

## A new species of ghost shrimp of the genus *Sergio* Manning & Lemaitre, 1994 (Crustacea: Decapoda: Callinassidae) from the Caribbean coast of Colombia

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**Abstract.**—A new species of ghost shrimp, *Sergio sulfureus*, is described from shoreline habitats of Barú, on the Caribbean coast of Colombia. This new species is the seventh known of the genus *Sergio* Manning & Lemaitre, and is most similar to *S. guassutunga* (Rodrigues), from Brazil, and *S. mericeae* Manning & Felder, from Florida. The new species can be distinguished from these two primarily by characters derived from the major cheliped, including color. The new species is described in detail, and information is given on adult and immature stages, habitat, and co-occurring burrowing decapods.

A new species of the recently proposed genus *Sergio* Manning & Lemaitre, 1994, was discovered while sampling infaunal decapods from inshore habitats of the Caribbean coast of Colombia. The number of species in this genus has now nearly doubled since it was proposed. In addition to this new species, *Sergio* includes six others, all from the western Atlantic: *S. guassutunga* (Rodrigues, 1971), *S. guara* (Rodrigues, 1971), *S. mirim* (Rodrigues, 1971), *S. trilobatus* (Biffar, 1970), *S. guaiqueri* Blanco Rambla, Liñero Arana, & Lares M., 1995, and *S. mericeae* Manning & Felder, 1995. Based on morphological similarities, the new species appears to be most closely related to *S. guassutunga* and *S. mericeae*.

The specimens were collected using a yabby pump as described by Hailstone & Stephenson (1961). The material has been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM), and the University of Southwestern Louisiana Zoological Collections, Lafayette (USLZ). The following measurements were taken (all in millimeters): postorbital carapace length

(cl); total length measured from the postorbital margin to the posterior margin of the telson (tl). Eggs were measured on their greatest diameter. All measurements were taken after preservation of specimens in 70% alcohol. Abbreviations used: M, male(s); F, female(s); ov, ovigerous; immat, immature of undetermined sex; mutl, mutilated; coll, collector.

### *Sergio sulfureus*, new species Figs. 1-6

**Holotype.**—F (cl 12.1 mm, tl 44.5 mm), Caribbean coast of Colombia, SW shoreline of Barú, beach facing Rosario Islands (on property of A. Zubirfa) adjacent to Ciénaga del Pelao, 0.5 m, 20 Jul 1995, coll. R. Lemaitre, USNM 275985.

**Paratypes.**—Same locality as holotype: 5 M (cl 7.6-15.3 mm), 2 F (cl 7.2-15.0 mm), 1 immat (cl 5.8 mm), 1 mutl (abdomen only), 23 Jul 1994, coll. R. Lemaitre, USNM 275989. 2 M (cl 11.3-20.4 mm), 1 F (cl 13.7 mm), 3 immat (cl 5.8-7.5 mm), 20 Jul 1995, coll. R. Lemaitre, USNM 275986, 275987, 275988. 7 M, of which 5

are photo vouchers (cl 22.9–8.8 mm), 2 F photo vouchers, of which 1 ov (cl 22.1–18.7 mm), 11 Mar 1996, colls. R. Lemaitre, D. L. Felder, S. Nates and C. Moreau, USLZ 3572.

*Diagnosis.*—Frontal margin of carapace with 3 triangular prominences each terminating in spine; median prominence acute rostrum slightly exceeding lateral projections. Eyestalks terminating in small outwardly curved spine. Third maxilliped with moderately developed crista dentata on ischium. Major cheliped with dactyl distinctly longer than palm; dactyl with proximal half of prehensile edge bearing 2 prominent teeth (1 basal subrectangular, 1 hooked distally); distal half of prehensile edge either unarmed, or armed with 2 or 3 small rounded teeth, or row of small triangular teeth proximally; carpus more than half length of palm; merus with distinct longitudinal carina on outer surface. Major and minor chelipeds light yellow at least on lower half, often light pink dorsally; entire chelipeds sulfur yellow in large specimens (tl  $\geq$ 70.0 mm).

*Description.*—Frontal margin of carapace (Fig. 1a, b) with 3 triangular prominences consisting of rostrum and 2 lateral projections. Rostrum acute, horizontal (in lateral view, Fig. 1c), terminating in small spine; slightly in advance of lateral projections in adults, much more prominent and distinctly exceeding lateral projections by half or more length of rostrum in immature specimens (cl  $\leq$ 6.0 mm, Fig. 1b). Lateral projections terminating in inwardly curved spine. Carapace lacking rostral carina, with distinct linea thalassinica, and with a defined dorsal oval marked posteriorly by deep transverse cardiac furrow, which extends anteroventrally to either side above linea thalassinica as shallow sinuous groove demarcating posterior half of dorsal oval. Shallow cervical groove originating immediately below linea thalassinica on anterior half of branchiostegite and curved anteroventrally, intersecting raised sinuous ridge in anterior third of branchiostegite; portion

of ridge anterior to intersection positioned ventrolaterally to rounded hepatic boss.

Eyestalks (Fig. 1a, c) flattened, weakly concave dorsally, length equal to or slightly less than twice basal width, tapering distally, and terminating in small distomesial spine directed slightly outward; slightly exceeding distal margin of basal antennular segment in mature specimens, or slightly shorter than basal antennular segment in immature specimens; mesial surfaces nearly in contact on proximal halves or more, slightly diverging distally; mesial margins abruptly rounded distally; anterolateral margin rounded from level of corneae to distomesial spine. Corneae dark, area of pigmentation underlying it sexually dimorphic, large and visible within much of eyestalk in males, more confined to immediate corneal area in females; rounded corneal surface more bulbous in immature than adults.

Antennular peduncle (Fig. 1a) shorter and heavier than antennal peduncle, terminal article slightly longer than penultimate and reaching to or beyond midlength of terminal article of antennal peduncle. Penultimate and terminal articles with ventromesial and ventrolateral rows of long setae (those of ventrolateral row longest, densest), and continued on ventral ramus of flagellum. Flagellum with rami subequal in length (about 4–5 times length of terminal article of peduncle); dorsal ramus with sparse tufts of long setae, distal half with heavier articles bearing dense tufts of short ventral setae, articles comprising tapered tip with dense line of short ventral aesthetascs.

Antennal peduncle (Fig. 1a) with fourth (terminal) article subequal in length or slightly longer and narrower than third article. Third article elongate, narrower than second, slightly longer than combined lengths of first two, proximolaterally with partially fused condylar process articulated to distolateral extreme of second article. Second article with deep, diagonal ventral suture, distolaterally with single tuft of setae, small rounded vestige of dorsal scale articulated at joint with third article. Basal

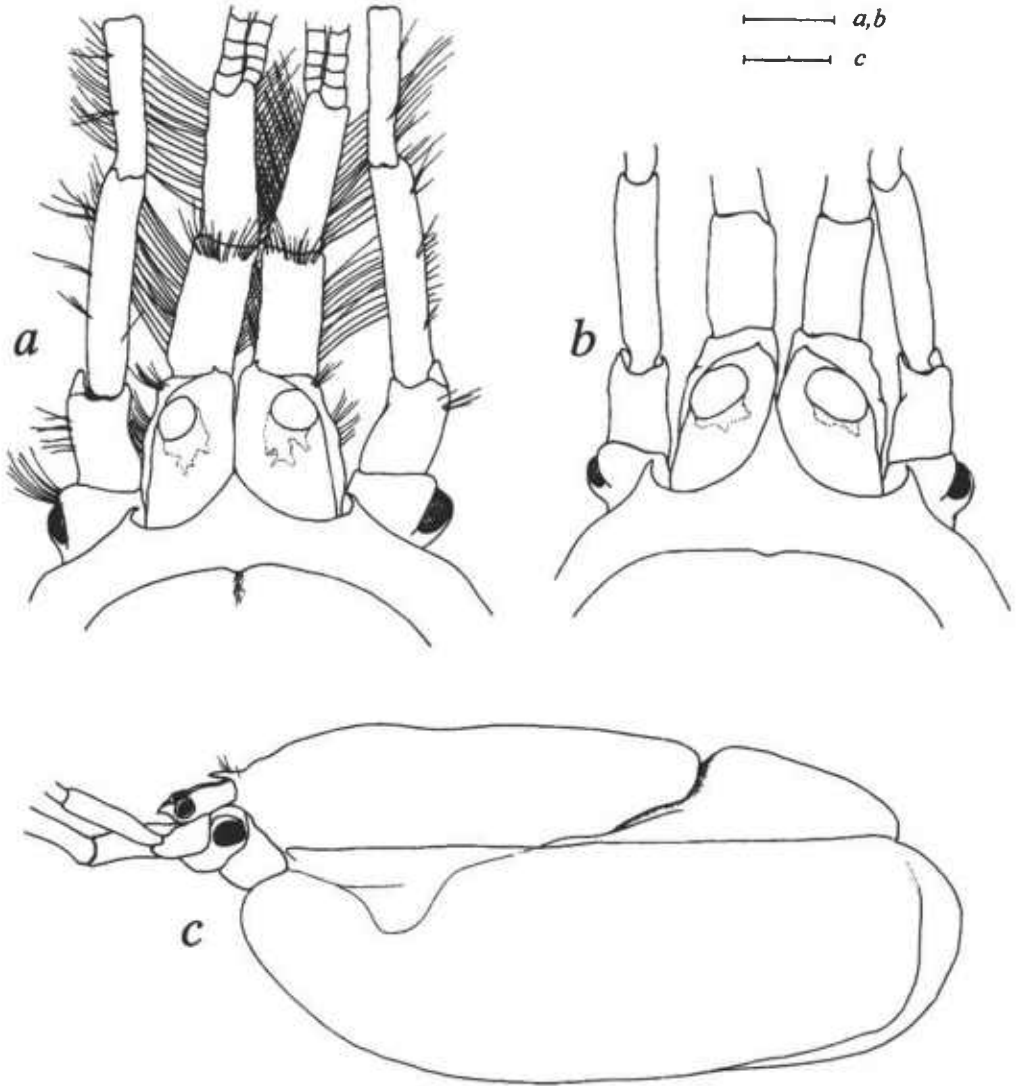


Fig. 1. *Sergio sulfureus*, new species, paratypes, USNM 275987, 275989. a,b, front of carapace and cephalic appendages, dorsal view: a, male (cl 15.3 mm); b, immature (cl 5.8 mm), setae omitted; c, carapace and cephalic appendages, female (cl 12.2 mm), lateral view. Scales equal 1 mm (a), 0.5 mm (b), and 2 mm (c).

article with dorsolateral carina above laterally produced excretory pore. Flagellum 2 to 2.5 times length of antennular flagellum.

Mandibles (Fig. 2a, b) with large 3-segmented palp, third article rounded distally and with short setae on extensor surface, second article with row of long setae on external and distal surfaces; incisor process with well developed corneous teeth on cutting margin, teeth largest on proximal half; molar process

with three or four small marginal teeth; paragnath rounded. First maxilla (Fig. 2c) with long, narrow endopod deflected proximally at articulation; proximal endite with setose, sinuous margin, and terminal lobe with field of long, terminally bifid setae; distal endite narrow proximally, broadening substantially distally, with row of short stiff bristles and setae (some bifid) on distomesial margin; exopod low, truncate and setose. Second maxilla (Fig.

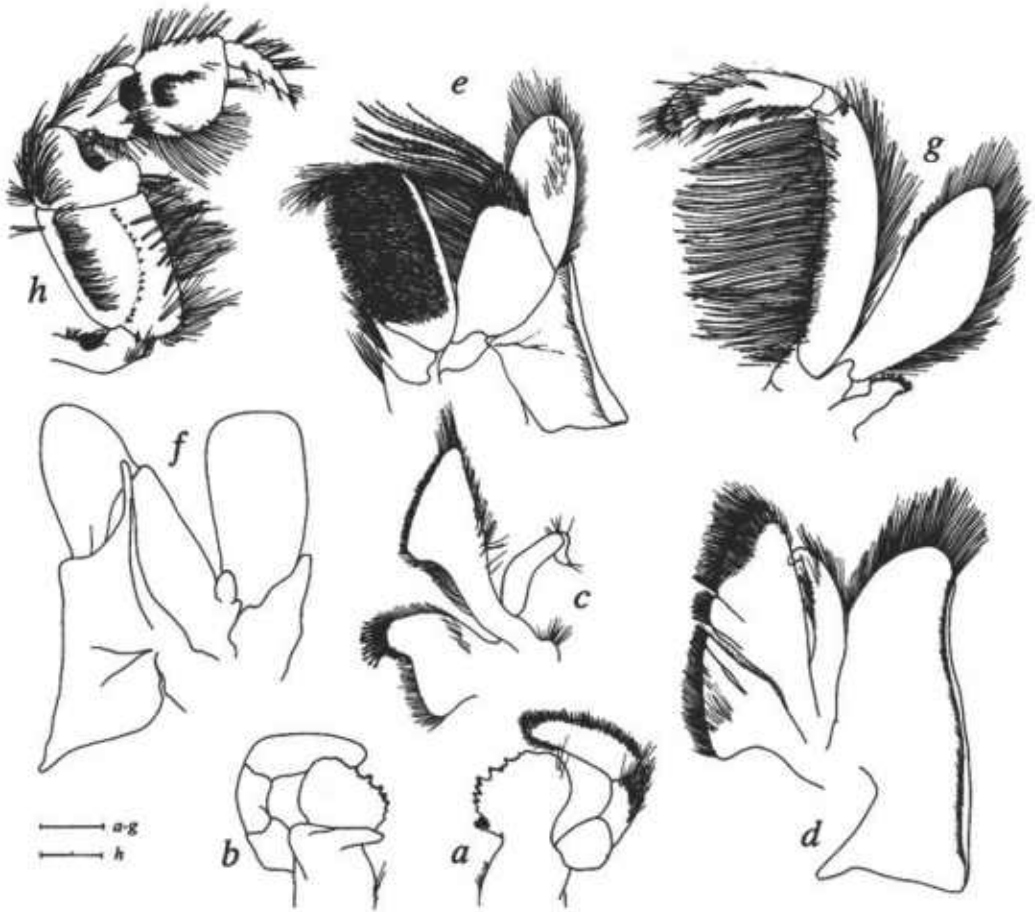


Fig. 2. *Sergio sulfureus*, new species, male (cl 15.3 mm), paratype, USNM 275989. Left mouthparts, all external view except b, f, and h, showing internal view: a, mandible; b, same, setae omitted; c, first maxilla; d, second maxilla; e, first maxilliped; f, same, setae omitted; g, second maxilliped; h, third maxilliped. Scales equal 1 mm (a-g), and 2 mm (h).

2d) with endopod narrow distally, tip slightly bent; first and second endite each unequally subdivided, marginally setose; exopod forming large, broad scaphognathite. First maxilliped (Fig. 2e, f) with proximal endite narrowly produced, marginally setose; distal endite subrectangular, mesial half of external surface and margins heavily setose, with longest setae distomesially, internal surface concave; exopod ovoid, setose, divided by transverse suture marking notch on mesial margin, with row of long pectinate setae on external margin near notch; epipod large, broad, anterior end tapered to elongate anterior process (Fig. 2f). Second maxilliped (Fig. 2g) with

long, narrow endopod; merus more than 4 times width, flexor margin with fringe of very long setae; carpus short; propodus weakly curved, increasing slightly in width distally, with row of setae on flexor margin; dactyl short, less than  $\frac{1}{2}$  length of propodus, with terminal brush of strong, short corneous spines; exopod phylliform, setose, shorter than endopodal merus; epipod small, divided into 2 proximal lobes and minute terminal lobe. Third maxilliped (Fig. 2h) lacking exopod; endopod with long dense setation on flexor and extensor margins; combined length of ischium-merus about 2 times width; ischium subrectangular, with moderately well de-

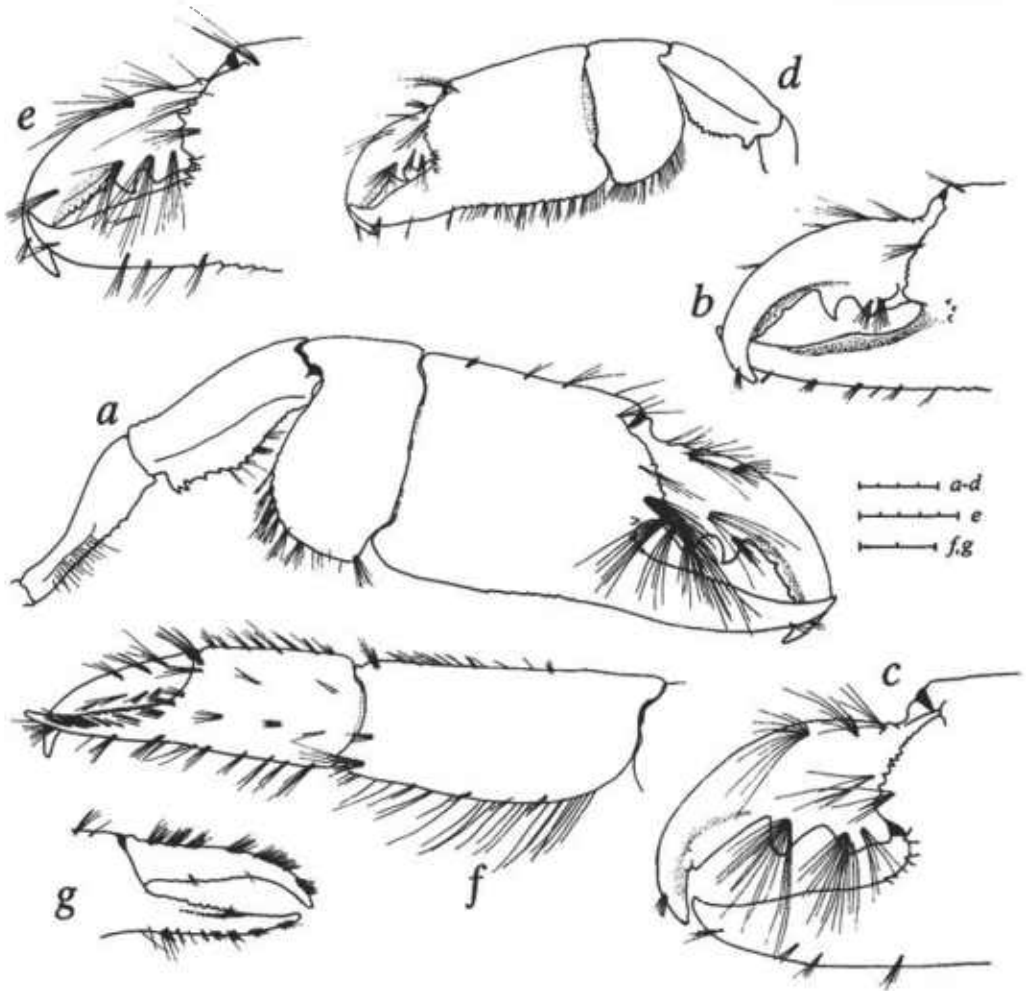


Fig. 3. *Sergio sulfureus*, new species: a-c, f, g, male paratypes, USNM 275988; d, e, holotype, USNM 275985. a, major cheliped of male (cl 15.3 mm), external; b, fingers of same, internal; c, fingers of male (cl 20.4 mm), external; d, major cheliped of female holotype (cl 12.1 mm), external; e, fingers of same, external; f, minor cheliped of male paratype (cl 15.3 mm), external; g, fingers of same, internal. Scales equal 4 mm (a-d), 5 mm (e), and 2 mm (f, g).

finned crista dentata in form of curving row of outwardly curving small spines; merus and carpus subtriangular, internal face with field of setae on distal third; propodus subquadrate (or at most height slightly exceeding length), internal face with field of setae medially; distal margin weakly emarginate; dactyl narrow, curved, with small brush of short setae terminally.

Branchial formula includes, in addition to exopods and epipods mentioned for first and

second maxillipeds: rudimentary arthrobranch on second maxilliped, pair of arthrobranches on third maxilliped, and pair of arthrobranches on each of first to fourth pereopods.

First pereopods forming greatly dissimilar chelipeds. Major cheliped heavy, massive (less so in immature than adults) in both sexes (Fig. 3a-e). Ischium slender, increasing in width distally; dorsal margin weakly sinuous; ventral margin with row of

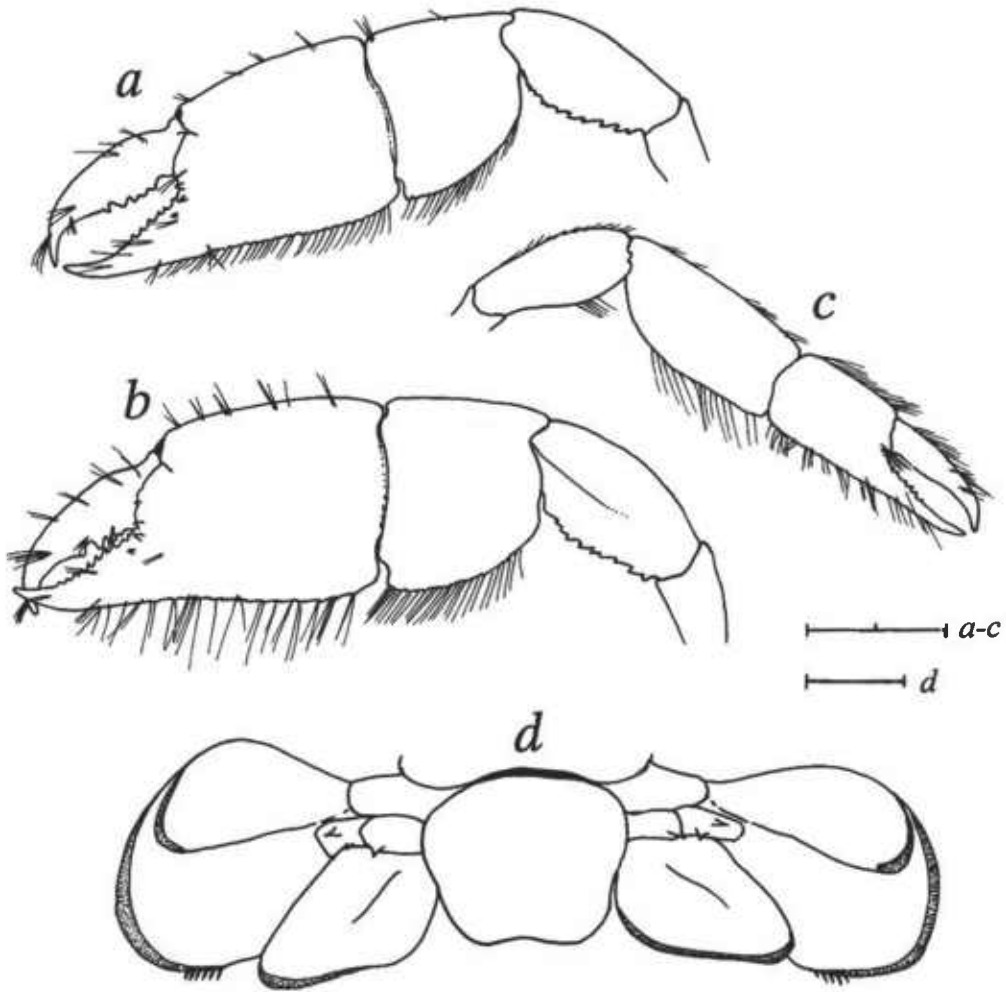


Fig. 4. *Sergio sulfureus*, new species, paratypes, USNM 275986. a, major cheliped of immature (cl 6.5 mm), external; b, major cheliped of immature (cl 7.0 mm), external; c, minor cheliped of immature (cl 6.5 mm), external; d, uropods and telson of immature (cl 6.5 mm), setae omitted, dorsal. Scales equal 2 mm (a-c) and 1 mm (d).

small denticles increasing in size and separation distally on proximal  $\frac{3}{4}$ . Merus about twice as long as greatest height; outer face with median longitudinal carina visible over at least half length of merus, carina not defined in immature specimens cl  $\leq 6.0$  mm (Fig. 4a); dorsal margin weakly sinuous, keel-like, with minute tubercles proximally; ventral margin in adults strongly rounded, often ventrally produced, armed with small spines and strong bifid process proximally (Fig. 3a, d); ventral margin in immature

broadly rounded, armed with small spines only (Fig. 4a, b); lateral face with longitudinal median carina. Carpus 0.6–0.8 as long as palm; shorter and higher in adults than in immature specimens (in adults length about 0.6 height, in immature length about 0.8 height); dorsal margin nearly straight, keel-like; ventral and proximal margins serrated (serrations most visible in internal view), with tufts of setae; proximal margin evenly rounded. Chela with length twice greatest height; palm about as long as high

in adults (Fig. 3a, d), slightly longer than high in immature specimens (Fig. 4a, b); fingers with hooked tips crossed when closed. Palm with dorsal margin keel-like, with few tufts of setae; ventral margin serrated, with tufts of setae; outer face with 3 spines distally just proximal to gape of fingers, and row of blunt or sharp spines on upper half of distal margin. Fixed finger with prehensile margin unarmed in adults (Fig. 3a–e), or armed with small, sharp teeth in immature specimens (Fig. 4a, b). Dactyl longer than palm; dorsal margin with tufts of setae proximally; proximal half of prehensile margin with strong proximal subrectangular tooth separated by deep indentation from following hooked sharp tooth, lateral faces of teeth with 2 tufts of long setae (subrectangular tooth) or 1 tuft of setae (hooked tooth); distal half of prehensile edge slightly flared outward in large specimens ( $tl \geq 70.0$  mm), variable: with U-shaped indentations (Fig. 3a, b), or with subdistal rounded teeth (Fig. 3c), or with row of small, sharp teeth (Figs. 3d, e, 4a).

Minor cheliped (Figs. 3f, g, 4c) slender, elongate (more so in adults); dorsal margins of merus, carpus, and propodus keel-like. Ischium narrow unarmed. Merus twice as long as high, ventral margin with long setae. Carpus twice or more as long as high; dorsal and ventral margins with tufts of setae (longer on ventral than dorsal margin). Chela with length nearly 3 times greatest height; dorsal and ventral margins of palm and fingers with tufts of setae; fingers distally hooked, tips crossed when closed. Palm with outer surface smooth except for scattered tufts of short setae. Fixed finger subequal in length to palm, prehensile margin weakly serrate. Dactyl longer than palm; prehensile margin weakly serrate (teeth weaker than on prehensile margin of fixed finger).

Second pereopod (Fig. 5a) chelate. Ischium short, with tufts of setae on ventral margin. Merus more than 3.5 times as long as ischium; ventral margin with long setae diminishing in length distally. Carpus with long setae on dorsal and ventral margins;

outer face with scattered tufts of setae, and short transverse rows of short setae subdistally on upper half. Chela triangular in shape when fingers closed; dorsal and ventral margins with long setae; outer face with scattered tufts of short setae; fingers straight, prehensile margins minutely serrate, corneous; fingers terminating in blunt corneous tip.

Third pereopod (Fig. 5b) with merus about 2.4 times as long as ischium. Merus and carpus with few setae on dorsal and ventral margins. Carpus with transverse row of stiff setae on outer face subdistally on upper half; distal margin of outer face with row of setae on lower half. Propodus with strong ventroproximal lobe bearing long setae; ventral margin with evenly spaced tufts of long setae; dorsal margin with long setae; outer face covered with numerous tufts of short setae. Dactyl tear-shaped, terminating in outwardly directed corneous tip; outer face densely setose.

Fourth pereopod (Fig. 5c) subchelate. Ischium, merus, and carpus with scattered setae. Merus about 1.7 times as long as ischium. Propodus with inferodistal corner produced in form of short fixed finger; outer surface covered with dense setation divided by naked region into upper and lower fields, lower field continued on lower half of internal face. Dactyl terminating in outwardly directed corneous tip; outer face with dense setation.

Fifth pereopod (Fig. 5d) chelate. Merus more than 3 times as long as ischium. Merus and carpus with scattered setae. Propodus with long dense setation on distal half of outer surface, and row of long setae on ventrodistal margin. Fingers with opposable surfaces excavate, spoon-like, each with row of minute, fused corneous teeth; dactyl with long setae on outer surface.

Abdomen (Fig. 6a) with dorsal surface of tergites smooth except for small, imperceptible (except under high magnification) pits. Second abdominal somite longest, about 1.3 times as long as first, and 1.7 times as long as third. Third to fifth somites each

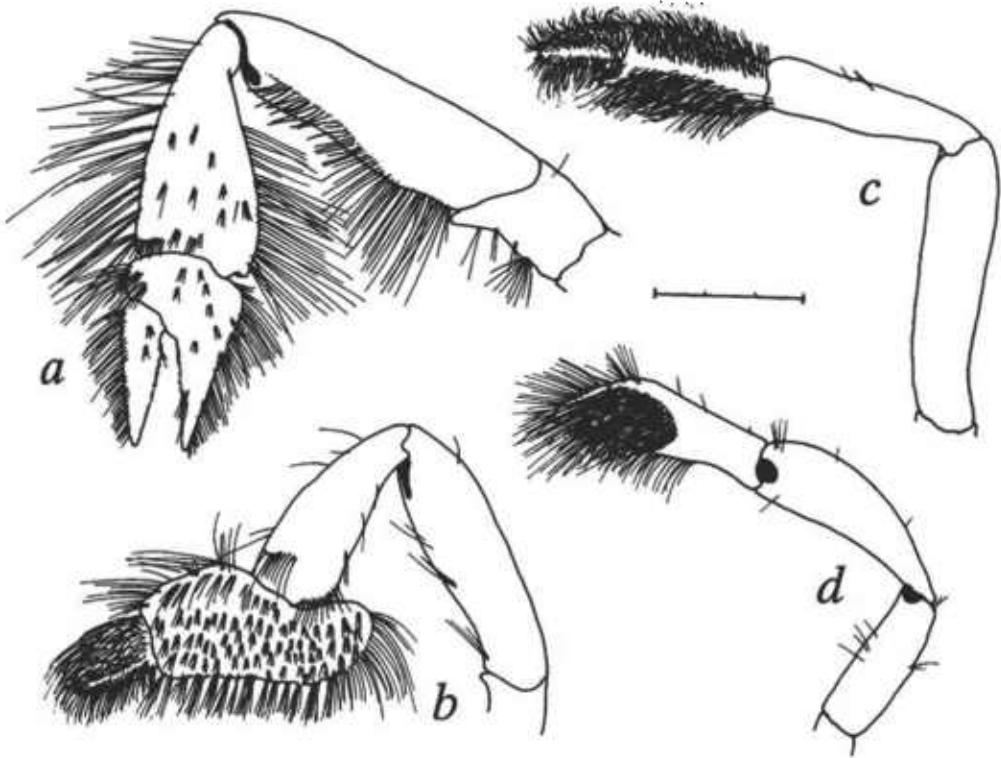


Fig. 5. *Sergio sulfureus*, new species, female (cl 12.2 mm), paratype, USNM 275989. Left second to fifth pereopods, external surface: a, second; b, third; c, fourth; d, fifth. Scale equals 3 mm.

with short transverse field of soft dense setae on lateral lobe (pleura). Sixth somite divided into unequal anterior and posterior portions by lateral constriction and transverse groove; posterior portion with short median longitudinal groove.

First pleopod of male (Fig. 6b) and female (Fig. 6c) uniramous, composed of 2 articles. In male, distal article with long setae, shorter than proximal one; subdivided into anterior and posterior lobe by weak longitudinal furrow, anterior lobe terminally rounded, posterior lobe terminally acute with tip directed anteroventrally; proximal article straight. In female, distal article with long setae, subequal in length to proximal article, anterior margin with small setose lobe at about midlength of margin; proximal article strongly curved anteriorly, with long setae on posterior margin distally. Second pleopod of male (Fig. 6d, e), and fe-

male (Fig. 6f, g) biramous. In male, exopod with long setae distally and on lateral margin; appendix masculina weakly separated from endopod, overreaching distal end of endopod; distal end of endopod terminating in minute, acute tip (Fig. 6e). In female, both rami with long setae; appendix interna small (Fig. 6g), tapered distally. Third to fifth pleopod pairs (Fig. 6h, i) forming large, posteriorly cupped fans when coupled at mesial margins of endopods; endopod of each with subtriangular, appendix interna embedded into mesial margin of endopod (Fig. 6i).

Telson (Figs. 4d, 6j) broader than long (broadest at lateral lobes) subhexagonal; dorsal surface elevated along midline on anterior half, with short transverse row of setae medially; posterior margin divided by shallow cleft into 2 lobes (cleft shallower in immature specimens, Fig. 4d), each lobe



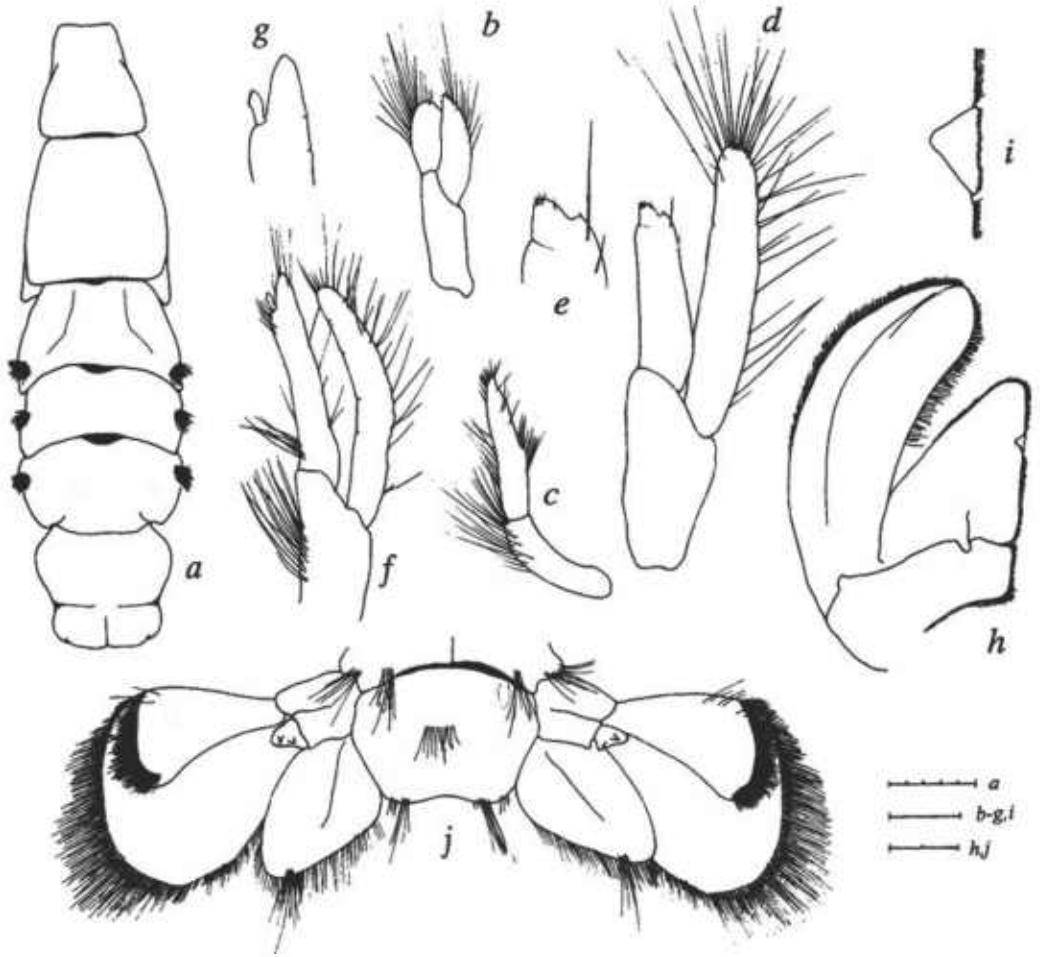


Fig. 6. *Sergio sulfureus*, new species, paratypes, USNM 275989: a, c, f, g, j: female (cl 12.2 mm); b, d, e, h, i: male (cl 15.3 mm). a, abdomen, female (cl 12.2 mm), dorsal; b, left first pleopod of male, internal; c, left first pleopod of female, lateral; d, left second pleopod of male, posterior; e, tip of endopod of same; f, left second pleopod of female, posterior; g, tip of endopod of same, showing appendix interna; h, left third pleopod, anterior; i, mesial margin of endopod of same, showing appendix interna; j, uropods and telson, female (cl 12.2 mm), dorsal view. Scales equal 5 mm (a), 1 mm (b-d, f), 0.5 mm (e, g, i), and 2 mm (h, j).

with tuft of long setae. Uropod with acute, posterolaterally directed spine on protopod, and 1 or 2 blunt or sharp dorsodistal spines. Endopod longer than broad, with tuft of setae dorsally near posterodistal corner; posterior margin setose. Exopod with anterodorsal plate falling well short of distal margin of exopod, distal edge of plate with dense setation grading posteriorly to stiff, bristle-like setae; posterior plate with dense setation on lateral and posterior edges, and

row of 5-9 short corneous spines on posterodistal corner.

*Size*.—The largest male specimen measured cl 22.9 mm, tl 76.1 mm. The largest female, an ovigerous specimen, measured cl 22.1 mm, tl 82.1 mm; mature, eyed eggs of this female were very near hatching and measured 0.63-0.76 mm in maximum diameter. The smallest specimen, of undetermined sex, measured cl 5.8, tl 14.0 mm.

*Color*.—(From field notes and color pho-

tographs of fresh specimens). Large males (cl 22.9, 21.2, 20.4 mm) and female (cl 22.1 mm), all with major cheliped distinct light sulfur-yellow; minor cheliped and second to fifth pereopods light yellow, fading distally; telson light brownish distally. Otherwise overall body color whitish or transparent. Color similar in slightly smaller male (cl 17.7 mm) and female (cl 18.7 mm) except for tinges of faint pink or mauve. Specimens < cl 15.0 mm with upper surfaces of major and minor chelipeds light salmon to rose pink, darkest on carpus and merus, lower surfaces grading from white to very light yellow; pink to rose also distributed on dorsal antennular flagellum and antennal peduncle as broad band across dorsal oval of cephalothorax, and over most of cardiac region; dorsal pink to rose color on abdomen sparse on first abdominal somite, extensive on second abdominal somite, and distributed as pattern on midline and posterior margins of third to fifth abdominal somites, and more extensive pattern on sixth somite; rose color deeper and especially evident on tailfan, where most intense on uropods and distal half of telson.

*Range, habitat, and commensals.*—Known only from the southwestern shoreline of Barú, on the Caribbean coast of Colombia (see Lemaitre 1981, for a general description of the collecting area). The specimens were obtained on the same beach during successive years (Jul 1994, 1995, and Mar 1996), just below the lower intertidal level, mostly from sediments in depths of 0.3–0.5 m. The southwest shore of Barú is lined typically by low stands of red mangroves (*Rhizophora mangle*) alternating with short sandy beach strips ranging in length from a few to several hundred meters. Mangrove lagoons (ciénagas) are found typically on the landward side of this shore, such as the Ciénaga del Pelao, adjacent to the type locality for this new species. Suspended matter in runoff water from these lagoons heavily influences sedimentary composition of adjacent beaches, which are separated by a channel about 5

km wide from the coralline archipelago of the Rosario Islands. At the collecting site, which is immediately inshore of shallow *Thalassia* beds, the sediment is composed of a thin surface layer of coralline sand overlying a mixture of calcareous sand, mud and clay, the lower layers of which release a strong hydrogen sulfide smell when disturbed to remove the burrowing fauna. Water is frequently turbid due to wave action which makes burrow openings inconspicuous. The new species was found alongside an undetermined species of pinnotherid crab of the *P. cristata* complex, and two other callianassids, *Neocallichirus lemaitrei* Manning, 1993, and *N. grandimana* (Gibbes, 1850).

*Etymology.*—The specific name is from the Latin *sulfureus*, of sulfur, and is given in reference to the distinct sulfur-like color of the major cheliped and the sulfide smell released by the sediment this species inhabits.

*Remarks.*—This new species most closely resembles *Sergio guassutina*, from Brazil, and *S. mericeae*, from Florida. The new species can be differentiated from these and other congeners primarily by characters of the major cheliped. The major cheliped of *S. sulfureus* differs from that of *S. guassutina* and *S. mericeae* in the relative length and armature of the dactyl (for the latter two see Manning & Felder 1995, fig. 1b–e, h). In the new species, the dactyl is consistently longer than the palm measured dorsally (Fig. 3a, d), whereas in the other two species the dactyl is at most subequal to the length of the palm. In the new species, the distal half of the prehensile edge of the dactyl can have two or three small rounded teeth (Fig. 3a–c), or small triangular teeth proximally (Fig. 3d, e); in the other two species the distal half typically has a prominent row of sharp teeth. In live specimens of *S. sulfureus*, the major cheliped in both sexes is light pink on the dorsal surface, and light yellow elsewhere; the major cheliped of the largest specimen collected, a male tl 71.0 mm, is entirely of a distinct sulfur yellow. The major cheliped in *S. mericeae* is

bright red (Manning & Felder 1995), and at least in males of *S. guassutinga*, it is pink-yellowish (Rodrigues 1971).

Comparison of the rostrum of *S. sulfureus* (Fig. 1a, b) with that of *S. mericeae* and *S. guassutinga* (see Manning & Felder (1995; figs. 1a, g, 5a, b), shows some differences that might be interpreted as diagnostic. In the new species the rostrum is more produced anteriorly than in *S. mericeae* or *S. guassutinga*; in the latter two species the rostrum is depicted by Manning & Felder as having a small slender spine terminally, whereas the rostrum of the new species usually tapers gradually to an acute tip. However, the degree of development of the rostrum and its distal termination has been observed to vary in all three species. Thus, the rostrum is not a reliable structure to use in distinguishing these species.

*Sergio sulfureus* shares a number of characters with *S. mericeae* and *S. guassutinga*. On the major cheliped, the armature of the dorsal and ventral margins of the merus is similar in *S. sulfureus* and *S. mericeae*. In both species, the dorsal margin has minute tubercles proximally; and the ventral margin is armed proximally with a prominent, usually bifid or trifid tooth which is separated by a distinct gap from the more distal teeth. As in *S. guassutinga*, the new species has a well defined carina on the outer face of the merus (except in smaller immature specimens), and the carpus is slightly longer than half the length of the palm. Like in *S. guassutinga*, the crista dentata on the ischium of the third maxilliped of *S. sulfureus* is moderately well developed.

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maitre family enthusiastically joined in the collecting effort, and made sure enough specimens were obtained for study. We also thank S. Nates and C. Moreau who assisted with the 1996 field work. This is contribution No. 408 for the Smithsonian Marine Station at Link Port, Fort Pierce, Florida, and contribution No. 51 for the Laboratory for Crustacean Research, University of Southwestern Louisiana.

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