gradually tapering to point, dorsal surface bordered by 2 low ridges. Outer uropod with strong tooth at distal fourth of outer border, fringe of plumose setae extends from that tooth to whole inner border (Fig. 1C).

Eye without ocular tubercle, cornea wider than ocular peduncle.

Antennular peduncle robust, gradually tapering. Basal segment with distinct spine at

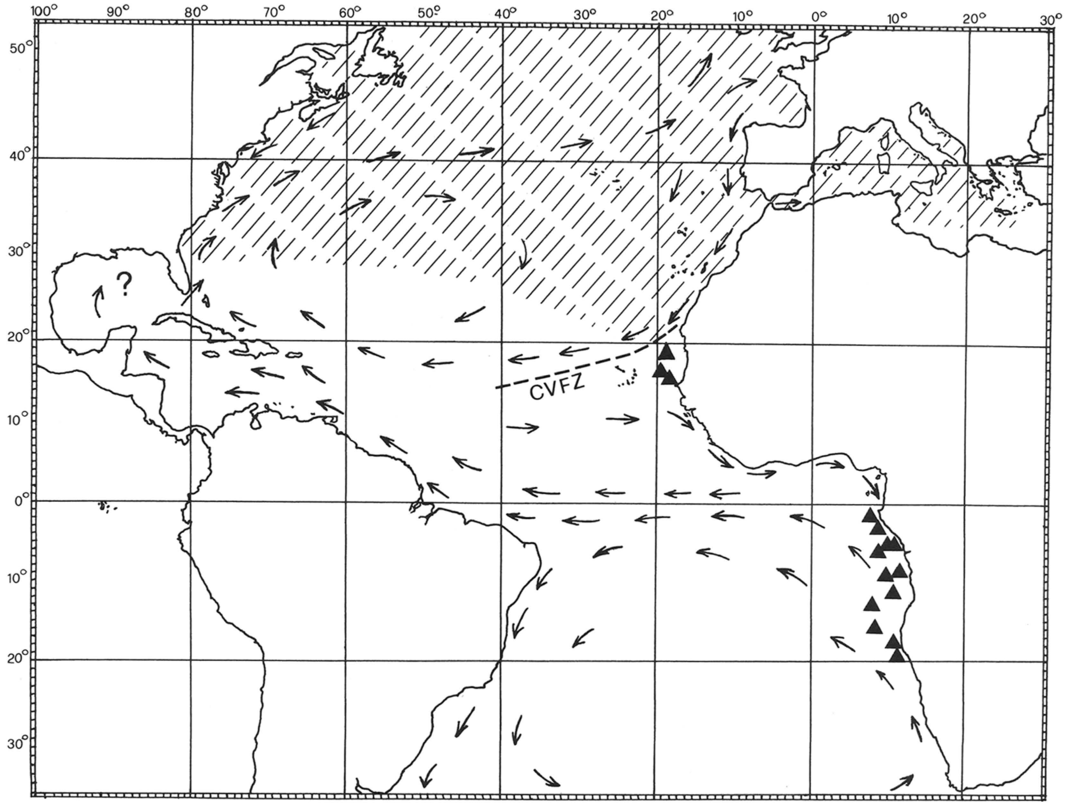

Fig. 3. Atlantic Ocean. Collection localities for *Sergia manningorum* sp. nov. (▲), and guessed distribution of *S. robusta* (dashed area), doubtful records of *S. robusta* in the Gulf of Mexico (?). General surface circulation (Pickard and Emery, 1990) and average position of Cape Verde Frontal Zone (CVFZ) are also indicated.

middle of outer margin, dorsomesial surface concave to receive eye. Second and third segments subequal, each about 2/3 length of first (Fig. 1B).

Ventromesial antennular flagellum composed of 20–25 segments, simple in females, with first 4 segments highly modified to form clasping organ in males (Fig. 1D). Third segment of clasping organ with upper prolongation reaching tip of fourth segment and ending with 3 or 4 long setae, like in males of *S. robusta*. Fourth segment distally curved upward, its proximal upper margin armed with row of 7 or 8 spatulate spines gradually decreasing in size. Terminal part of flagellum, composed of about 20 simple segments, articulates subdistally on fourth segment (Fig. 1D). (It articulates distally in all other species of *Sergia* (Fig. 1E).)

Scaphocerite reaching middle of third antennular segment, length 3.5 times width, with outer distal tooth slightly overreaching blade and with longitudinal row of photophores (Fig. 1B).

Mouth parts as figured (Fig. 2A–F). Mandible with leaf-like three-segmented palp, basal segment much shorter (Fig. 2A). Palp of first maxilla ending with long bristle and 4 setae (Fig. 2B). Third maxilliped reaching distal margin of scaphocerite in males and only the middle in females (Fig. 2F).

First pereiopod not chelate, as long as third maxilliped, lower margins of dactylus and propodus at articulation of the 2 joints bear tufts of bristles that form clasping device (Fig. 2G). Second pereiopod chelate, reaches with distal end of merus, tip and middle of scaphocerite respectively in males and females (Fig. 2H). Third pereiopod longest, overreaches scaphocerite with at least half of carpus (Fig. 2I). Fourth pereiopod nearly reaches distal end of merus of second pereiopod. Dorsal margins of ultimate and penultimate joints naked, all others fringed with long plumose setae (Fig. 2J). Fifth pereiopod reduced, hardly reaches distal half of antepenultimate joint of fourth pereiopod (Fig. 2K).

Petasma of adult males with terminally hooked processus uncifer reaching base of lobus armatus. Processus basalis slender. Processus ventralis long and slender, tapering in an acute tip. Lobus armatus incurved, with retractile hooks distributed all along anterior margin. Lobus inermis acute, slightly bent inward, not reaching middle of lobus terminalis. Lobus connectens only slightly overreaches lobus terminalis, its tip slightly curved forward, bearing single large hook. Lobus terminalis with tip curved outward, with few hooks both on outer and inner distal margins, basal portion with surface covered by large retractile hooks and markedly protruded toward the lobus armatus (Fig. 1F).

Size.—Carapace length of examined males 5.1 to 10.5 mm, of females 5.5 to 13.0 mm.

Etymology.—The species is named for our friends the Mannings; for over 25 years Raymond Manning encouraged in many ways our studies on decapods, and Lilly K. Manning taught to one of us (MEG) the techniques of scientific drawing.

Remarks.—The peculiar shape of the clasping organ of antennula, with the terminal flagellum articulating subdistally on the fourth segment (Fig. 1D), allows an easy recognition of males of *S. manningorum* from the closely related *S. robusta* and the other members of *Sergia* in which terminal flagellum articulates distally (Fig. 1E). The presence of few simple setae at the tip of third article of clasping organ separate the above-mentioned two species from all other species of *Sergia* in which tip of third article ends with a strong elongated spine.

The petasma of *S. manningorum* mostly resembles that of *S. robusta,* differing by the additional hooks on the outer margin of distal part of lobus terminalis and by the shape of the basal part of the same lobus that decisively protrudes toward the lobus armatus, as a kind of lobus accessorius, whereas it is simply swollen in *S. robusta.*

Number and position of photophores have also been used as distinctive characters to identify species of *Sergia* (Vereshchaka, 1994), but in preserved material photophores fade out and their distribution and number have to be used cautiously. In most of the specimens of *S. manningorum,* we observed one single photophore at the proximal fourth of antepenultimate joint of fourth pereiopod (Fig. 2J), whereas up to three distinct photophores were observed in Mediterranean specimens of *S. robusta.* Both species have a single proximal photophore at ultimate joint of fourth photophore. Also, the scaphocerite and outer uropod have similar photophores patterns in the two species.

Sergestes dissimilis (Bate, 1888) was described on an incomplete juvenile collected by the *Challenger* near Cape Verde Islands. Hansen (1922) synonymized *S. dissimilis* with *S. robusta.* The type locality of *S. dissimilis* is near the northern limit of the distribution of *S. manningorum.* Only a study of laboratory-grown larvae will definitively prove its identity with one of the species of *Sergia* present in the area.

Males of *S. manningorum* have fully developed petasma (i.e., lobes full grown and with evident retractile hooks) already at the size of 6 mm CL, whereas in the Mediterranean *S. robusta,* fully developed petasma could be observed only in males larger than 12 mm CL.

Discussion

Most sergestid shrimps make diel vertical migrations of several hundred meters. Vertical distribution of *S. robusta* in the northern Atlantic has been investigated near the Bermuda Islands by Donaldson (1975), who found the population was centered between 600 and 800 m at night and between 800 and 1,150 m during the day, and near the Canary Islands by Foxton (1970), who reported the aggregation of this species between 500 and 600 m at night and around 800 m at daytime.

In the Western Mediterranean *S. robusta* concentrates between 100 and 350 m at night and descends below 750 m during daytime (Froglia and Giannini, 1982). Therefore, the species exhibits a wider diel vertical migration in the warmer Mediterranean waters, but remains below the seasonal thermocline.

As a consequence of these vertical movements, pelagic shrimps can displace themselves through different water masses, and several species have a cosmopolitan distribution. Nevertheless, marine frontal systems and zones of divergence may act as boundaries also for mesopelagic species and may lead to speciation through divergence following geographic isolation (Knowlton, 1986).

Foxton (1972), who studied large collections made in the Eastern Atlantic at six positions, between 11°N and 60°N, roughly along the meridian 20°W, suggested the existence of a faunal boundary in the region of 18°N on the basis of the distribution of four species of *Acanthephyra* (Oplophoridae), *A. purpurea* A. Milne Edwards, 1881, and *A. pelagica* (Risso, 1816) being distributed mainly within the North Atlantic Central Water mass, and *A. sexspinosa* Kemp, 1939, and *A. acanthitelsonis* Bate, 1888, being associated with the South Atlantic Central Water.

Backus *et al.* (1977), analyzing assemblages of mesopelagic fish in the Atlantic, placed at the same latitude off West Africa the boundary between the Atlantic Tropical and the North Atlantic Subtropical regions.

Analysis of the literature records (Smith, 1882; Kemp, 1910; Hansen, 1922) and museums collections evidenced *S. robusta* (Smith) was collected on both sides of the Atlantic within the Northern gyre that is delimited southerly by the Canary Current and the North Equatorial Current. The species is found also in the whole Mediterranean Sea (Băcescu and Mayer, 1961), Southern Adriatic included (Froglia and Giannini, 1984). According to Crosnier and Forest (1973), the old records of *S. robusta* from the Indo-Pacific area most probably refer to *S. bisulcata.*

On the contrary *Sergia manningorum* seems to be restricted to Tropical Eastern Atlantic (Fig. 3). Its southern limit may be represented by the Angola gyre (Macpherson, 1983), as it seems to be absent from South Africa waters (Kensley, 1971, 1977). The Cape Verde Frontal Zone, which separates the South Atlantic Central Waters from the North Equatorial Current (Stramma and Schott, 1999), seems to be the Northern boundary of its distribution. Only in one sample (*Atlantis II* sta. 2047) collected in that zone, *S. manningorum* and *S. robusta* have been found together.

Looking at the geographic distribution depicted for *S. robusta* by Vereshchaka (1994, fig. 8) after the study of the *Dana I* collections, we can reasonably guess (Fig. 3) that both *S. robusta* and *S. manningorum* are not present in the Caribbean Sea and off the northern coast of South America, which surface and central-water layers are respectively under the influence of the North Brazilian Current and the Guiana Undercurrent. Records of *S. robusta* from the Gulf of Mexico (Springer and Bullis, 1956) need also to be verified.

Acknowledgements

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