

## Redescriptions and taxonomic notes on species of the *Synalpheus townsendi* Coutière, 1909 complex (Decapoda: Caridea: Alpheidae)

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### Abstract

We compared morphological features in 122 specimens of the *Synalpheus townsendi* species complex from the Caribbean, Gulf of Mexico and eastern Pacific. Our objectives were to examine the taxonomy of *S. townsendi townsendi*, *S. t. mexicanus*, *S. t. brevispinis* and *S. t. peruvianus*, which we felt have not been appropriately described and to reconsider their status. Based on examination of type material and different characters, we conclude that these taxa should be treated as distinct species, *S. townsendi* Coutière, 1909; *S. mexicanus* Coutière, 1909, *S. brevispinis* Coutière, 1909 and *S. peruvianus* Rathbun, 1910. We agree with Dardeau, 1986, that *S. scaphoceris* Coutière, 1910, is a distinct species. Specimens identified as *S. townsendi productus* Coutière, 1909, overlap in morphology with typical *S. townsendi*, and therefore are not considered to warrant designation as a separate taxon. *Synalpheus mexicanus* is not endemic to the Gulf of California.

**Key words:** Crustacea, Decapoda, Caridea, *Synalpheus*, shrimp

### Introduction

The genus *Synalpheus* Bate, 1888 contains over 115 described species (Chace, 1988), 19 of which have been cited for the eastern Pacific Ocean (Ríos, 1992; Wicksten & Hendrickx, 2003). There has been taxonomic confusion regarding the status of species in this genus. Most of the species of *Synalpheus* are small. Their characters are difficult to interpret. Existing diagnoses of species often are unclear and may be accompanied by inadequate illustrations. In addition, thoracic appendages bearing relevant characters are very

fragile and commonly are lost in preserved specimens. Species and subspecies have been described in the past, sometimes with slight differences. Often, the diagnosis of these species or subspecies was based on few or a single specimen (Coutière, 1909). Banner & Banner (1975) suggested that at least ten specimens should be examined in order to identify a species of *Synalpheus* adequately.

Coutière (1909) described the nominal species *S. townsendi* from the western Atlantic, with three “forms”: *S. t. brevispinis* from Baja California, *S. t. mexicanus* from the Gulf of California, and *S. t. productus* from the Gulf of Mexico. Rathbun (1910) described a further subspecies, *S. t. peruvianus*, from Peru. Coutière (1910) described yet another subspecies, *S. t. scaphoceris*, from the Dry Tortugas, Florida. According to Banner & Banner (1975), dealing with polymorphic species may be confusing, especially when appropriate diagnostic characters are lacking. The absence of complete descriptions, the questionable or questioned validity of the described subspecies, and the different interpretation of morphological characters used in Coutière’s (1909) keys may lead to problems while identifying species and subspecies of *Synalpheus*. Our objectives were to re-examine the taxonomic status of *S. t. townsendi*, *S. t. mexicanus*, *S. t. brevispinis* and *S. t. peruvianus*, which we feel that have not been appropriately described.

## Material and methods

We examined the type material of *S. t. mexicanus* and *S. t. peruvianus*, as well as two specimens from Ensenada de Utra, Colombia, loaned from the collection of the National Museum of Natural History, Smithsonian Institution, Washington, D.C (USNM). We also examined five other specimens identified as *S. t. mexicanus* from the collections of the Natural History Museum of Los Angeles County (LACM), and eight other specimens sent to one of us (MKW) for identification. We compared these eastern Pacific specimens to 37 specimens of *S.t. townsendi* from the Gulf of Mexico deposited in the Marine Invertebrate Collection, Texas Cooperative Wildlife Collection (TCWC), Texas A&M University.

Illustrations of *S.t. mexicanus*, *S.t. peruvianus*, and *S.t. brevispinis* were made on the basis of single specimens. Those of *S.t. townsendi* were made from several specimens, as some otherwise good specimens were broken or lacked appendages, and others showed variation from the typical form. All scale bars are in millimeters.

## Results and discussion

Coutière (1909) mentioned in a key the main differences between *Synalpheus townsendi*, *S. t. productus*, *S. t. brevispinis*, and *S. t. mexicanus*: presence/absence of a spine (*sic*, actually a tooth) or acute projection on the dorsal angle of the basicerite, presence/absence of a spine (*sic*) on the distal dorsal margin of the palm of the major cheliped and shape of the

posterior angles of the telson. Rathbun (1910) described a further subspecies, *S.t. peruvianus*, and distinguished it by the length of the carpocerite and rostrum. We have observed notable variation in these characters, mainly in the tooth on the basicerite. The type material of *S. t. mexicanus* (USNM 038392) bears a small tooth on the basicerite, although according to Coutière (1909), the basicerite has a straight superior angle. In Wicksten's (1983) key, it is stated that *S. t. mexicanus* lacks this tooth. According to Coutière (1909), specimens lacking this tooth belong to *S. t. brevispinis*; however, examination of 18 specimens from the Gulf of California showed that the tooth varied in size. In some specimens, the superior angle is straight, as was noted by Villalobos-Hiriart (2000).

Christoffersen (1979) stated that *S. t. productus* overlapped in morphology with the typical form and should be considered as a synonym. We agree. We examined 12 specimens with a rostrum reaching about 0.3 times the length of the second segment of the antennular peduncle and elongate orbital teeth, approximately as long as the first segment of the antennular peduncle. According to Coutière (1909), in *S. t. productus*, the lateral spine of the scaphocerite overreaches both the antennular peduncle and carpocerite. However, in 10 of our specimens, this tooth did not reach past the end of the antennular peduncle. In 51 specimens of the typical form, the lateral tooth of the scaphocerite was as long as the carpocerite. Both the *productus* form and the typical form co-occurred in three out of five samples in which the form was present. There were no detectable differences in geographic range or depth of the stations at which the *productus* form was taken from those of the typical form. We therefore conclude that *S. t. productus* should be considered as a synonym of *S. townsendi*, concurring with Christoffersen (1979).

Twelve specimens from the TCWC were identified as *S. scaphoceris* Coutière, 1910 by Michael Dardeau. Four of them, from Isla de Lobos, Mexico originally were identified as *S. townsendi* by Ray (1972). He noted that Fenner A. Chace, Jr. of the USNM examined these four specimens and thought that the specimens are "similar to the subspecies *S. townsendi brevispinis*". Another eight specimens from the West Flower Garden Bank were identified by Pequegnat and Ray (1974) as *?Synalpheus townsendi*. Later, Dardeau identified the twelve specimens as *S. scaphoceris*.

*Synalpheus t. scaphoceris* was distinguished from the typical *S. t. townsendi* by Coutière (1910) by the following features: carpocerite surpassing the antennule (actually the antennular peduncle, according to Fig. 2); scaphocerite with a broad scale, 3.3 times as long as broad; stylocerite reaching to the end of the second segment of the antennular peduncle; anterior margin of the palm of the major cheliped without a "spine", and the posterior border of the telson very convex, with spines shorter than in the typical *S. t. townsendi*. A photograph taken by electron microscopy by Ray (1972, Fig. 173) shows a specimen from the Gulf of Mexico having a rounded telson lacking the posterolateral projections characteristic of the typical form. Christoffersen (1979) stated that Ray's material seemed to agree with "several new Brazilian samples" and "should be considered a distinct species".

One of us (MKW) re-examined the twelve specimens. (The specimen figured by Ray, 1972, was destroyed by preparation for electron microscopy). All of these specimens either have missing appendages or they are detached. These specimens do not agree with the figure or the description of *S. t. scaphoceris* given by Coutière (1910). Coutières Figure 2 shows that the blade and distolateral tooth of the scaphocerite fall short of the end of the carpocerite by a distance approximately equal to the third segment of the antennular peduncle. In all of the TCWC specimens, the tooth and blade are almost equal in length to the carpocerite. Coutière stated that the carpocerite of *S. t. scaphoceris* exceeds the antennular peduncle, but in the TCWC specimens, where the carpocerite is intact, either it is of the same length as the antennular peduncle or the carpocerite barely exceeds its length. In a specimen from lot #2-6467, the major chela bears a small tooth at the anterior border of the palm; in the others, if this chela is present with the specimen, there is a knob at the anterior border of the palm of the major chela. However, the tooth can be absent in the typical form. The length of the stylocerite relative to the second segment of the antennular peduncle is variable in the typical form. Although all of these twelve specimens have a telson with an unusually rounded posterior margin, they fall within the range of variation of *S. townsendi*.

Dardeau (1986) re-described and illustrated *S. scaphoceris*. He noted that useful diagnostic features for the species included the color pattern. According to Dardeau, *S. scaphoceris* can be distinguished from *S.t. townsendi* by the “distinctive spotted color pattern” There are no color notes accompanying the TCWC specimens identified as ?*S. townsendi* by Pequegnat and Ray and later by Dardeau as *S. scaphoceris*. Pequegnat and Ray (1974) noted that the color pattern of 10 specimens they examined was “dark red polka dots on a pale background with fingers of major chela green”, but also quoted Williams (1965), saying that the color was “body and legs translucent pinkish red; large chela pink, changing to green on fingers”. Pequegnat and Ray (1974, Fig. 55) provided a black-and-white photograph of ?*Synalpheus townsendi* showing a spotted color pattern. However, Pequegnat deposited in the TCWC a color slide labeled “*Synalpheus townsendi*, West Flower Gardens (*sic*)” showing a red shrimp. Without knowing exactly which specimen is shown in the photograph or the slide, we cannot state which one had each color pattern. Dardeau (1986) did not specify in detail how the color pattern of *S. scaphoceris* differed from that of *S.t. townsendi*, but the presence of large polka dots instead of small scattered chromatophores could be a useful feature for distinguishing between the species.

Other features mentioned by Dardeau (1986) for distinguishing between *S. scaphoceris* and *S.t. townsendi* included a rostrum with a strongly produced ventral process, palm of major chela first terminating dorsodistally in an obscure, blunt projection, and absence of appendices internae on pleopods 2–5. The ventral rostral process is not strongly produced in *S. t. townsendi*; however, comparisons are difficult because Dardeau did not illustrate this feature. The palm of the major chela often bears a tooth in *S.t. townsendi*, but it may be blunt. In *S. t. townsendi*, the appendix interna is present on pleopods 2–5. In a

female from TCWC 2-6465, identified as *S. scaphoceris* by Dardeau (1986) and listed in that paper among the material examined, a small appendix interna is present on pleopod 2. An appendix interna also is present on pleopod 2 of specimens from TCWC 2-6463 and 2-6463, both identified as *S. scaphoceris* by Dardeau.

We have been unable to examine the type material of *S. scaphoceris* or the material mentioned by Christoffersen (1979); nor most of the specimens mentioned by Dardeau (1986). Based on the illustrations and descriptions by Coutière (1910) and Dardeau (1986), as well as comparison with *S. t. brevispinis*, we concur that *S. scaphoceris* is distinct from typical *S. townsendi*, and should be considered to be a separate species, *S. scaphoceris* Coutière, 1910. However, further examination is needed of the presence or absence or an appendix interna on pleopod 2 and the relative lengths of the antennal scale, carpopocrite and antennular peduncle.

The type specimens of *S. t. mexicanus* and *S. t. peruvianus* are clearly distinct. A comparison of characteristic features of each subspecies is given in Table 1. Based on these characters, we conclude that these taxa should be treated as distinct species, *S. mexicanus* Coutière, 1909 and *S. peruvianus* Rathbun, 1910.

**TABLE 1.** Comparison of *Synalpheus townsendi mexicanus* with *Synalpheus townsendi peruvianus*.

	<i>S. t. mexicanus</i>	<i>S. t. peruvianus</i>
Length of orbital teeth	Equal to or shorter than rostrum	0.7–1.0 times length of rostrum
Ventral rostral process	Ventral margin rounded	Ventral margin bilobed
Length of antennular peduncle	4 times as long as wide	5.8 times as long as wide
Length of blade of scaphocerite	0.8 times length of third segment of antennular peduncle	0.2 times length of third segment of antennular peduncle
Length of tooth of scaphocerite	Overreaches antennular peduncle by length of its third segment Overreaches carpopocrite by length of third segment of antennular peduncle	Reaches or overreaches distal end of antennular peduncle Shorter than carpopocrite by 0.4 times length of third segment of antennular peduncle
Dorsal tooth of basicerite	Present but small	Absent
Length of palm of major chela	2.5 times length of fingers	1.6 times length of fingers
Carpus of major chela	Unarmed	With subtriangular prolongation
Distal angles of telson	Acute and slightly produced	Rounded

The type material of *S. t. brevispinis* could not be located at the Muséum National d'Histoire Naturelle, Paris. This subspecies has not been recorded in the literature since its original description. We located 10 specimens (listed in the material examined for *S. brevispinis*) that closely match the description of *S. t. brevispinis*, and used them as a basis for comparison.

*Synalpheus townsendi brevispinis* is morphologically similar to *S. scaphoceris*. In both alpheids, the dorso-distal margin of the palm of the major chela lacks a tooth; the basicerite lacks a dorsal tooth; the dactylus of the third pair of pereopods is long and slender, with the distal ungui subparallel; the pleura of the first abdominal somite of males are slightly produced, the second male pleopods lack an appendix interna; and the distal angles of the telson are rounded and slightly produced. Nevertheless, the two alpheids are easily differentiated according to the features in Table 2. In addition, the telson of *S. scaphoceris* is slightly longer than that of *S. t. brevispinis*. The two alpheids do not co-occur in the same ocean. Therefore, we elevate *S. t. brevispinis* to specific rank as *S. brevispinis* Coutière, 1909.

**TABLE 2.** Comparison of *Synalpheus scaphoceris* with *Synalpheus townsendi brevispinis*.

	<i>Synalpheus scaphoceris</i>	<i>S. t. brevispinis</i>
Length of antennular peduncle	3 times as long as wide	3.6–3.9 times as long as wide
Mesial margin and apex of orbital hood	Mesial margin slightly concave, apex straight	Mesial margin slightly convex, apex directed mesially
Shape of ventral rostral process	Straight	Curved
Length of telson	More than twice as long as wide	Twice as long as wide

### *Synalpheus townsendi* Coutière, 1909

Figures 1–4

*Synalpheus townsendi* Coutière, 1909: 32, fig. 14.— Chace 1972: 104.— Christoffersen 1979: 352 (including extensive synonymy).— Williams 1984: 106, fig. 73.

?*Synalpheus townsendi*— Pequegnat and Ray 1973: 249, figs. 53d, 55.

*Synalpheus townsendi productus* Coutière, 1909: 32, fig. 15.

*Material examined:* GULF OF MEXICO: Sonnier Bank (28°20'N, 90°27'W), 25–60 m, submersible vehicle (sub), 27 Sept. 1977, cruise 77G10-2, 5 spec. (TCWC 2-6817). Diaphus Bank (28°05'N, 90°41'W), 92 m, remote-operated vehicle (ROV), 29 Sept. 2003,

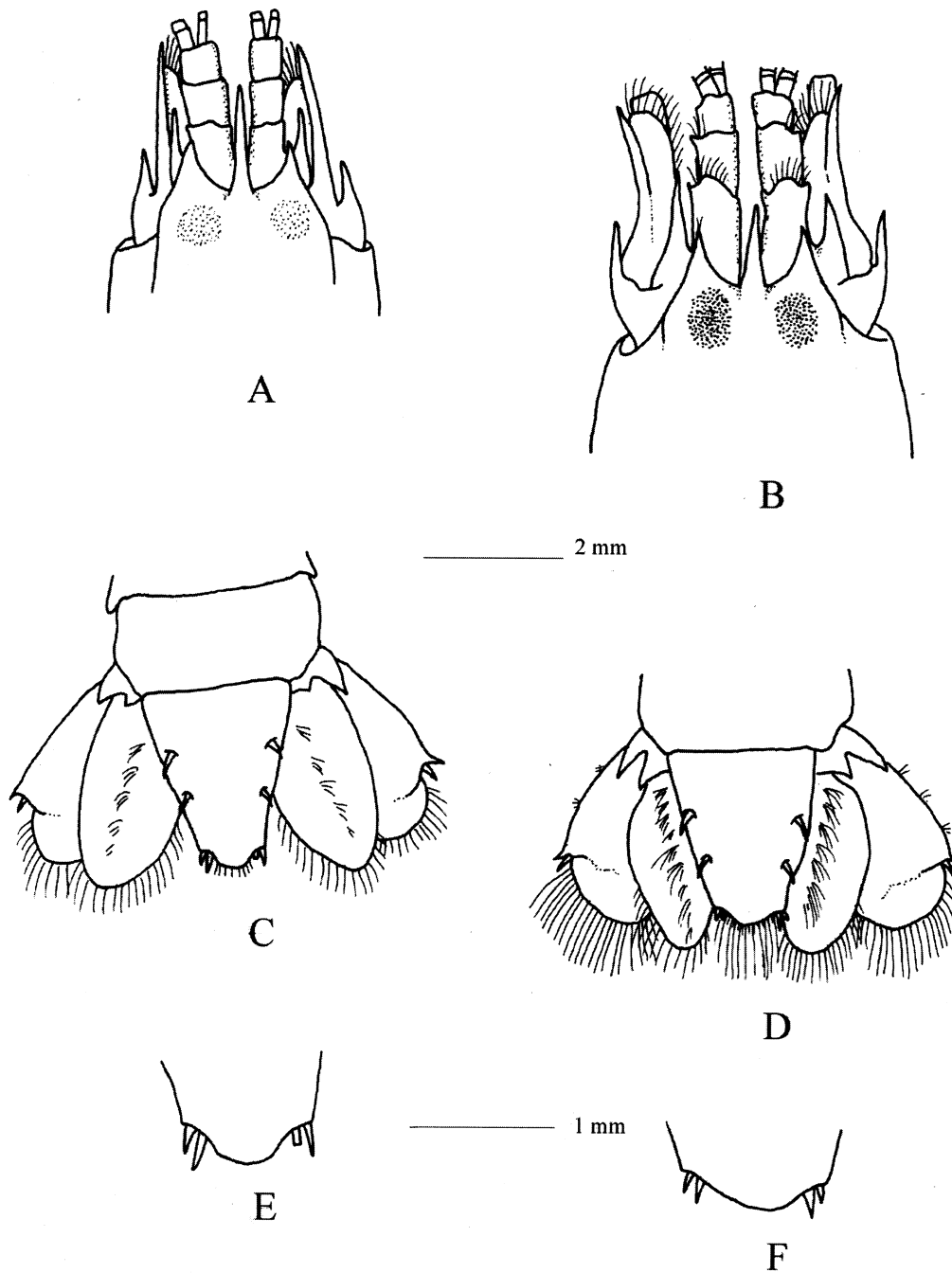
*Ronald Brown* sta. 42, 1 spec. (TCWC 2-8875). Fishnet Bank (28°10'N, 91°49'W), 70 m, sub, 13 Oct. 1978, sta. 78G9III3A, 1 spec. (TCWC 2-7864). Sidner Bank (27° 59'N, 92° 22'W), 68–103 m, sub, 17 Oct. 1978, sta. 78G9IIID120, 1 spec. (TCWC 2-7924). Eighteen Fathom Bank (27° 58'N, 92° 36'W), 46 m, sub, 28 Sept. 1977, sta. 77G10-2, 3 spec. (TCWC 2-6818). Twenty-eight Fathom Bank (27° 55'N, 93° 27'W), 132 m, box core?, 3 Aug. 1976, sta. 4F, 1 spec. (TCWC 2-7861). East Flower Gardens Bank (27° 55'N, 93° 36'W), 16–120 m, sub, 24 Oct. 1978, sta. 78G9IIID134, 1 spec. (TCWC 2-7865). West Flower Garden Bank (27° 53'N, 93° 49'W), 23 m, hand, 12 Jan. 1972, sta. 770110-IV, 1 spec. (TCWC 2-2443). Coffee Lump (28° 3'N, 93° 54'W), 60–67 m, sub, 11 Oct. 1978, sta. 78G9IIID1, 1 spec. (TCWC 2-7862). Stetson Bank (28° 10'N 94° 17'W), 3 lots as follows: 50 m, grab, 6 Aug. 1976, sta. STB-4D, 1 spec. (TCWC 2-7971); 22 m, scuba, 1 March 2000, M.K. Wicksten, collector, 1 spec., (TCWC 2-8720); 24 m, scuba, 2 Sept. 2003, M. Wicksten, coll., 5 spec. (TCWC 2-8865). Little Sister Bank (28° 51'N, 94° 15'W), 86 m, trawl, 10 Oct. 1978, sta. 78G9III-4, 1 spec. (TCWC 2-7866). Islas de Lobos (21°27'N, 94°14'W), 7.6 m, 6 Oct. 1972, hand, IL sta. 1, 3 spec. (TCWC 2-2134, 2-2135, 2-8750); 7.6 m, 8 Oct. 1972, hand, IL sta. 2, 5 spec. (TCWC 2-2128, 2-2129, 2-2130, 2-2131, 2-2132); 7.6 m, 8 Oct. 1972, hand, IL sta. 3, 5 spec. (TCWC 2-2127, 2-2133); 9.8 m, hand, 10 Oct. 1972, IL sta. 6, 1 spec. (TCWC 2-2126). FLORIDA (Atlantic): Pepper State Park, off St. Lucie County, 5.7 m, among *Oculina* coral, 12 Sept. 1977, J.K. Reed, 2 spec. (1 ov.) (LACM).

#### *Description*

Rostrum slender, straight, 2–4 times longer than wide, reaching from end of first segment of antennular peduncle to 0.3 times length of second segment, overreaching length of orbital teeth; anterior margin between orbital teeth and base of rostrum almost straight. Orbital hoods triangular, at least as long as wide; orbital teeth slender and acute. Ventral rostral process short. Pterygostomial angle of carapace produced. Carapace margin ventrally convex.

Antennular peduncle short and stout, 5 times as long as wide; visible part of first segment almost as long as combined lengths of segments 2–3, approximately 1.3 times length of second segment; second segment 1.3 times length of third segment. Stylocerite reaching almost to 0.6 times length of second segment. Lateral antennular flagellum thicker at base than mesial flagellum. Basicerite without dorsal tooth, but small tubercle or tooth may be present at end of dorsal obtuse angle, lateral tooth reaching 0.7–1.0 times length of first segment of antennular peduncle. Tooth of scaphocerite exceeding blade by length of third segment of antennular peduncle, reaching to or beyond end of antennular peduncle and carapocerite; blade well developed, 5.6 times as long as wide, with rounded distal margin. Carapocerite 4.2 times as long as wide, exceeding antennular peduncle by 0.5 times length of third segment.

Apex of third maxilliped with five strong spines; ultimate segment 3.5 times length of penultimate segment.

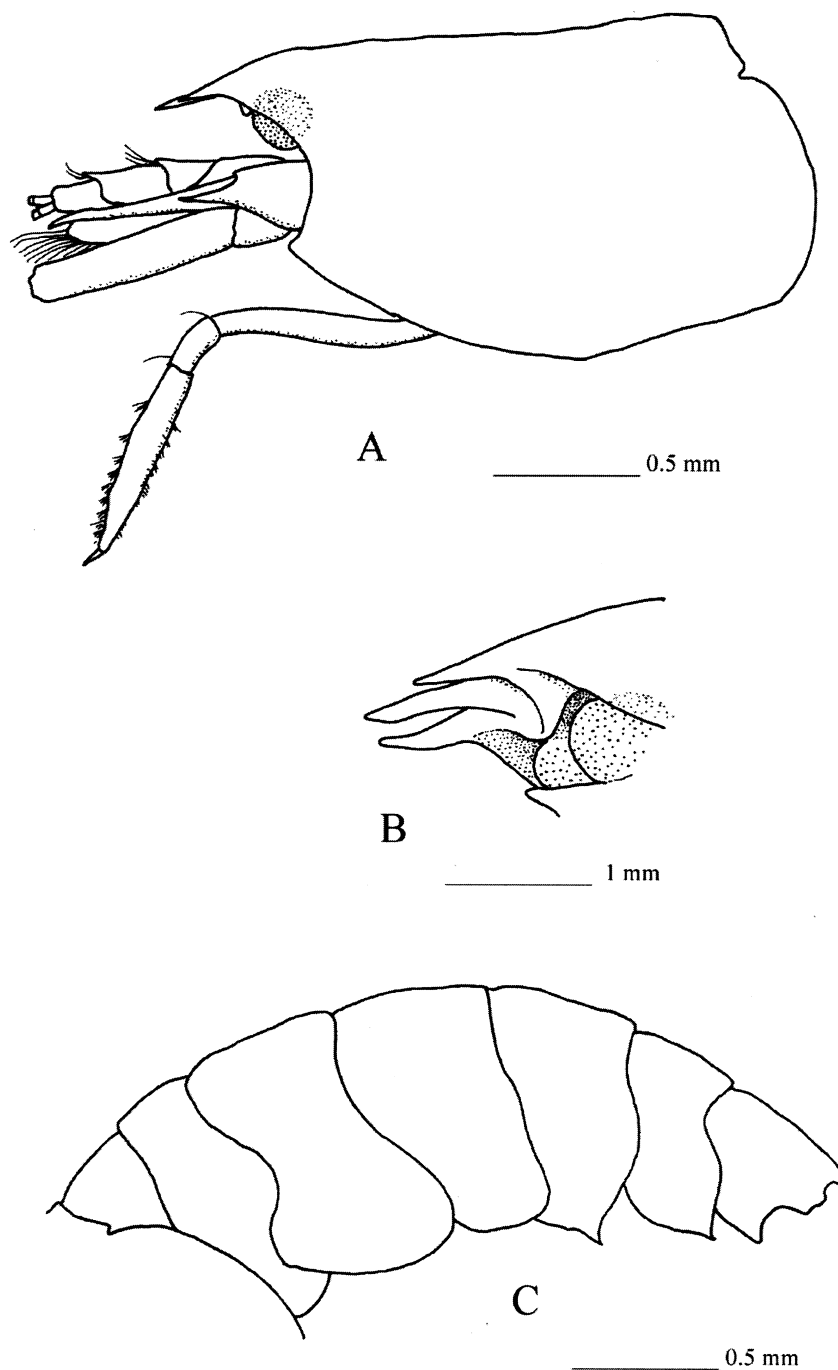


**FIGURE 1.** *Synalpheus townsendi* Coutière, 1909. A, frontal region of typical specimen in dorsal view. B, frontal region of specimen with elongate rostrum. C, D, telson and uropods. E, F, detail of posterior region of telson. A, C, E, TCWC 2-7863; B, D, E, TCWC 2-7920.

Ischium of major cheliped 1.5 times as long as wide. Merus twice as long as wide, bearing hooked tooth at distal end above articulation with carpus. Carpus short, 1.9 times as long as wide, cup-shaped. Chela 2.2 times as long as wide, palm 3.1 times as long as

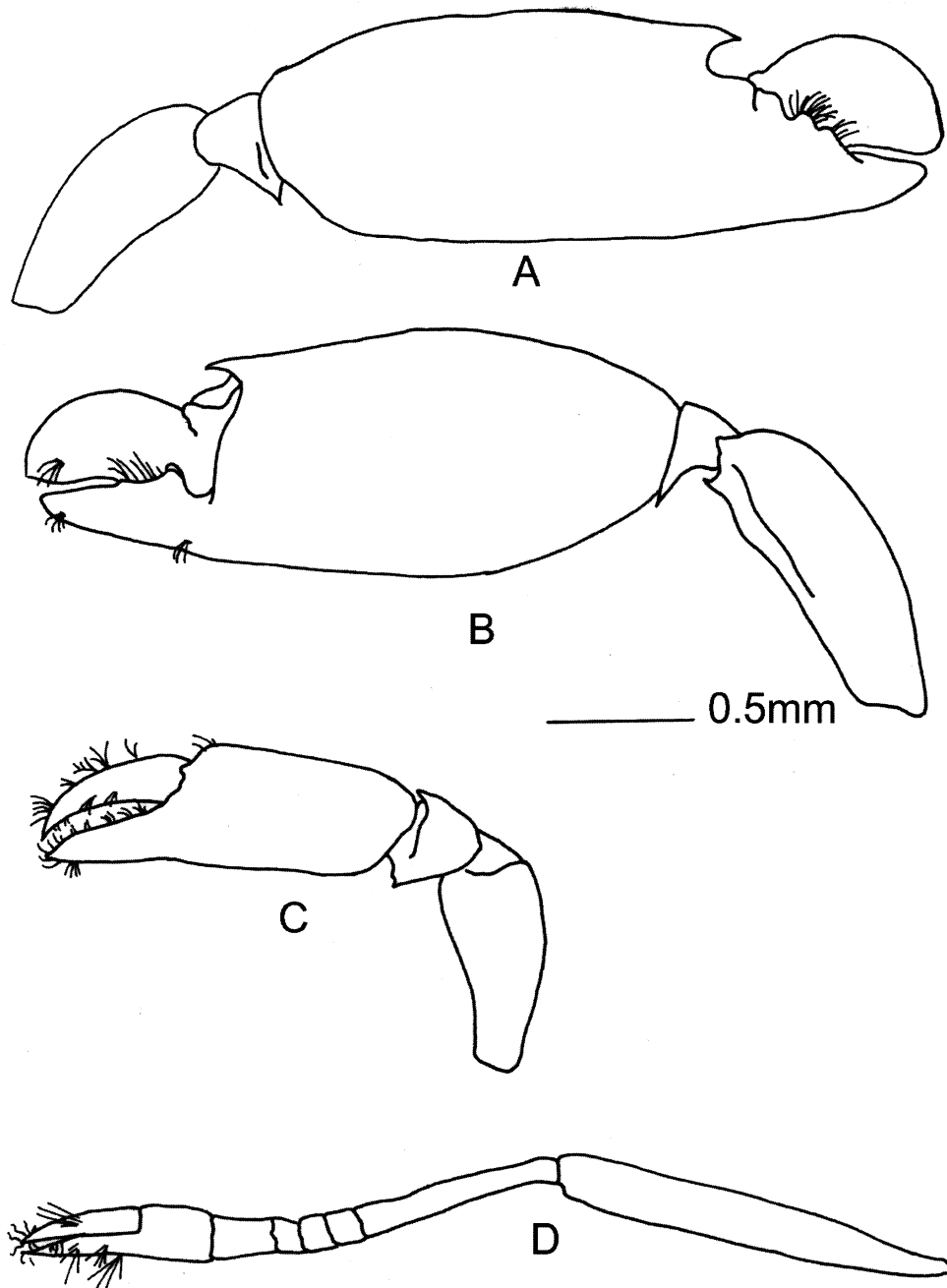


fingers, smooth, approximately 3.7 times as long as wide, with blunt to sharp tooth on distal margin above articulation with dactylus; fixed finger with two blunt teeth, dactylus evenly rounded and without tufts of setae along margin.



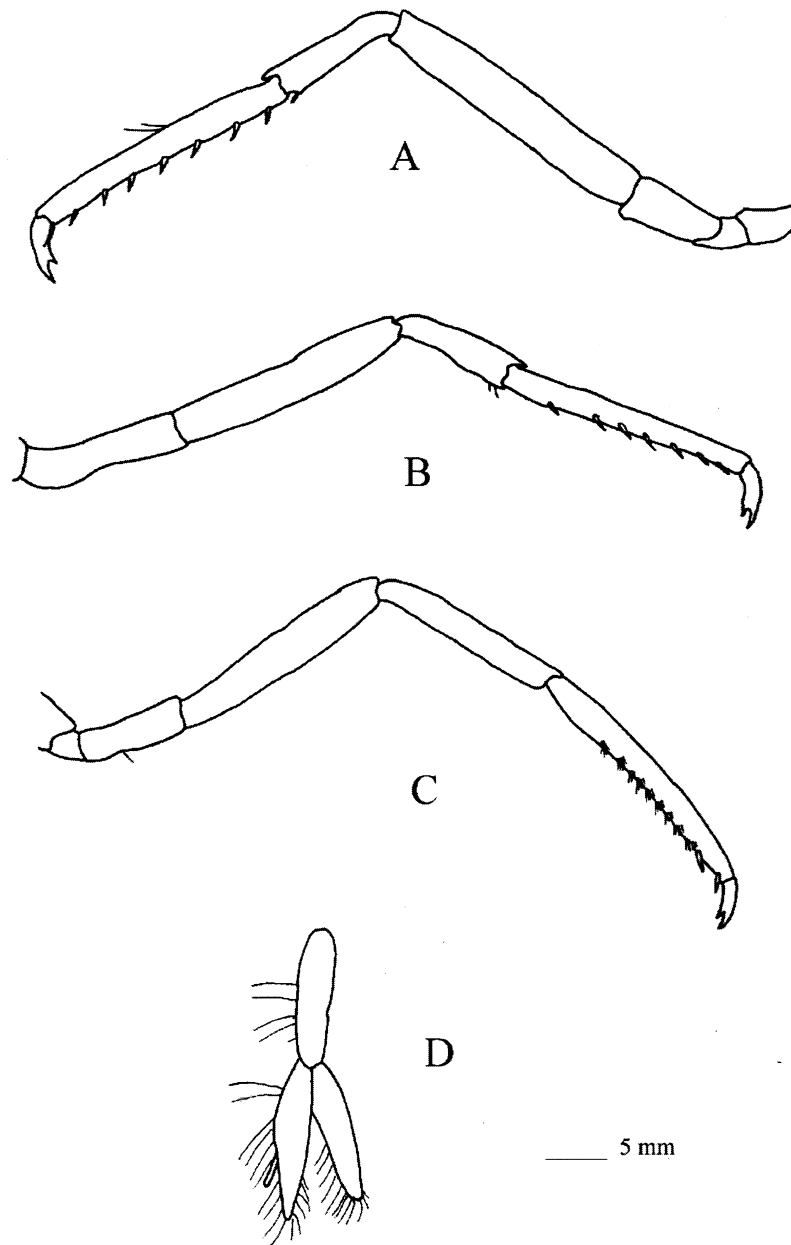
**FIGURE 2.** *Synalpheus townsendi*. A, carapace, frontal region and third maxilliped. B, ventral rostral process. C, abdomen. TCWC 2-7863 (specimen A).

Ischium of minor cheliped slightly shorter than wide. Merus 3.2 times as long as wide, ventral margin convex, dorsal margin with sharp angle at distal end above articulation with carpus. Carpus approximately as long as wide. Palm smooth, 2.2 times as long as wide, convex, 1.5 times as long as fingers; fingers evenly curved, with few setae.



**FIGURE 3.** *Synalpheus townsendi*. A, major cheliped, lateral view. B, major cheliped, mesial view. C, minor cheliped. D, second pereopod. TCWC 2-7863 (specimen C).

Ischium of second pereopod twice as long as wide, 0.8 times length of merus. Merus 5.8 times as long as wide, 1.1 times as long as carpus. Carpus slender, with five segments having ratios of lengths from first to fifth as follows: 6:1:1:1:2. Chela slender, shorter than first segment of carpus, palm 0.9 times length of fingers, fingers straight and bearing tufts of setae.



**FIGURE 4.** *Synalpheus townsendi*. A, third pereopod. B, fourth pereopod. C, fifth pereopod. D, second pleopod. TCWC 2-8720.

Third to fifth pereopods gradually decreasing in size. Third pereopod with ischium 3.5 times as long as wide, 0.4 times length of merus, without spine. Merus 5–5.2 times as long as wide, more than twice length of carpus and without spines. Carpus short, 0.4 times length of propodus, without spines. Propodus shorter than merus, 2.9 times length of dactylus, with row of 8–14 spines (usually 9–12) on flexor margin. Dactylus slightly curved, ending in two ungui approximately equal in width but with flexor unguis about 0.3 times length of extensor unguis. Fourth and fifth pereopods similar but shorter. Fifth pereopod with 8 tufts of short setae as well as row of spines on flexor margin.

Pleuron of first abdominal somite of female rounded; of male, with small sharp posteroventral point, partially covered by pleuron of second abdominal somite; pleura of somites 2–3 rounded, those of 4 and 5 subrectangular in female, sharply pointed at ventral margin in male; those of sixth somite acuminate. First pleopod with endopod 0.3 times length of exopod. Second pleopod with appendix interna. Telson shorter than uropods, 1.3 times as long as wide, widest at proximal end, tapering gradually to rounded apex, with 2 pairs of dorsal spines: first pair inserted at 0.6 times length, second at 0.7 times length; distolateral margin ending in sharp tooth; posterior margin with two distolateral spines, lateral spine about half length of mesial spine. Uropods rounded on posterior margin, exopod with two lateral teeth at diaeresis and spine between them.

Carapace length to 4.8 mm.

*Color in life.*— Red, dactylus of major chela dark green. Under a microscope, the shrimp has small red chromatophores against a translucent background. Hay and Shore (1918) described *S. townsendi* as light pellucid red, the large chela changing to green on the fingers.

*Type locality.*— Cape San Blas, Florida (29°14'00"N, 84°29'15"W).

*Habitat.*— In the Gulf of Mexico, *S. townsendi* was collected among coral rubble, sponges or algal nodules. It also has been collected among sea grasses, algae, rocks, shells and tubes of polychaetes (Christoffersen, 1979).

*Geographic distribution and depth range.*— Off Beaufort, North Carolina, U.S.A. to Rio de Janeiro, Brazil; Gulf of Mexico, Caribbean, Bermuda; intertidal to 132 m.

*Remarks.*— Specimens of *S. townsendi* show variation. The basicerite may be unarmed or bear a tiny tooth on the dorsal margin. Although illustrations of *S. townsendi* show a sharp tooth above the articulation of the palm of the major chela with the dactylus, this tooth may be absent, especially among the largest specimens. The shape of the abdominal pleura of somites 4 and 5 is sexually dimorphic. The length of the rostrum also varies, from as long as the first segment of the antennular peduncle to 0.3 times the length of the second segment. The distolateral tooth of the scaphocerite equals or surpasses the length of the antennular peduncle.

***Synalpheus mexicanus* Coutière, 1909**

Figures 5–6

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*Synalpheus townsendi mexicanus* Coutière, 1909: 34, fig. 17.— Chace, 1937: 123.— Carvacho & Ríos, 1982: 284.— Wicksten, 1983: 38.— Villalobos *et al.*, 1989: 15.— Ríos, 1992: 12.— Villalobos-Hiriart, 2000: 82, fig. 41.— Wicksten & Hendrickx, 2003: 66.

*Material examined:* GULF OF CALIFORNIA, MEXICO: 4 males and 3 females (types, USNM 038393 USNM). Isla Espíritu Santo, Canal de San Lorenzo, 23 m, coral. 15 March 1949, *Velero IV* station 1738-49, 1 female (LACM). Bahía de La Paz, 7 males, 5 females, and 6 ovigerous females (CCUBCS). Roca Shepard, Cabo San Lucas, 8–15 m, year 1974, Donald G. Lindquist, 1 female (LACM 322-05). COLOMBIA: Ensenada de Utría, 1 male and 1 female (USNM 244261).

*Description*

Rostrum slender, with several setae at apex, straight in lateral view, 3.3 times longer than wide at base, reaching 0.6 times as long as visible part of first segment, not overreaching level of the orbital teeth in lateral view. Anterior margin between orbital teeth and base of rostrum almost straight, orbital hoods separated from rostrum by marked, depressed anterior slope of carapace. Orbital hoods slightly inflated dorsally; orbital teeth slender, acute, tip slightly directed mesially in dorsal view, straight in lateral view, shorter than rostrum, with one or two setae at apex, reaching 0.4 times as long as visible part of first segment of antennular peduncle. Ventral rostral process short, ventral margin rounded. Pterygostomial margin produced as broad, subtriangular, acute lobe.

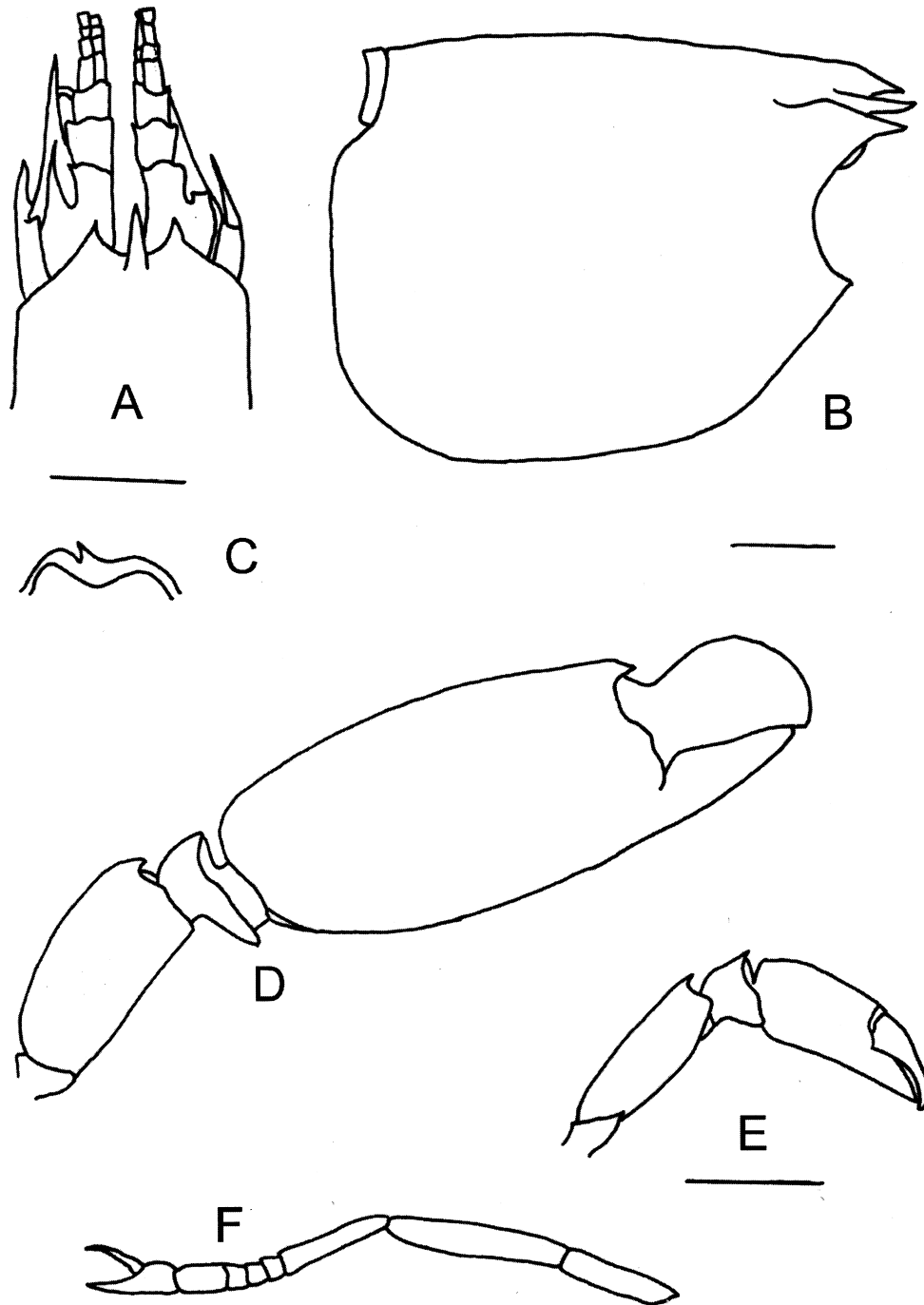
Antennular peduncle short, 3.9 times longer than wide, first segment 1.1 times as long as second and third segments combined, 1.8 times as long as second segment, second segment 1.3 times as long as third segment. Stylocerite slender, reaching to 0.4 times as long as second segment.

Blade of scaphocerite well developed, 3.6 times longer than wide, 0.8 times as long as third segment of antennular peduncle; disto-lateral tooth straight, lateral margin concave, surpassing blade by 1.1 length of third segment, overreaching antennular peduncle and carpocerite by more than half length of third segment. Basicerite with very short dorsal tooth, 0.1 times as long as ventro-lateral spine; lateral tooth long, reaching 0.9 times as long as visible part of first segment of antennular peduncle, eight times as long as dorsal spine. Carpocerite short and slender, 4.6 times as long as wide, almost reaching distal end of antennular peduncle.

Apex of third maxilliped with five strong, dark spines; ultimate segment 3.6 times as long as penultimate segment.

Ischium of major first pereopod 0.6 times as long as wide. Merus thick, 2.1 times as long as wide, 0.53 times as long as palm, dorsal margin convex, ventral margin almost straight, distal end of dorsal margin with strong tooth with apex pointed downward. Carpus with dorsal distal margin rounded, ventral margin bilobed. Chela long and slender, 2.8

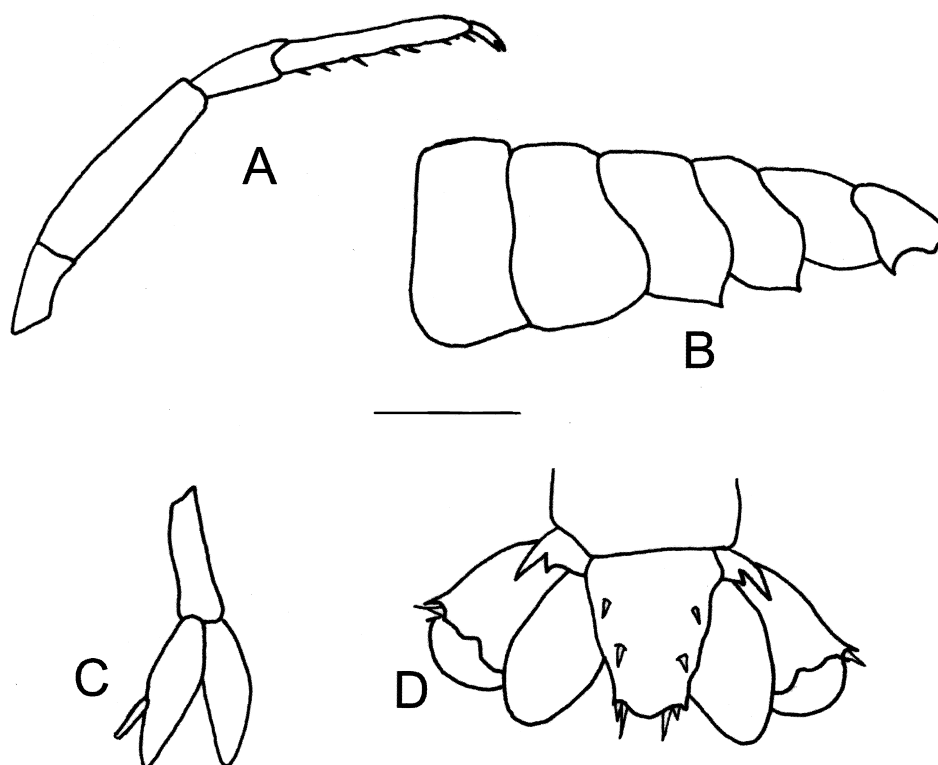
times as long as wide; palm slightly compressed laterally, twice as long as wide, 2.5 times as long as fingers, dorso-distal margin with slender tooth, slightly directed downward; fingers short, 0.3 times as long as palm.



**FIGURE 5.** *Synalpheus mexicanus* Coutière, 1909. A, frontal region in dorsal view. B, carapace. C, abnormal rostrum. D, major cheliped. E, minor cheliped. F, second pereopod.

Ischium of minor first pereopod 0.3 times as long as merus. Merus 2.5 times as long as wide, dorsal and ventral margin slightly convex, dorsal distal margin with small tooth. Carpus half as long as palm, dorsal distal margin with small tooth. Palm of chela 1.8 times as long as wide, 1.7 times as long as fingers, with numerous setae.

Ischium of second pereopod 0.8 times as long as merus. Merus 6.6 times as long as wide, 0.8 times as long as carpus. Carpus slender, with 5 segments having ratios of lengths from first to fifth as follows: 4:1:1:1:2. Palm of chela 1.6 times as long as wide, 0.7 times as long as fingers, fixed finger with tuft of scarce setae, dactylus with scarce setae.



**FIGURE 6.** *Synalpheus mexicanus*. A, third pereopod. B, abdomen of male. C, second pleopod. D, telson and uropods.

Ischium of third pereopod 2.5 times as long as wide. Merus 4.5 times as long as wide. Carpus 2.7 times as long as wide, 0.5 times as long as propodus, with spine at distal end of ventral margin. Propodus 7.6 times as long as wide, 4.9 times as long as dactylus, ventral margin with 9–10 movable spines and pair at distal end. Dactylus slender, 3.5 times as long as basal width, ungui approximately equal in width at base, following main axis of dactylus. Fourth and fifth pereopods similar but shorter, fifth pereopod with tufts of setae along flexor margin of propodus.

Pleura of first abdominal somite sexually dimorphic, in male with broad tooth on posterior ventral margin; pleura of second abdominal somite broadly rounded in both sexes; pleura of third to fifth abdominal somites with acute tooth on posterior half of ventral margin in male, rounded in female. Second pleopod with appendix interna. Telson broad, 1.3 times as long as wide at anterior margin, 2.4 times as long as wide at posterior margin; dorsal surface with slight longitudinal median depression, lateral margins sinuous, posterior margin convex; with 2 pairs long dorsal spines, both pairs of spines slightly removed from lateral margin, anterior pair situated at 0.3 times length, posterior pair at mid-length; posterolateral angles projecting and slightly acute; posterior margin armed with 2 slender lateral spines; mesial spines 1.5 times as long as lateral spines. Uropodal exopod with lateral margin convex anteriorly; diaeresis with 2 lateral teeth; lateral tooth longer, one spine between these.

Carapace length to 3.7 mm.

*Color in life*.—Not reported.

Type locality. —Southern Gulf of California.

*Habitat*. —Rock coral and sand; intertidal to 35 m (Wicksten, 1983).

*Geographic distribution and depth range*.—Angel de Guarda island to Cabo San Lucas, Gulf of California; Revillagigedo Islands (Wicksten and Hendrickx, 2003); Estero de Utrías, Colombia (this paper). Several authors (Coutière, 1909; Chace, 1937; Steinbeck & Ricketts, 1941; Carvacho & Ríos, 1982; Wicksten, 1983; Rodríguez de la Cruz, 1987; Villalobos-Hiriart *et al.*, 1989; Hendrickx, 1992, 1993; Rodríguez Alámarz *et al.*, (2002) considered *S. mexicanus* to be endemic to the Gulf of California, but the record from Colombia extends its distribution southwards.

*Remarks*.—The type material of *S. mexicanus* consists of seven damaged specimens. The most complete one was chosen for the redescription. This species is morphologically variable, although its variability was not discussed previously in the literature. In the studied material, we observed variation in the length and width of the rostrum. The anterior margin of the carapace, between the orbital teeth and the rostrum, may be concave or almost straight. The relative length of the carapocerite varies from almost reaching the end of the antennular peduncle to slightly surpassing it. The dorsal tooth of the basicerite is more marked in some specimens. Its proportion in relation to the length of the lateral spine varies from 0.1 to 0.2 times. In the third pair of pereopods the length/width proportions of its articles are variable: dactylus 3.5–4, propodus 7.1–8.3, carpus 2.2–2.8, and merus 4.2–4.7. The longitudinal median depression of the telson is less conspicuous in some specimens.

We were unable to examine all of the specimens discussed by Wicksten (1983). Some of these specimens may be misidentified.



*Synalpheus peruvianus* Rathbun, 1910

Figures 7–8

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*Synalpheus townsendi peruvianus* Rathbun, 1910:563, fig. 4, Plate 5.—Méndez, 1981: 92.—von Prael 1986: 96.—Lemaitre & Álvarez-León, 1992:43.

*Material examined*: Matapalo, Peru: 1 ovigerous female (Holotype, USNM 40503).

*Description*

Rostrum very short, slender, straight, with several long setae at apex, 2.5 times longer than wide, reaching to 0.3 times length of visible part of first segment of antennular peduncle, overreaching level of orbital teeth in lateral view; anterior margin between orbital tooth and base of rostrum broad, almost straight; orbital hoods separated from rostrum by marked depressed anterior slope of carapace. Orbital hoods slightly inflated dorsally; orbital teeth short, acute, apex directed slightly laterally in dorsal view, slightly upward in lateral view. Rostrum and orbital tooth equally long, with scarce setae at apex of rostrum. Ventral rostral process short and slightly bilobed. Pterygostomial margin produced as subtriangularly, short and distally acute lobe.

Antennular peduncle long, slender, 5.8 times longer than wide; visible part of first segment 0.9 times as long as second and third segments combined, 1.5 times as long as second segment; second segment 1.4 times as long as third segment. Stylocerite elongated, reaching to 0.5–0.6 times length of second segment.

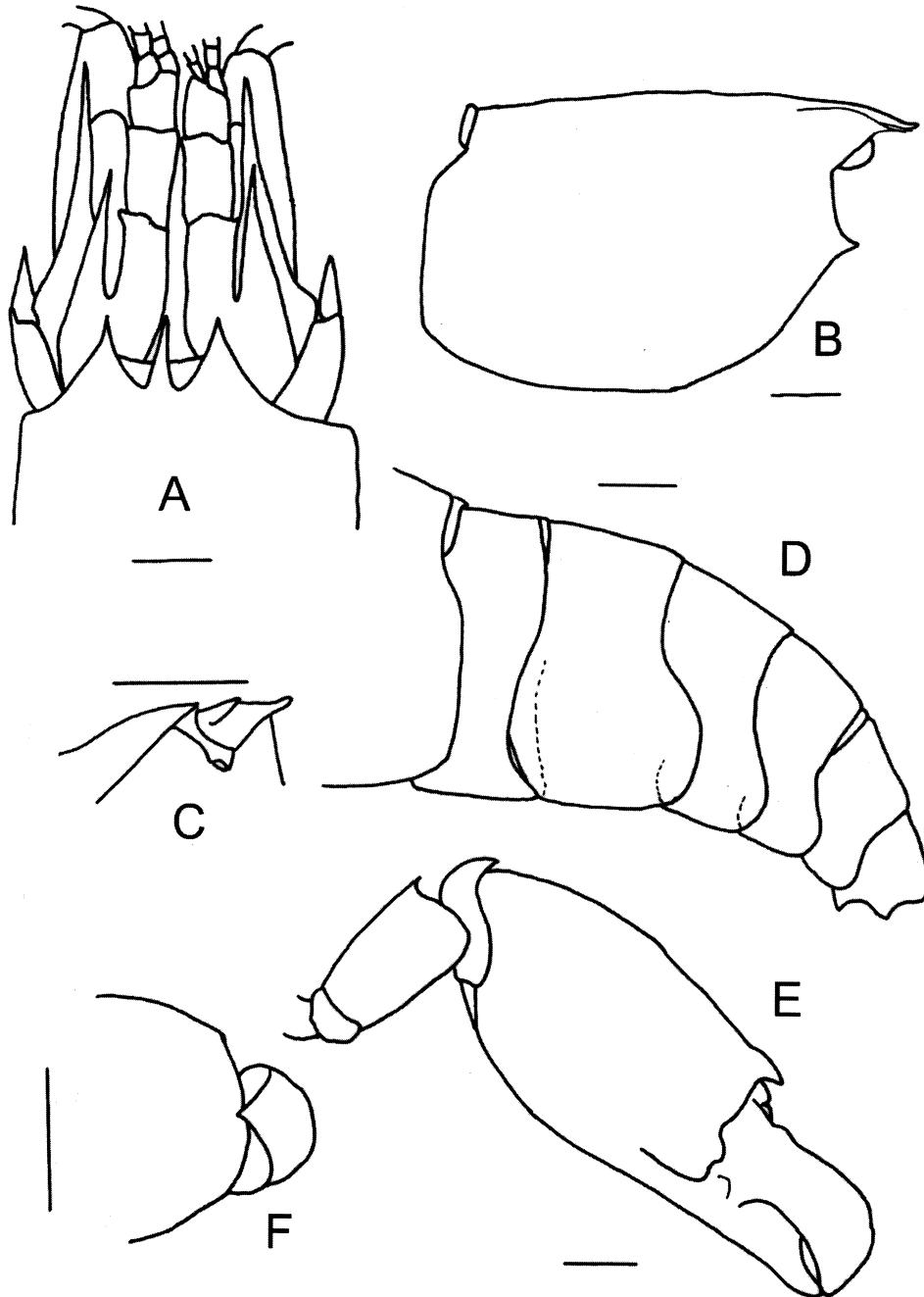
Blade of scaphocerite well developed, 3.2–3.3 times as long as wide, reaching to 0.2 times length of third segment of antennular peduncle; disto-lateral tooth slender, apex slightly directed laterally, lateral margin slightly concave, overreaching blade by approximately 0.8 length of third segment of antennular peduncle, reaching or surpassing antennular peduncle by 0.1 length of third segment, shorter than carpocerite by 0.4 length of third segment. Basicerite without dorsal tooth; lateral tooth broad proximally, reaching to 0.7 times length of visible part of first segment of antennular peduncle. Carpocerite broad, broader at mid-length, 3.8 times as long as wide, surpassing antennular peduncle by 0.5 times length of third segment of antennular peduncle.

Apex of third maxilliped with six dark spines; ultimate segment approximately 4 times as long as penultimate segment.

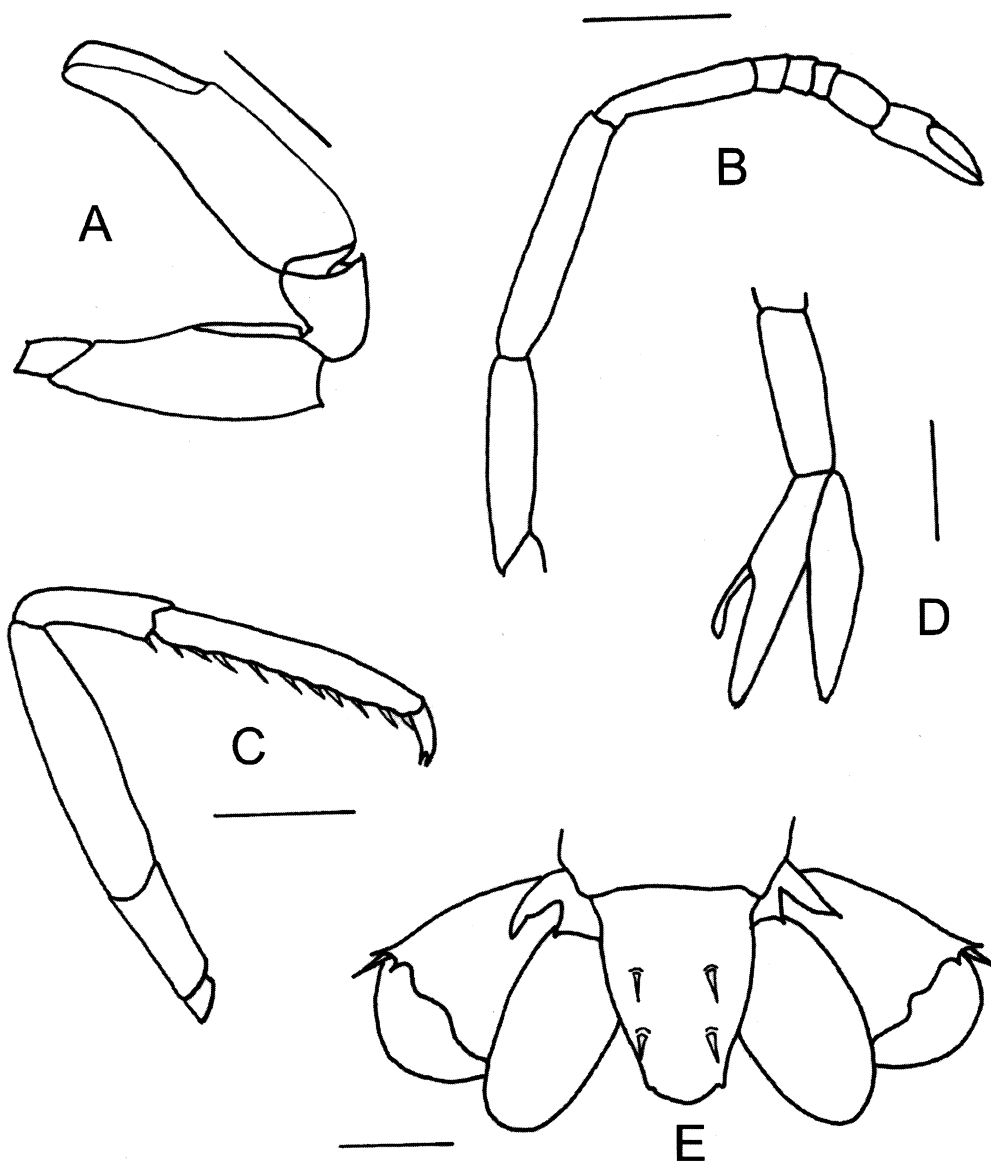
Ischium of major first pereopod 0.5 times as long as wide. Merus broad, twice as long as wide, 0.4 times as long as palm, dorsal margin almost straight, ventral margin slightly sinuous, distal end of dorsal margin with spine. Carpus with subtriangular lobe on dorso-distal margin, ending in small, acute tooth; ventral margin bilobed. Chela long and slender, 2.6 times as long as wide; palm 1.6 times as long as wide, dorso-distal margin with acute distal tooth, directed ventrally; fingers 0.4 times as long as palm.

Ischium of minor first pereopod 0.2 times as long as merus, 1.5 as long as wide. Merus 3.1 times as long as wide, dorsal margin slightly convex, ventral margin almost straight, dorso-distal margin with small tooth. Carpus 0.5 times as long as palm, small

spine on dorso-distal margin. Palm 1.9 times as long as wide, 1.4 times as long as fingers; fingers with scarce tufts of long setae.



**FIGURE 7.** *Synalpheus peruvianus* Rathbun, 1910. A, frontal region in dorsal view. B, carapace. C, ventral rostral process. D, female abdomen. E, major cheliped. F, carpal junction with major chela.



**FIGURE 8.** *Synalpheus peruvianus*. A, minor cheliped. B, second pereopod. C, third pereopod. D, second pleopod. E, telson and uropods.

Ischium of second pereopod 0.8 times as long as merus. Merus 5.7 times as long as wide, 0.9 times as long as carpus. Carpus slender, with five segments having ratios of lengths from first to fifth as follows: 4:1:1:1: 2. Palm of chela 1.5 times as long as wide, 0.9 times as long as fingers, fingers and palm with several tufts of setae and single setae.

Ischium of third pereopod 2.3 times as long as wide. Merus 4.4 times as long as wide. Carpus half as long as propodus, with pair of spines at distal end of ventral margin. Propo-

dus 7.5 times as long as wide, 4.7 times as long as dactylus, ventral margin with nine pairs of spines and pair of spines at distal end. Dactylus long, slender, 3.2 times as long as basal wide, ungui approximately equal in width.

Pleura of first fifth abdominal somites rounded. Second pleopod with appendix interna.

Telson broad, 1.3 times as long as wide at anterior end, 2.5 times as long as wide at posterior margin; dorsal surface with slight longitudinal median depression; lateral margins sinuous, posterolateral angles rounded; posterior margin convex; with two pairs of long dorsal spines situated at some distance from lateral margin; anterior pair situated at 0.4 times length of telson, posterior pair at 0.7 times length of telson. Posterolateral spines broken in this specimen. Uropodal exopod with lateral margin convex anteriorly; diaeresis with two lateral teeth, lateral tooth longer, one long spine between these two teeth.

Carapace length to 4.0 mm.

Color in life.—Not reported.

Type locality.—Matapalo, Peru.

*Habitat*.—Found among oysters (Rathbun, 1910) or coral reefs (von Prahl, 1986).

*Geographic distribution and depth range*. Ensenada de Utría, Colombia to Matapalo, Peru, less than 10 m (von Prahl, 1986; Lemaitre & Álvarez León 1992).

*Remarks*. Many species of *Synalpheus* present a wide range of intraspecific variation. Even the same specimen may present differences when sides are compared. Frequently, the variation in the cephalic appendages is correlated to both the position of the major chela of the first pair of pereopods. In the holotype of *S. peruvianus*, the major chela is on the left side and incidentally the left appendages are smaller than the appendages on the right side.

We do not agree with some of the characters listed by Rathbun (1910). According to her, the rostrum exceeds slightly the length of the orbital teeth; however, we observed that they have the same length. Rathbun (1910) mentioned that the scaphocerite reaches the apex of the antennular peduncle, but we found that in the holotype, the scaphocerite reaches only to about 0.2 times the length of the third segment of the antennular peduncle. She also stated that the carpocerite surpassed slightly the antennular peduncle, but we found that the carpocerite reached only slightly beyond half the length of the third segment of the antennular peduncle. These discrepancies may be because Rathbun measured the holotype in a different position or at a different angle.

*Synalpheus peruvianus* has been poorly collected. Lemaitre and Ivarez León (1992) recorded the species from Isla Gorgona, Colombia. The only other record of this species is Rathbun's specimen from the type locality. Méndez (1981) did not report any other specimens from Peru.

***Synalpheus brevispinis* Coutière, 1909**

Figs. 9–10

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*Synalpheus townsendi brevispinis* Coutière, 1909: 33, fig. 16.— Ray 1974: 177.

*Material examined:* GULF OF CALIFORNIA, MEXICO: Puerto Peñasco, Sonora, 13 April 1988, A. Kerstitch: 1 specimen. Calerita, Baja California Sur, in coral heads; intertidal; 23 July 1997, L. Hernández: 6 specimens (3 of them ovigerous). Los Islotes, Baja California Sur, from coral (no other data): 1 specimen. Punta Chileno, Cabo San Lucas: 5–10 m, 22–25 July 1981, A. Kerstitch, 1 specimen (LACM). GALAPAGOS ISLANDS: Wolf Island, 7 February 2000, scuba, subtidal, C. Hickman Jr.: 1 specimen.

*Description*

Rostrum subtriangular, apex straight in lateral view, 2.4 times longer than wide, reaching 0.8 times length of visible part of first segment of antennular peduncle, exceeding orbital teeth in lateral view, originating over the surface of the carapace. Orbital hoods slightly inflated; orbital teeth subtriangular, distal portion sharp, apex slightly directed mesially in dorsal view and straight in lateral view, lateral margins slightly convex, shorter than rostrum, without setae, reaching 0.4 times length of visible part of first segment of antennular peduncle. Anterior margin of carapace between rostrum and orbital teeth slightly concave, with slight depression visible on the surface of carapace between rostrum and orbital hoods. Ventral rostral process curved and laterally narrow, markedly bilobed. Pterygostomial angle of carapace sharply produced, antennal margin sinuous.

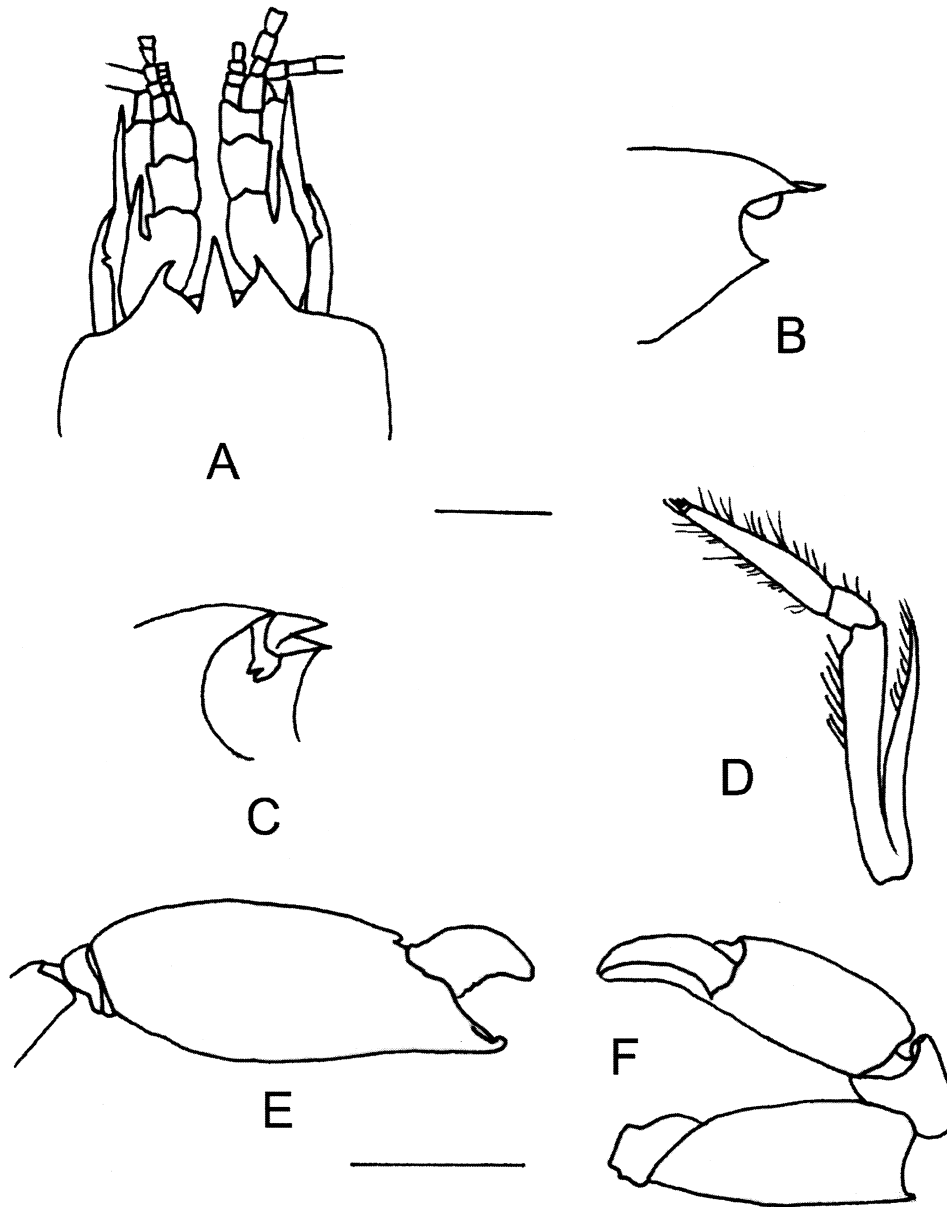
Antennular peduncle somewhat thick, total length 3.9 times width. First segment of antennular peduncle slightly longer than second and third segments combined, 1.1 times length of second segment, length of second segment subequal to that of third segment. Stylocerite wide proximally and distally sharp, reaching 0.7 times length of second segment of antennular peduncle.

Blade of scaphocerite well developed, length 2.5 times width, almost reaching distal end of antennular peduncle. Tooth of scaphocerite almost straight, lateral margin slightly concave, exceeding scale by 0.4 times length of third segment of antennular peduncle, often reaching to distal end of third segment of antennular peduncle, shorter than carpocerite by approximately 0.4 times length of third segment of antennular peduncle. Dorsal tooth of basicerite absent; lateral tooth thin, almost reaching distal end of visible part of first segment of antennular peduncle, exceeding rostrum and orbital teeth. Carpocerite 3.6 times as long as wide, equal to or overreaching antennular peduncle by approximately half of length of third segment of antennular peduncle.

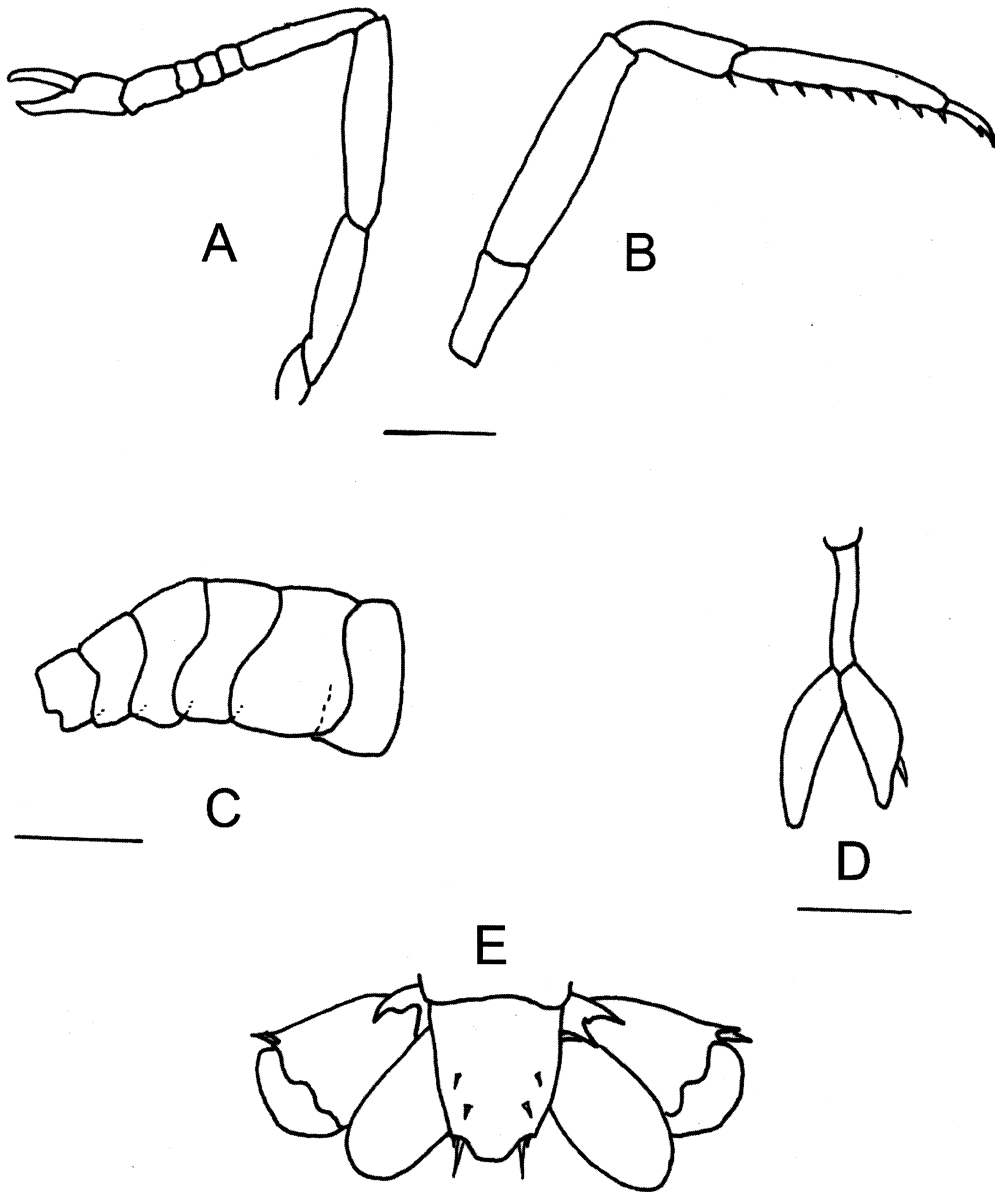
Length of ultimate segment of third maxilliped 4 times length of the penultimate segment, distal end with five dark spines.

Ischium of major first pereopod 0.6 times as long as wide. Length of merus 2.1 times width, 0.9 times length of palm, dorsal margin somewhat convex, ventral margin slightly concave, distal end of dorsal margin with tooth pointed downward. Carpus short, distal

end of dorsal margin with tooth on external face, not elongated, ventral margin somewhat bilobed. Chela somewhat inflated, length of chela 2.8 times its width, length of palm 1.9 times its width, 2.3 times length of fingers, distal end of dorsal margin of palm with a lobule, fingers short, 0.3 times length of chela.



**FIGURE 9.** *Synalpheus brevispinus* Coutière, 1909. A, frontal region. B, rostrum and ocular hoods. C, ventral rostral process. D, third maxilliped. E, major cheliped. F, minor cheliped.



**FIGURE 10.** *Synalpheus brevispinus*. A, second pereopod. B, third pereopod. C, female abdomen. D, second pleopod. E, telson and uropods.

Ischium of minor first pereopod 1.2 times as long as wide, 0.3 times length of merus. Length of merus 2.3 times width, dorsal and ventral margins slightly convex, distal end of dorsal margin with spine pointed downward. Length of carpus 0.9 times width, 0.4 times length of palm, distal tip of dorsal margin with spine on external face, not elongated. Length of palm of chela 1.7 times width, 1.2 times length of fingers, with sparse setae on chela and fingers.

Second pereopod slender and chelate. Length of ischium of second pereopod 0.8 times length of merus. Length of merus 5.5 times its width, 0.8 times length of carpus. Carpus slender, with five segments having ratios of length from first to fifth as follows: 5:1:1:1:3. Length of palm 1.5 times its width, 0.8 times length of fingers, two patches of setae on fixed finger, some setae on movable finger

Ischium of third pereopods 2.2 times as long as wide. Length of merus 4.7 times its width. Length of carpus 3.5 times its width, 0.5 times length of propodus. Length of propodus 8.4 times its width, 3.6 times length of dactylus, ventral margin with 6 movable spines and 1 pair distal spines. Dactylus long and thin, length 4.4 times maximum width, inferior tooth diverging slightly from central axis of dactylus, width of base of teeth subequal. Fourth and fifth pereopods similar but shorter, fifth pereopod with patches of short setae on flexor margin of propodus.

Posterior end of ventral margin of pleura of first abdominal somite with marked sexual dimorphism: in male, slightly produced, rounded in female. Ventral margins of pleura of second abdominal somite subquadrate, fifth pleura somewhat angular. Second pleopod with appendix interna only in females. Telson wide, length 1.3 times its anterior width, 2.1 times its posterior width, dorsal surface without median longitudinal depression, lateral margins convex at half their length, posterior margin markedly convex. Dorsal spines short, removed from lateral margin, anterior pair of spines inserted at 0.5 times length of telson, posterior pair at 0.7 times length of telson. Distal angles of telson slightly produced. Spines of posterior margin thin, length of mesial pair 3.5 times length of lateral pair. Uropodal exopod with margin slightly sinuous, diaresis with two teeth: one strong lateral tooth, mesial tooth minute, with spine between them.

Carapace length to 5.0.

*Color in life.*— Not reported.

*Type locality.*— Lower California.

*Habitat.*— Among rocks and coral heads.

*Geographic distribution and depth range.*— Puerto Peñasco, Sonora (northern Gulf of California) to Wolf Island, Galapagos (this paper), intertidal to 10 m.

*Remarks.*— As in *S. townsendi*, the sexual dimorphism of the pleura of the first abdominal somite is marked. Another useful feature to distinguish between the sexes is the absence of an appendix interna on the second pleopod of the male.

The length of the rostrum and orbital teeth varies. The rostrum often exceeds the midlength of the first segment of the antennular peduncle. The orbital teeth do not exceed half of the length of the first antennular segment. The range of variation in the ratio of length to width of the antennal blade is between 2.4 and 2.8. Often, it reaches the distal third of the third segment of the antennular peduncle. The ventro-lateral tooth of the basicerite may or may not reach the distal end of the first segment of the antennular peduncle. The dorso-lateral margin of the carpus of the major and minor chelipeds often has a small tooth on the external face.



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