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Description of *Synalpheus williamsi,* a new species of sponge-dwelling shrimp (Crustacea: Decapoda: Alpheidae), with remarks on its first larval stage

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Abstract.—A new species of *Synalpheus* is described based on specimens collected from sponges in Belize and the Atlantic coast of Panamá. The new species, *S. williamsi,* is most similar morphologically to *S. goodei* Coutière, but the two species are consistently different in several morphological and larval features, and occupy distinct species of sponges. The shape of the major chela and of the uropodal exopods are the most reliable morphological characters that distinguish the two species. The first larval stage, a zoea I, was obtained from an ovigerous female of the new species. The zoea I is similar to that of *S. neomeris* (De Man), *S. triunguiculatus* (Paulson), *S. tumidomanus* (Paulson), and *S. scaphoceris* Coutière, in lacking pleopods and chelae, but can be distinguished by the presence of an acute projection on the pterygostomian corner.

Resumen.—Se describe una nueva especie de *Synalpheus* en base a especímenes recolectados dentro de esponjas en Belice y la costa Atlántica de Panamá. La nueva especie, *Synalpheus williamsi,* es muy parecida a *S. goodei* Coutière, pero posee distintas características ecológicas, morfológicas y larvarias. Estas dos especies de *Synalpheus* habitan distintas especies de esponjas. Los caracteres morfológicos más confiables para distinguirlas son la forma de la quela mayor y de los exópodos uropodales. De una hembra ovígera se obtuvo la primera fase larvaria, una zoea I desprovista de pleópodos y de quelas. La zoea I de la nueva especie es muy similar a la de *S. neomeris* (De Man), *S. triunguiculatus* (Paulson), *S. tumidomanus* (Paulson), y *S. scaphoceris* Coutière, pero se distingue de ellas por la presencia de una proyección pterigostomiana aguda en el caparazón.

During the course of collections made over several years in Belize and on the Atlantic coast of Panamá, we obtained a number of shrimps of a sponge-dwelling *Synalpheus* species morphologically similar to *S. goodei* Coutière, 1909. Specimens were collected from living sponges taken by SCUBA from various depths (1–15 m) on the outer reef ridge at the Smithsonian Institution's field station on Carrie Bow Cay, Belize (16°48′N, 88°05′W), and from Ulagsukun, Pico Feo, and Mamitupo reefs near the Smithsonian Tropical Research Institute's (STRI) field station in the San Blas Islands, on the Atlantic coast of Panamá (9°34′N, 78°58′W). Specimens from both areas were collected from the internal canals of the midnight-blue sponge *Hymeniacidon caerulea* Pulitzer-Finali, 1986, although one was associated with an unidentified orange encrusting sponge of tubular shape. Four specimens were collected free from any host, and had probably left their host sponges during sample handling. Usually, a heterosexual pair or a single adult was found in a same sponge. Here we de-

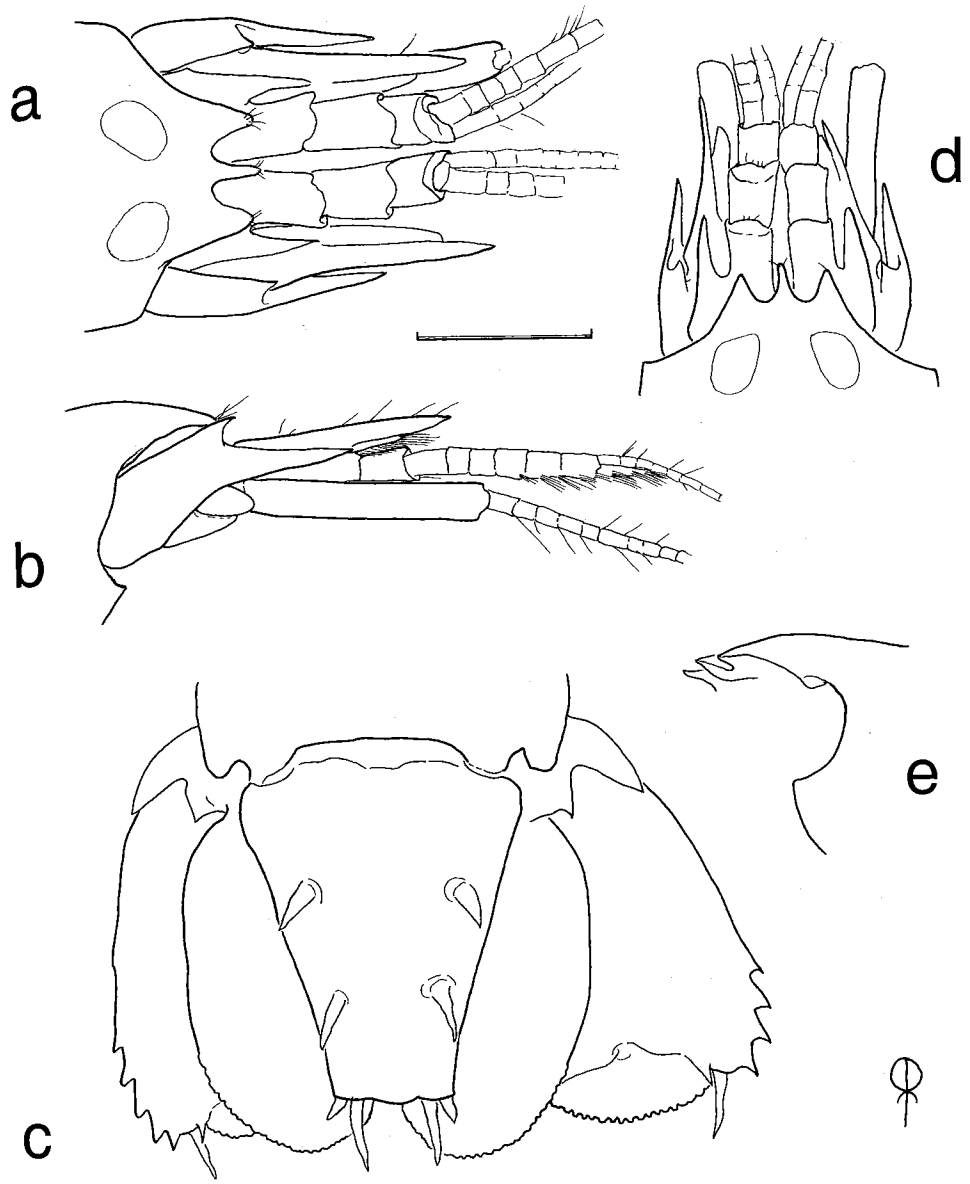


Fig. 1. *Synalpheus williamsi,* new species. Paratype male 4.4 mm (USNM 276160): a, anterior region of carapace and cephalic appendages, dorsal view; b, same, lateral view; c, telson and uropods, dorsal view. Paratype ovigerous female 4.3 mm (USNM 276160): d, anterior region of carapace and cephalic appendages, dorsal view; e, anterior region of carapace, lateroventral view. Scale bar = 1 mm for a, b, d, e and 0.72 mm for c.

movable spines, lateral pair shorter than innermost; mesial gap wider than combined bases of both pairs of spines, with 2 tufts of 3 erect setae on dorsal surface mesially adjacent to inner spines, and single row of 8 more conspicuous, posteriorly directed plumose setae of similar size, emerging from under mesial distal lobe.

Stylocerite (Fig. 1a, d) slender, with mesial side slightly concave, barely overreaching distal margin of basal article of antennular peduncle; this latter with lateral fan of

scribe these specimens. We also include a diagnosis of the first zoeal stage of this species hatched in the laboratory. Material is deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); Colección Nacional de Crustáceos from the Instituto de Biología UNAM, México (CNCR), the Muséum National d'Histoire Naturelle, Paris (MNHN), and in the Virginia Institute of Marine Science (VIMS). Measurements indicated are of carapace length including rostrum.

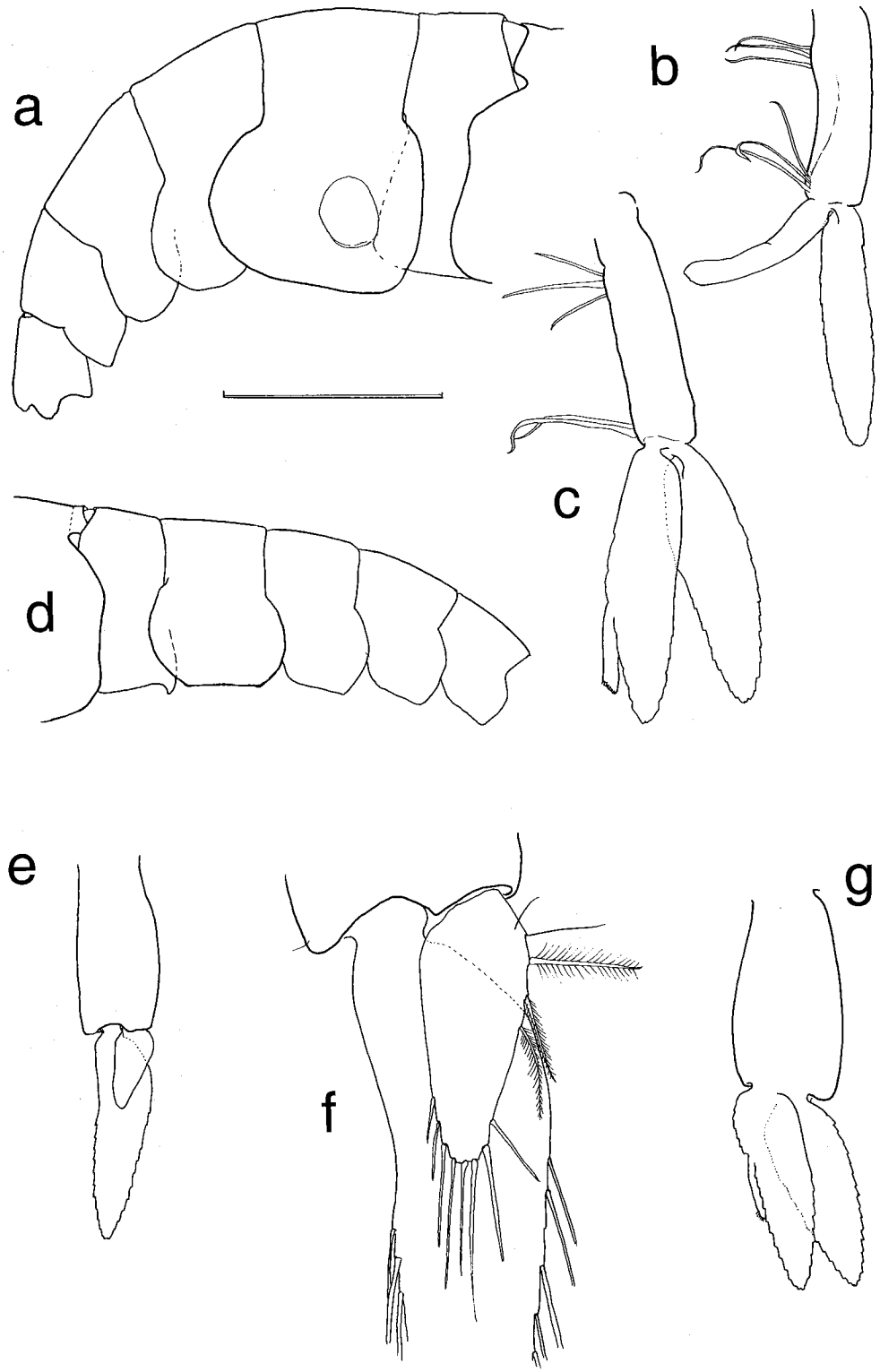
Synalpheus williamsi, new species
Figs. 1–6

Type specimens.—Holotype ♂, 3.6 mm (USNM 276158), allotype ovigerous ♀, 4.5 mm (USNM-276159), Carrie Bow Cay, Belize, 13 Jun 1996, from canals of same specimen of midnight-blue sponge *Hymeniacidon caerulea,* 18 m.—Paratypes: ♂, 4.4 mm, 2 ovigerous ♀♀, 4.3, 4.8 mm (USNM-276160), Carrie Bow Cay, Belize, 4 Apr 1993, from canals of same specimen of midnight-blue sponge *H. caerulea,* 13 m; Paratype ♂, 2.3 mm (CNCR 17987) Carrie Bow Cay, Belize, 12 Jun 1996, from canals of midnight-blue sponge *H. caerulea,* 18 m; Paratype ♂, 3.7 mm (MNHN-Na 13561) Ulagsukun Reef, Panamá, 17 Jan 1991, from canals of midnight-blue sponge *H. caerulea.*

Additional specimens examined (non paratypes).—Belize: Carrie Bow Cay, 5 Apr 1993, 2 ♂♂, 2.9, 3.8 mm (VIMS); 18 Aug 1994, ♂, 3.5 mm (VIMS); 26 Aug 1994, ♂, 4.7 mm (VIMS), zoea larvae (USNM-276161); in midnight-blue sponge *H. caerulea.* Panamá: Ulagsukun Reef, 18 Jan 1991 ovigerous ♀, 4.2 mm (VIMS); 10 Nov 1992, ♂, 3.7 mm (VIMS), in midnight-blue sponge *H. caerulea,* 1 m; Pico Feo Reef, 18 Jan 1991, ♂, 3.4 mm, ovigerous ♀, 4.2 mm (VIMS), in midnight-blue sponge *H. caerulea*; San Blas Islands: 1991, ♂, 4.3 mm (VIMS); Mamitupo Reef: 19 Jan 1991, ♂, 4.1 mm (VIMS), in orange tubular sponge.

Description of holotype.—Body form subcylindrical. Carapace smooth, with sparse short simple setae. Rostrum (Fig. 1a, d, e) slender, distally upturned, slightly overreaching orbital teeth, not reaching to distal margin of first segment of antennular peduncle; dorsally carinated; ventrally produced into small longitudinal keel, but without true orbitorostral process. Ocular hoods (Fig. 1a, d, e) dorsally convex, separated from rostral carina by broad depressions; triangular ocular teeth and rostrum with few apical setae; adrostral notches broadly rounded. Pterygostomian corner (Fig. 1b) produced into bluntly acute angle. Posterior margin (Fig. 2a, d) with distinct cardiac notch.

Abdomen with sparse simple setae; pleuron of first somite (Fig. 2d) with anterior corner almost in right angle, ventral margin sinuous and posteriorly bearing a blunt strongly hooked tooth directed anteriorly; second pleura broadly rounded anteriorly, with ventral margin slightly concave and posterior corner rounded, but with widely obtuse projection behind 3/4 of length; third to fifth pleura anteriorly and posteriorly obtuse, ventral margin triangular with apex progressively displaced posteriorly; sixth abdominal segment (Fig. 2a) with bluntly acute projection on posteroventral margin, shallow curved inferior concavity, triangular lateral lobe with convex sides, shallow obtuse upper emargination, and convex dorsal margin slightly overhanging telson. Telson (Fig. 1c) subtriangular, truncate, proximal margin slightly more than twice as wide as distal margin; lateral margins slightly convex just as far as distal pair of dorsal spines, then slightly concave; dorsal surface with mesial shallow depression and 2 pairs of dorsal spines, anterior pair situated slightly anterior to proximal third of length of telson, posterior pair of dorsal spines at second third of length of telson; distal margin arcuate, posterolateral corners not projected, 2 pairs of flanking distal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setae proximally on dorsal face; second and third segments of antennular peduncle decreasing in length. Upper flagellum (Fig. 1a, b) biramous, rami fused for 5 segments; lower ramus shorter, with 3 groups of aesthetascs on ventral face, and 4 and 5 additional groups posteriorly, upper ramus with 12 and 15 segments (left and right side, respectively). Lower flagellum normal, longer than upper.

Basicerite (Fig. 1a, b, d) with acute dorsolateral projection, and longer acute ventrolateral spine overreaching tip of stylocerite; scaphocerite with slightly reduced blade reaching to distal edge of antennular peduncle, narrower at base than lateral spine, which is robust, acute, with slightly concave lateral margin, and clearly overreaching antennular peduncle. Carpocerite (Fig. 1b, d) about 7 times as long as wide when viewed laterally, overreaching tip of lateral spine of scaphocerite.

Exopod of third maxilliped (Fig. 3f) not overreaching antepenultimate article, tip of ultimate segment (Fig. 3g) with circle of 7 strong blunt spines finely denticulate on proximal half of inner face. Remaining mouthparts as figured from paratypes (Fig. 3 a–e).

Major first pereiopod (Fig. 4a, b, c) massive, subcylindrical, with few sparse setae; palm about 1.75 times longer than wide, dorsodistal margin with blunt prominence overhanging insertion of dactyl, and bearing subterminal, ventrally directed, acute spine. Dactyl 0.3 times as long as palm, strongly compressed, dorsal margin broadly semicircular in lateral view (Fig. 4b), cutting edge almost flat with discrete blunt tip, internal face opposing outer face of pollex when closed. Pollex 0.7 times as long as dactyl, deeply excavated proximally to receive dactylar molar process, in ventral view (Fig. 4g), thick, triangular, with accessory subdistal obtuse projection on outer face, flanking outer face of dactyl when closed. Carpus cup-shaped, short and broad. Merus, about 0.8 times as long as height of palm, nearly triangular in cross section, inner edges slightly concave, outer convex, lower side flattened, with lamellar triangular projection on distal outer corner, upper side clearly convex.

Minor first pereiopod (Fig. 4d) slightly compressed. Palm about 1.7 times longer than high. Dactyl 0.7 times as long as palm, with several tufts of regular setae; extensor margin convex, with 2 longitudinal series of transverse parallel rows of setae distally curved towards tip of dactyl, inner series composed of about 12 rows, first row at start of second third of dactyl, last row at end of fourth fifth, shorter outer series, with first row opposing fifth row of inner series, setae similar in shape, length, and orientation, but slightly thinner; dactyl flexor margin excavated (Fig. 4e), tip with strong tooth flanked by two accessory blunt projections. Pollex with sinuous lower margin, sparse tufts of setae, strong apical tooth (Fig. 4f) continued backward into oblique widely convex blade. Carpus cup-shaped, about 0.5 times as long as palm; 1.2 times higher distally than mesial length in lateral view; upper and lower margins distally expanded over proximal portions of palm. Merus 1.5 times as long as palm, 2.5 times longer than maximum width; almost triangular in cross section; distal outer corner flared, without true spine.

Second pereiopod (Fig. 4h) more slender than all others. Fingers with strong tufts of setae, slightly more than 1.3 times as long as palm, latter 1.4 times longer than high.

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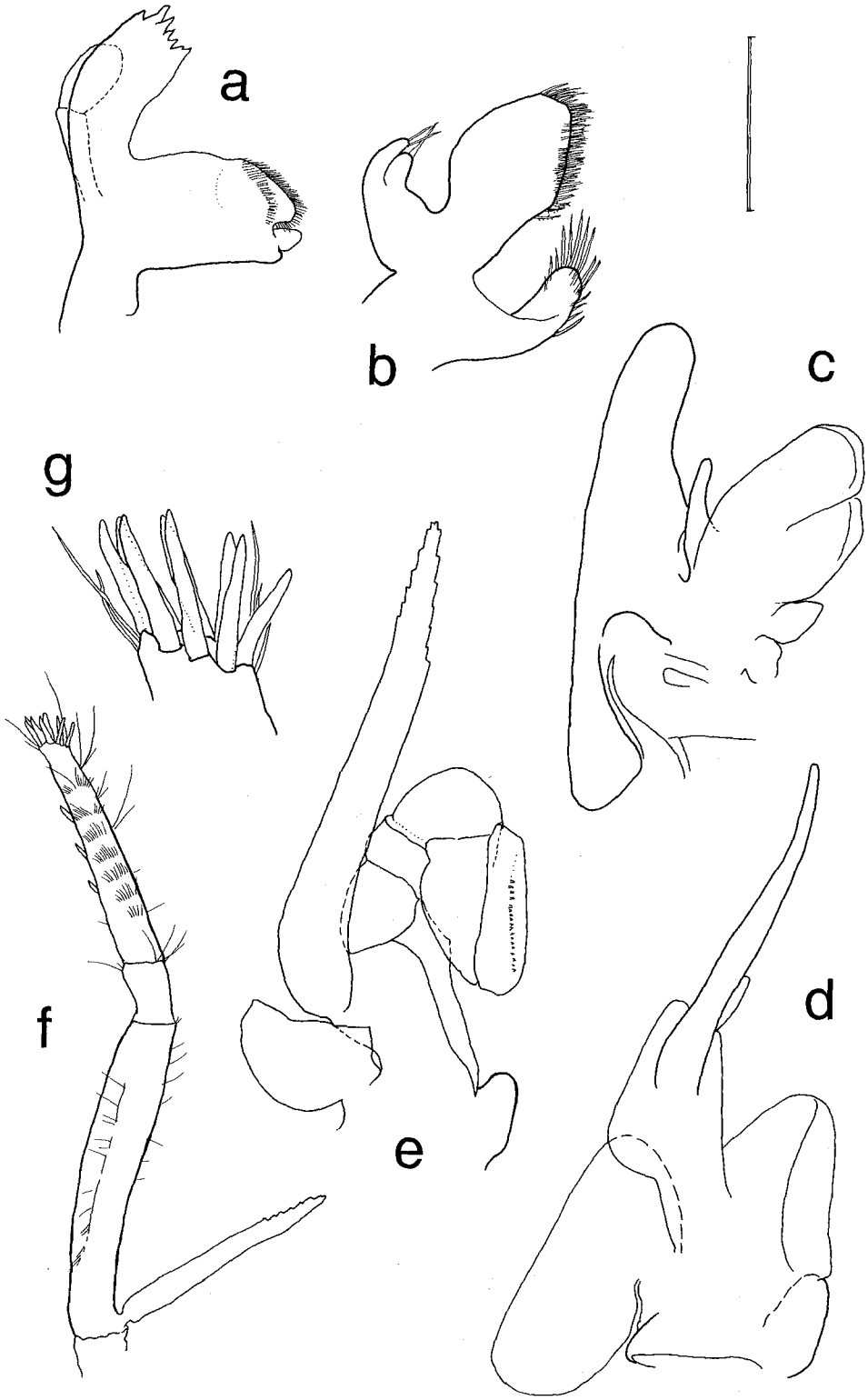
Fig. 2. *Synalpheus williamsi,* new species. Paratype ovigerous female 4.8 mm (USNM 276160): a, abdomen with one egg, lateral view; b, first pleopod; c, second pleopod. Paratype male 4.4 mm (USNM 276160): d, first 5 segments of abdomen, lateral view; e, first pleopod; f, same, detail of endopod; g, second pleopod. Scale bar = 2.2 mm for a, d, 1 mm for b, c, e, g, and 0.31 mm for f.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Carpus composed of 5 articles with ratio 4.5:1:1:1:2, second through fourth equally as long as high. Merus about 5.3 times longer than wide, and 0.9 times as long as carpus. Ischium four times longer than wide, and 0.7 times as long as merus.

Third pereiopod (Fig. 5a), strongest of posterior legs. Dactyl (Fig. 5d) biunguiculate, slightly longer than width of propodus, flexor margin concave. Propodus 6.3 times longer than wide, flexor margin with a longitudinal series of 7 strong movable spines and one terminal pair of movable spines flanking base of dactyl. Carpus 2.6 times longer than wide, extensor distal margin projected over propodus, strong movable spine on distal flexor margin. Merus 4.4 times longer than wide, unarmed. Ischium unarmed.

Fourth pereiopod (Fig. 5b, e) very similar to third, but slightly weaker.

Fifth pereiopod (Fig. 5c, f) weaker than fourth, with following slight differences, propodus with only two or three spines on flexor margin besides distal pair, and about five combs of stout setae transversely arranged on distal half of posterior face; carpus without spine.

Endopod of first pleopod (Fig. 2e) not as long as width of exopod, with few apical setae (Fig. 2f). Second pleopod (Fig. 2g) without appendix masculina. Pleopods 2–5 with appendix interna.

Uropodal exopod (Fig. 1c) with 5 strong distolateral teeth, longer movable spine and acute mesial tooth. Diaeresis present, distinct.

Color.—Live specimens were translucent faint gold to golden brown, with tip of chelae (fingers and distal part of palm included) of first pereiopods bright orange to red, second legs golden, third to fifth transparent, and traces of blue in the gut and in the branchiae. These traces were the same dark blue as the host sponge, and they still can be seen in some of the preserved specimens.

Variations.—The few discrepancies between the illustrations, from a male paratype, and the holotype are most probably due to the larger size of the figured paratype. The greater development of the endopod on the first pleopod (Fig. 2f) could be related to different stages of sexual maturity. Regarding sexual dimorphism, the most striking female characters are the broadly rounded shape of the first to fourth pleurae (Fig. 2a), the larger endopod of the first pleopod (Fig. 2b), and the insertion of

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Fig. 3. *Synalpheus williamsi,* new species. Mouthparts. Paratype male 4.4 mm (USNM 276160): a, mandible; b, first maxilla; c, second maxilla; d, first maxilliped; e, second maxilliped. Paratype ovigerous female 4.3 mm (USNM 276160): f, third maxilliped; g, same, detail of tip. Scale bar = 0.5 mm for a, b, c, d, e, 1 mm for f, and 0.25 mm for g.

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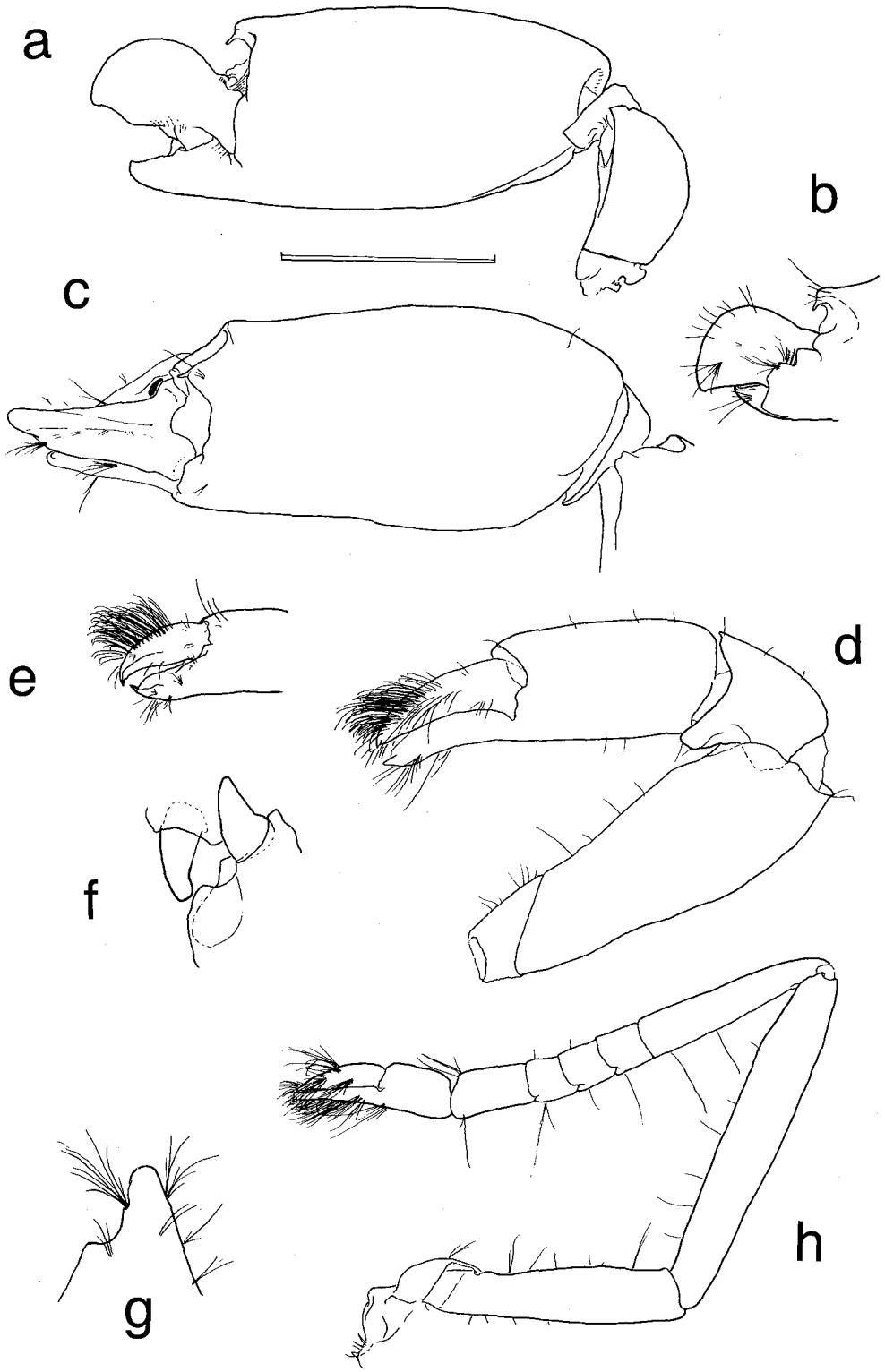
Fig. 4. *Synalpheus williamsi,* new species. Paratype male 4.4 mm (USNM 276160): a, major first pereiopod in lateral view; c, chela of same, dorsal view; g, same, tip of pollex, ventral view; h, second pereiopod. Paratype ovigerous female 4.3 mm (USNM 276160): b, anterior portion of major first pereiopod, external face, lateral view; d, minor first pereiopod, lateral view; e, distal portion of same, lateroventral view; f, same, detail of tip, frontolateral view. Scale bar = 2.5 mm for a, 2.2 mm for b, c, 1 mm for d, 1.4 mm for e, g, 0.2 mm for f, and 2 mm for h.

Fig. 5. *Synalpheus williamsi,* new species. Paratype male 4.4 mm (USNM 276160): a, third pereiopod; b, fourth pereiopod; c, fifth pereiopod; d, detail of distal portion of third pereiopod; e, detail of distal portion of fourth pereiopod; f, detail of distal portion of fifth pereiopod. Scale bar = 1 mm for a, b, c, and 0.31 mm for d, e, f.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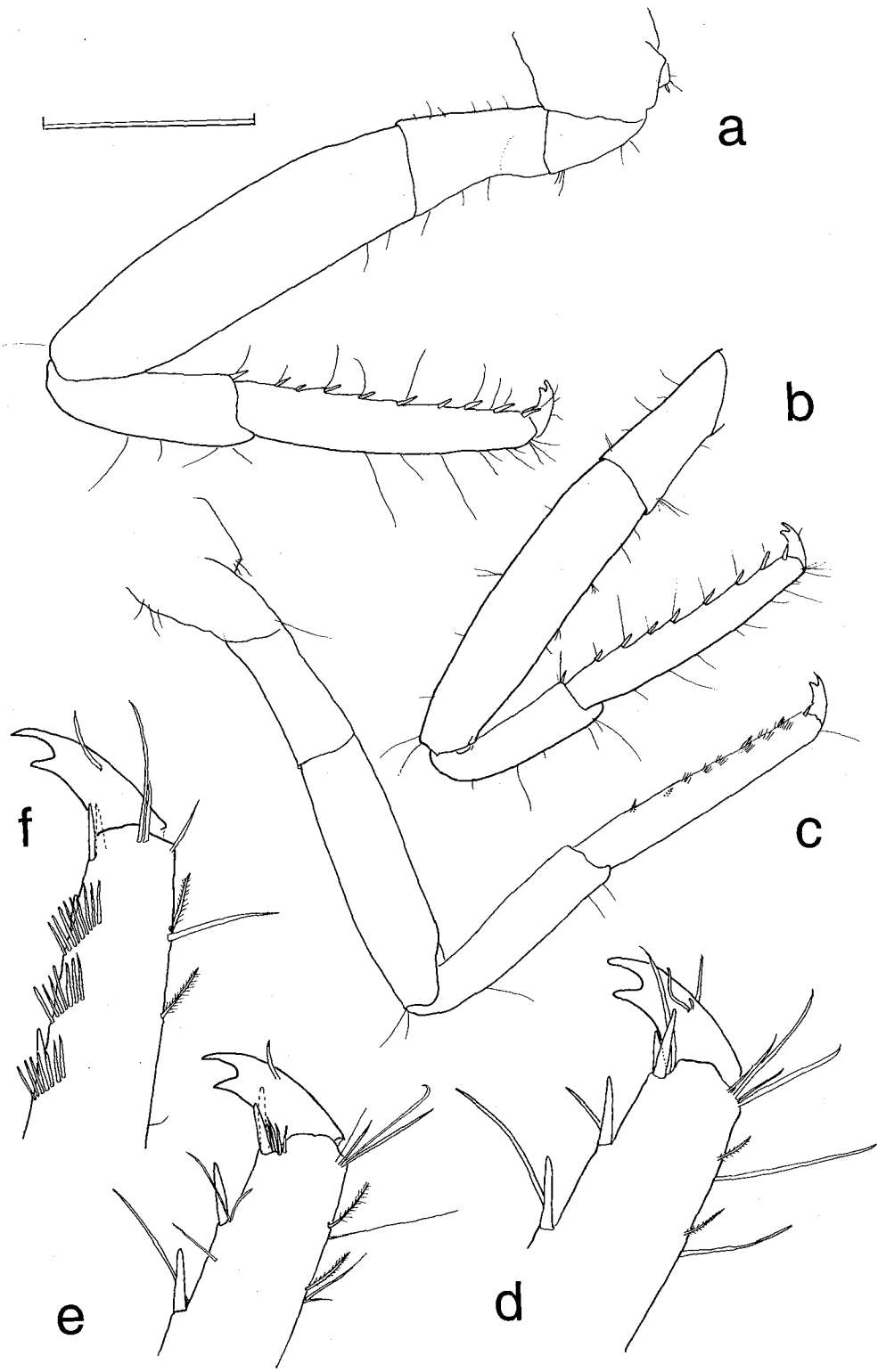
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the appendix interna beyond the midpoint in the remaining pleopods (Fig. 2c).

On the tip of third maxilliped, eight or seven spines is the most frequent formula (as in the holotype), but the allotype has nine spines on one side and ten on the other. The number of immovable teeth on the lateral margin of the uropodal exopod varies from three to six, with a mode of four; this variation apparently relates to size and perhaps sex, considering that the smaller specimens have fewer teeth, and that the only two specimens with six teeth were males.

Eggs and larva.—Eggs measure 0.9–1.0 mm long, and about 0.6 mm wide. One ovigerous female released larvae in the laboratory. Seven larvae were recovered swimming freely, but no attempts were made to raise them beyond the first stage. They were both preserved and stored in ethanol along with two eggs and another larva with half its body still in the egg case.

Description of zoea I.—Carapace subcylindrical (Fig. 6a), pterygostomian corner projected into acute spine, low bump on middorsal line, and angular projection proximal to depression at base of rostrum; latter, broadly triangular, pointed, directed downwards, shorter than, and somewhat hidden by ocular peduncles; eyes not covered by carapace.

Antennular peduncle with 3 segments. Antennal scale with 2 outer plumose setae, outer apical spine, and 9 plumose setae on inner and distal margins; endopod reaching to first inner seta on scale, entire, with one strong and one small apical seta. Maxillae and mandible buds present. All maxillipeds with well developed endopods and strong exopods, but setae present only on exopods.

First to fourth pairs of pereiopods biramous, without apparent segmentation, exopods without setae. Third and fourth pereiopods rudimentary, folded anteriorly against thorax. Fifth pair, long, turned forwards, uniramous, without setae.

Abdomen with sixth segment not clearly separated from telson. Pleopods absent. Uropods fused with telson. Telson (Fig. 6b), broad, bilobate, with 7 + 7 setae, outer 2 pairs feathered on inner side only, remaining 5 pairs plumose on both sides, innermost pair less than 0.25 as long as adjacent.

Ecology.—Most specimens of the new species, *S. williamsi,* came from internal canals of the midnight-blue sponge *Hymeniacidon caerulea.* In a few cases (<25%) we were not able to record the exact origin of our specimens, since they were found among debris in sampling containers. Only once did we collect a specimen (male) of *S. williamsi,* new species, from an unidentified orange encrusting sponge of tubular shape that was clearly different from *H. caerulea.*

Traces of blue in the gut of some specimens, and the anecdotal record in our field notes of a voided fecal pellet containing sponge spicules, are suggestive of a parasitic relation between the shrimp and the sponge.

Etymology.—It is an honor and pleasure to name this species after Dr. Austin B. Williams, National Oceanic and Atmospheric Administration, National Marine Fisheries Service Systematics Laboratory, National Museum of Natural History, Smithsonian Institution, Washington, D.C. This is in appreciation for his many important contributions to the knowledge of decapod crustaceans, and in recognition of his personal generosity and integrity.

Remarks.—*Synalpheus williamsi,* new species, is morphologically similar to *S. goodei* Coutière, but the following characteristics of the latter serve to distinguish the two species: the blade on the scaphocerite is more reduced, the pollex on the large chela is longer and without an accessory lateral emargination (best seen in ventral view), the small chela is more elongate, the distal margin of the telson is narrower, the lateral margin of the uropodal exopod has more fixed spines and has a noticeably stronger inner spine, adjacent to the movable one (see Coutière 1909, and Dardeau 1984). Also, unlike the new species, the first larva of *S. goodei* hatches at a more

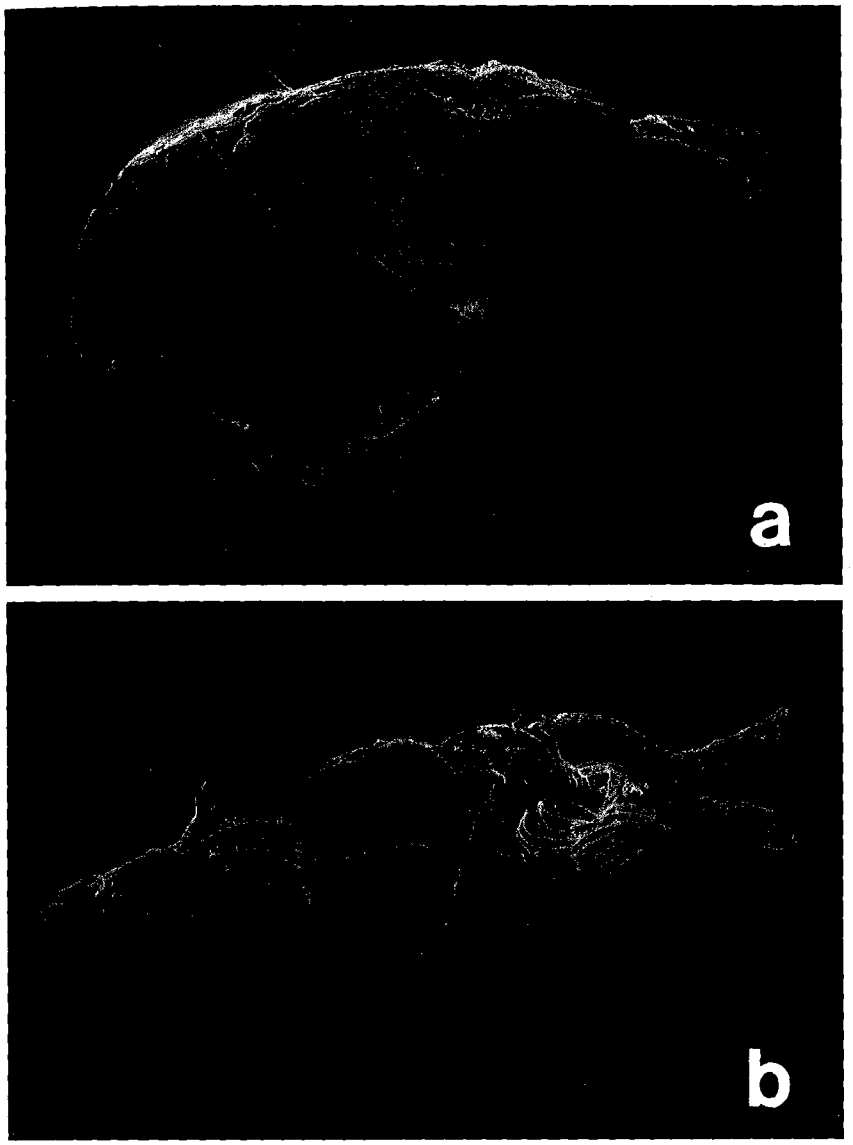

Fig. 6. *Synalpheus williamsi,* new species. Scanning electron micrographs of first zoea stage: a, lateral view; b, ventral view. Magnification = 71×.

advanced stage with both pairs of chelae and pleopods present (Gurney 1949).

Among the 12 species of *Synalpheus* whose first larva has been described or figured, the zoea I from the new species, *S. williamsi,* is most similar to that of *S. neomeris* (De Man, 1888), *S. triunguiculatus* (Paulson, 1875), *S. tumidomanus* (Paulson, 1875), and *S. scaphoceris* Coutière, 1910, but it can be readily distinguished by the acute projection of the pterygostomian corner; additionally, the first zoea of *S. scaphoceris* has the sixth abdominal somite clearly distinct (Dardeau 1986: fig. 3b). Lack of pleopods and chelae on the first pair of pereiopods is suggestive of a normal development pattern, i.e., not abbreviated nor direct as has been documented for other species of *Synalpheus* (see Knowlton 1973, and Bhuti et al. 1977).

As in the case of *S. gambarelloides* (Nardo, 1847), and probably *S. longicarpus* (Herrick, 1891), recorded by Rüetzler (1976) and Erdman & Blake (1987) respectively, the new species, *S. williamsi,* appears to be a parasitic endobiont of sponges; more careful observations on live specimens might provide conclusive evidence on its diet.

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Literature Cited

Bhuti, G. S., S. Shenoy, & K. N. Sankolli. 1977. Laboratory reared alpheid larvae of the genera *Automate, Athanas* and *Synalpheus* (Crustacea Decapoda, Alpheidae).—Proceedings of the Symposium on Warm Water Zooplankton. Special Publication, National Institute of Oceanography, Goa (India), Pp. 588–600.

Coutière, H. 1909. The American species of snapping shrimps of the genus *Synalpheus.*—Proceedings of the United States National Museum 36:1–93.

———. 1910. The snapping shrimps (Alpheidae) of the Dry Tortugas, Florida.—Proceedings of the United States National Museum 37:485–487.

Dardeau, M. R. 1984. *Synalpheus* shrimps (Crustacea: Decapoda: Alpheidae). I. The Gambarelloides Group, with a description of a new species.—Memoirs of the Hourglass Cruises 7(2):1–125.

———. 1986. Redescription of *Synalpheus scaphoceris* Coutière, 1910 (Decapoda: Alpheidae) with new records from the Gulf of Mexico.—Journal of Crustacean Biology 6:491–496.

De Man, J. G. 1888. On the podophtalmous Crustacea of the Mergui Archipelago.—Journal of the Linnean Society, Zoology 22:241–312.

Erdman, R. B., & N. J. Blake. 1987. Population dynamics of the sponge-dwelling alpheid *Synalpheus longicarpus,* with observations on *S. brooksi* and *S. pectiniger,* in shallow-water assemblages of the eastern Gulf of Mexico.—Journal of Crustacean Biology 7:328–337.

Gurney, R. 1949. The larval stages of the snapping-shrimp, *Synalpheus goodei* Coutière.—Proceedings of the Zoological Society of London 119: 293–295.

Herrick, F. H. 1891. *Alpheus*: A study in the development of Crustacea.—Memoires of the National Academy of Sciences, Washington 5: 370–463.

Knowlton, R. E. 1973. Larval development of the snapping shrimp *Alpheus heterochaelis* Say, reared in the laboratory.—Journal of Natural History 7:273–306.

Nardo, G. D. 1847. Sinonimia moderna delle specie registrate nell'opera intitolata: Descrizione de'Crostacei, de'Testacei e de'Pesci che abitano le lagune e golfo Veneto, rappresentati in figure, a chiaro-scuro ed a colori dall'Abate Stefano Chiereghini Ven. Clodiense. i–ix + 64 pp. in 128 columns.

Paulson, O. 1875. Podophtalmata i Edriophtalmata (Cumacea). Chast I in Izsledovaniya Rakoobraznykh krasnago morya s zametkami otnositel'no Rakoobraznykh drugikh morei. Kiev, 144 pp. [English translation: Por, F. D. 1961 Podophtalmata and Edriophtalmata (Cumacea). Part I in Studies on Crustacea of the Red Sea with notes regarding other seas. Jerusalem, Israel. 164 pp.]

Pulitzer-Finali, G. 1986. A collection of West Indian Demospongiae (Porifera). In appendix, a list of Demospongiae hitherto recorded from the West Indies.—Annali del Museo Civico di Storia Naturale "Giacomo Doria", Genova 86:65–216.

Rüetzler, K. 1976. Ecology of Tunisian commercial sponges.—Tethys 7:249–264.