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SHORT COMMUNICATION

NEW RECORDS FOR *CUBANOCUMA GUTZUI* BĂCESCU AND MURADIAN, 1977 (CRUSTACEA: CUMACEA: NANNASTACIDAE) FROM THE WESTERN ATLANTIC

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INTRODUCTION

The nannastacid cumacean genus *Cubanocuma* was erected by Băcescu and Muradian (1977) to accommodate a new, small species, *C. gutzui* Băcescu and Muradian, 1977, that was described from several specimens collected from six shallow water sites off the coast of Cuba. This little cumacean is distinctive and easily recognized by its a large and anteriorly truncated, nodulose carapace (Figure 1). The adult male holotype measured only 1.76 mm total length. The type locality is off Batabanó, Cuba (22º70'N, 81º80'W), 3 m depth, from "muddy sand with *Thalassia*" (Băcescu and Muradian 1977:8). In addition to the type locality, Băcescu and Muradian (1977:3) reported the species from "in front of Havana" and from Ana María Gulf, in depths ranging from 6 to 12.5 m. The substrata types from habitats where specimens were collected included "muddy sand with coral scraps," "rough sand with *Thalassia*," and "spongiae." Băcescu (1992), in the *Crustaceorum Catalogus*, maintained that the only record was that of the type. Apparently, Băcescu (1992) was unaware of a report for the genus from Bermuda by Markham and Sterrer (1986, in Sterrer 1986). Markham and Sterrer (1986:362) reproduced some of the original figures for *C. gutzui* from Băcescu and Muradian (1977) and also provided a brief rewritten synopsis of the diagnostic characters (1986:364). They believed their Bermuda specimens to be the same or a very similar species, referring to "*Cubanocuma* cf. *gutzui*," and reporting it as "not uncommon" on "silty bottoms in inland seawater caves" (Markham and Sterrer 1986). Later, Petrescu and Sterrer (2001) illustrated material also referred to "*Cubanocuma* cf. *gutzui*," which they considered synonymous with *Campylaspis cousteaui* Petrecsu, 1990, a species also described from Bermuda. They ambiguously listed *C. gutzui* Băcescu and Muradian, 1977, and *C. cousteaui* as synonyms under *C.* cf. *gutzui.* Iorgu Petrescu (Museum d'Histoire naturelle "Grigore Antipa," Romania) and W. Sterrer (Bermuda Aquarium Natural History Museum and Zoo, Bermuda) in personal communications with one of the authors (JWM) have confirmed that the Bermudan material did, in fact, represent true *Cubanocuma gutzui* Băcescu and Muradian, 1977 (=*Campylaspis cousteaui* Petrescu, 1990).

There are some additional published reports from Caribbean and Bahamian waters. In the Caribbean *C. gutzui* has been recorded as *Campylaspis cousteaui* Petrescu, 1990, from Jamaica (Petrescu et al. 1993) and Honduras (Petrescu 2003). In the Bahamas it was reported from Abaco, Andros, and Exuma (Petrescu 1996, 2003).

Because the original description and many subsequent records for *C. gutzui* have appeared in a Romanian journal, Travaux du Muséum d'Histoire naturelle "Grigore Antipa," which has limited distribution in the west, many workers studying tropical western Atlantic crustaceans still remain unaware of both the genus and species. Also, the species may have gone unrecognized (recorded as an odd specimen of *Campylaspis*, for instance) or may have been overlooked because of its small size. As part of an ongoing survey of the marine invertebrates of Guana Island, British Virgin Islands (BVI) (led by T.L. Zimmerman and J.W. Martin), numerous specimens of this nannastacid species were collected extending the known range eastward to the BVI. At the same time, the examination of other regional collections by two of us (RWH, TJH) established the presence of this species in Southeast Florida and the Gulf of Mexico (GOM), and we have found additional material from the southern Bahamian region and the northern Caribbean. In this note, we list the known occurrences of *Cubanocuma*, comment on the habitat, and mention certain morphological features observed from scanning electron microscopy (SEM).

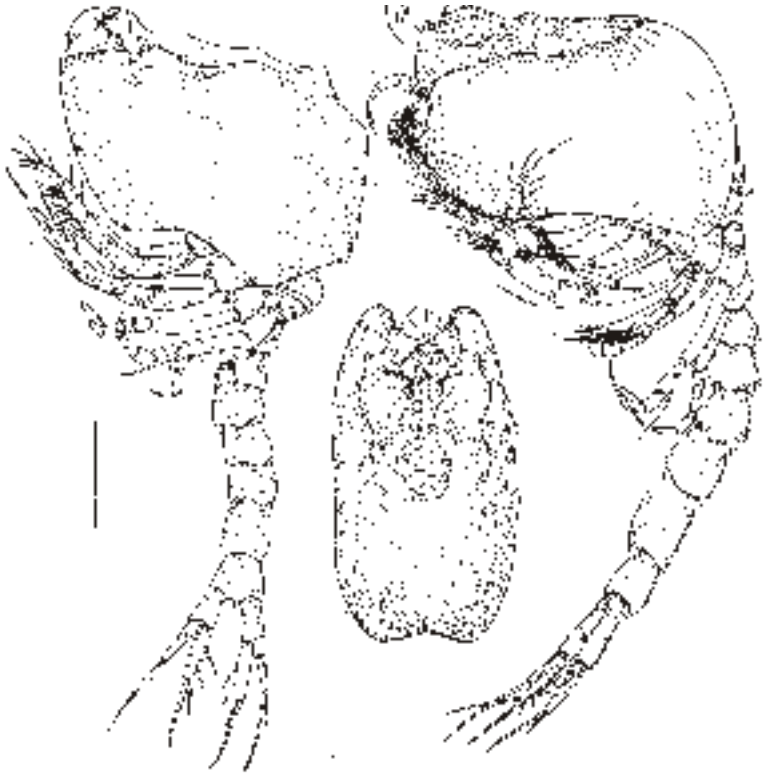

Figure 1. ***Cubanocuma gutzui*** **Băcescu and Muradian, 1977. From left to right. Female, lateral aspect; male, dorsal view of carapace; male, lateral aspect . Modified slightly from Băcescu and Muradian 1977:4 (Figure 1). Scale = 0.2 mm.**

MATERIALS AND METHODS

Most of the specimens from Florida and the GOM resulted from NOAA or EPA surveys, and vouchers and sorted material were often retained by these agencies. These records come from the personal laboratory notes of T. Hansknecht. Specimens from the BVI are housed at the Natural History Museum of Los Angeles County. Specimens from Bermuda are catalogued in the Bermuda Aquarium and Museum of Zoology. Specimens from South Florida, Florida Middle Ground, Turks and Caicos, and Grand Cayman are housed in the Gulf Coast Research Laboratory, Ocean Springs, MS.

RESULTS

Taxonomy

Order Cumacea Krøyer, 1846

Family Nannastacidae Bate, 1866

Genus *Cubanocuma* Băcescu and Muradian, 1977

Cubanocuma gutzui **Băcescu and Muradian, 1977:3–9 (Figures 1–3)**

Synomyms. *Cubanocuma gutzui***,** 1977:3–9 (Figures 1–3); Ortiz and Lalana 1988:15; Petrescu and Sterrer 2001:195–196 (Figures 2–11); Petrescu 2003:121; 2004:90.—*Cubanocuma* cf. *gutzui*: Markham and Sterrer 1986:362 (Plate 120), 364; Petrescu and Sterrer 2001:95–96 (Figures 2–11).—*Campylaspis cousteaui* Petrescu, 1990:9–12 (Figure 1); Petrescu and Sterrer 2001:95–96 (Figure 2–11*)*; Petrescu et al. 1994:392 (Figure 11)-393; Petrescu 1996:158, 160, 161 (Figure 2**).**

Diagnosis. (modified from Băcescu and Muradian 1977). Nannastacidae. Body small, compact, length 1.5–2.0 mm. Carapace relatively large, deep, covering part of free thoracic segments; eye lobe prominent, especially in male; fronto-pseudorostral line short, sinuous, nearly transverse. Antenna of male with peduncular article 5 slightly longer than article 4; flagellum short, not extending much beyond carapace, articles bearing numerous aesthetascs. Maxillipeds 1–3 similar to genus *Campylaspis*. Exopods present on thoracopods 3–6 (maxilliped 3, legs 1–3) of male and thoracopods 3–5 (maxilliped 3, legs 1–2) of female.

Remarks. Only one other Northwest Atlantic species, *Normjonesia danieli* Petrescu and Heard, 2002, presently known only from the mid-Continental Shelf (88 m) off southwestern Florida, appears superficially similar to *C. gutzui*. *Normjonesia danieli*, which like *C. gutzui* belongs to a monotypic genus, appears to be a deeper water

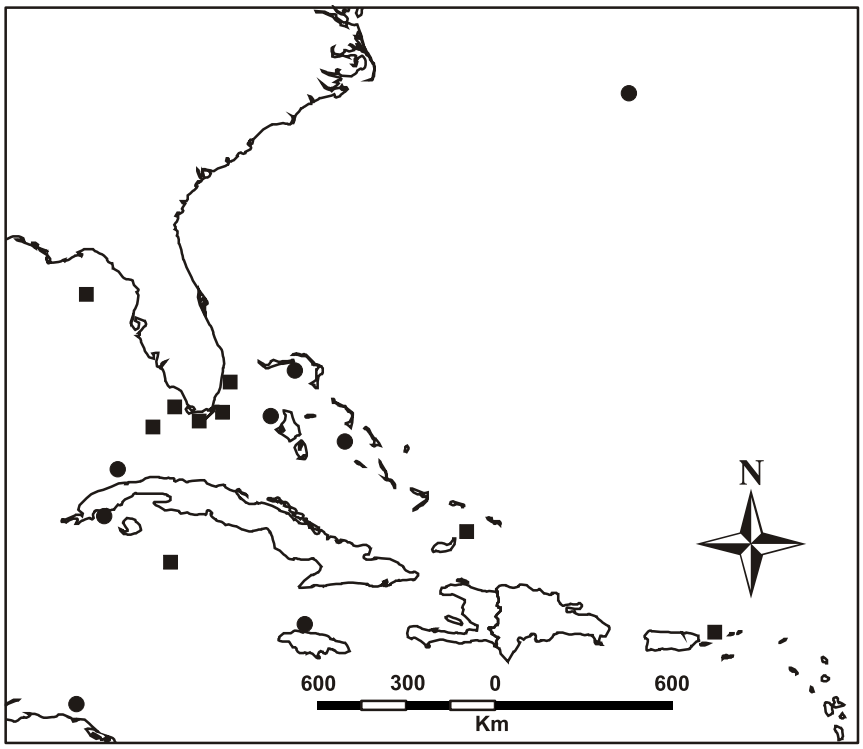

Figure 2. Map showing the general distribution of *Cubanocuma gutzui*. Black circles represent previously published records and squares indicate new distribution locations.

species. Morphologically it can be distinguished from *C. gutzui* by having 1) a more prominent, upturned pseudorostrum, 2) strong spines on the carapace, 3) exopods absent on the female, and 4) 5 pairs of exopods present on the male (Petrescu and Heard 2001).

New Records for *Cubanocuma gutzui* from the Northwest Atlantic (see Figure 2)

USA

Florida/ Port Everglades.—15 specimens from shallow reef, *Acropora cericornis* rubble, 26º09.63'N, 80º05.412'W, 6–7 m. Collection made as part of artificial substratum study conducted by Judy Roberts, Nova Institute of Marine Science.

Florida/Biscayne Bay. NOAA.—1 spec., Sta. 162, 25º79.30'N, 80º18.00'W, 4.6 m, 7 Jun 1996.—3 spec., Sta. 175, 25º78.60'N, 80º14.70'W, 4.0 m, 5 Jun 1996.—1 spec., Sta. 181, 25º71.10'N, 80º21.40'W, 2.7 m, 29 Jun 1996.—1 spec., Sta. 183, 25º69.70'N, 80º19.90'W, 3.5 m, 29 Jun 1996.—3 spec., Sta. 188, 25º60.60'N, 80º22.50'W, 2.7 m, 29 Jun 1996.—1 spec., Sta. 198, 25º61.20'N, 80º22.60'W, 2.4 m, 26 Jun 1996.—20 spec., Sta. 216, 25º40.40'N, 80º26.90'W, 1.5 m, 25 Jun 1996.—7 spec., Sta. 218, 25º34.20'N, 80º30.00'W, 2.4 m, 25 Jun 1996.

Florida Keys. EPA.—1 spec., Sta. KWS, 24º27.20'N, 81º52.70'W, 7 m, live bottom, 3 Nov 1994.—6 spec., Sta. KWR, 24º32.00'N, 81º49.45'W, 7–10 m, 80% sand substratum, 3 Nov 1994.—6 spec., Sta. KWT, 24º32.00'N, 81º48.80'W, 7–10 m 82%, sand substratum, 3 Nov 1994.

Florida Keys/Dry Tortugas. NOAA.—1 spec., Sta. 163, 24º42.260'N, 83º41.019'W, 63 m, shell/rock substratum, 4 Aug 1999.—1 spec., Sta. 134, 25º13.590'N, 81º56.246'W, 16 m, sand/shell substratum, 9 Aug 1999.

Florida/adjacent Southeast GOM. NOAA.—1 spec., Sta. MR04, 24º70.42'N, 81º57.15'W, 1.1 m, 8 Sep 1994.—1 spec., Sta. MR04, 24º70.45'N, 81º57.15'W, 1.5 m, 29 Aug 1996.—1 spec., Sta. MR36, 25º33.60'N, 81º34.63'W, 5.4 m, 1 Sep 1994.—1 spec., Sta. MR36, 25º33.76'N, 81º34.52'W, 6.0 m, 30 Aug 1995.—1 spec., Sta. MR37, 25º05.40'N, 81º57.10'W, 9.6 m, 8 Sep 94.—1 spec., Sta. WI96LR36, 24º91.45'N, 81º11.53'W, 4.1 m, 15 Aug 1996.—1 spec., Sta. WI96LR40, 24º87.40'N, 80º79.67'W, 2.5 m, 13 Aug 1996.—6 spec., Sta. WI96LR43, 24º85.14'N, 80º85.90'W, 2.1 m, 13 Aug 1996.—4 spec., Sta. WI97LR50, 23º77.10'N, 81º03.25'W, 2.0 m, 19 Aug 1997.—7 spec., Sta.WI97LR51, 24º76.22'N, 81º11.77'W, 2.4 m, 13 Aug 1997.

Florida Middle Ground (FMG). Northeast GOM, [28º–29ºN, 84º–84º25'W]. Minerals Management Service sponsored study.—4 ♀♀, FMG III, Habitat 3.—2 ♂♂, 10

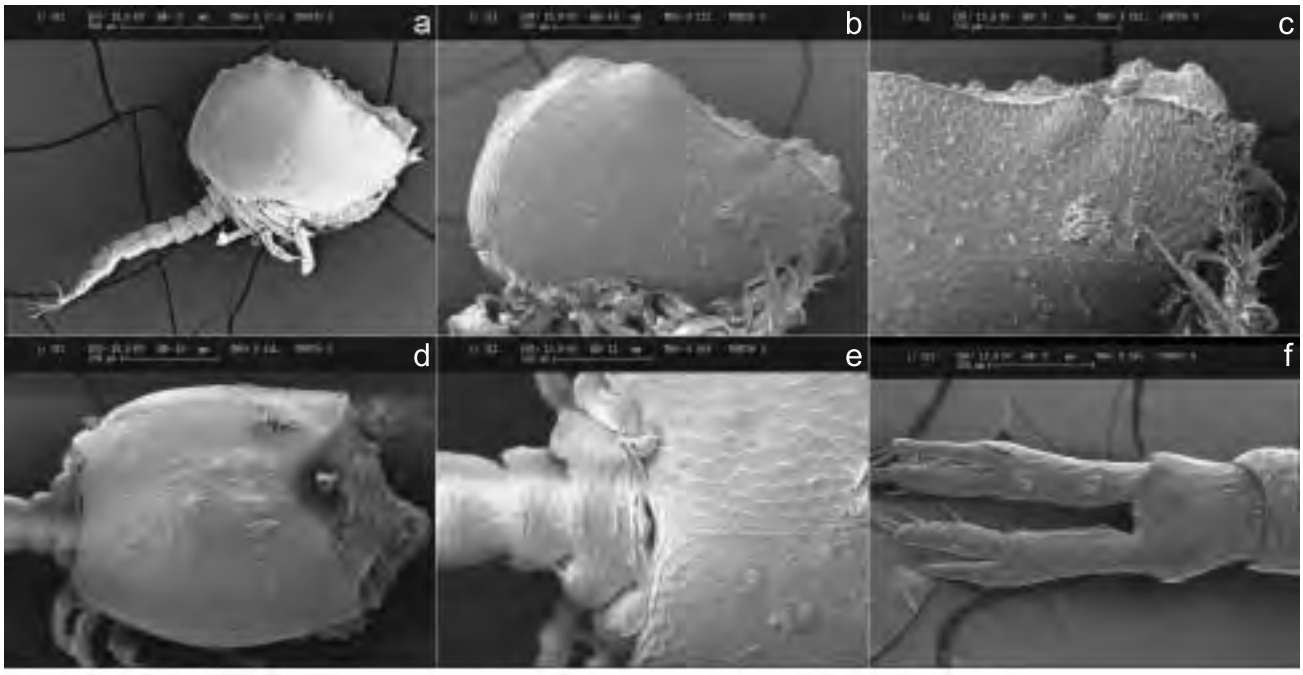

Figure 3. ***Cubanocuma gutzui*** **Băcescu and Muradian, 1977. SEM views of selected morphological features. Lateral aspect, a–c; a, entire specimen; b, enlargement of carapace; c, further enlargement of carapace showing anterior region (tuberculation of ocular and rostral areas). Dorsal aspect, d–f; d, view of entire carapace; e, enlargement of posterior part of carapace indicating presence of a mid-dorsal suture; f, last abdominal segment and uropods.**

♀♀, 7 juvs., FMG III, Habitat 5.—1 ♂, 2 ♀♀, FMG III, Habitat 7.—2 ♂♂, 7 ♀♀, FMG III, Habitat 9.—1 ♂, 7 ♀♀, 5 juvs., FMG III, Habitat 10.—1 ♂, 7 ♀♀, FMG 1V, Habitat 5.—21 spec., FMG III, Habitat 8.—10 specs., FMG III, Habitat 10.

The FMG collections were made during 1978 and 1979. Two other nannastacid cumaceans, *Cumella garrityi* Băcescu and Muradian, 1977 and *Campylaspis heardi* Muradian, 1880, co-occurred with *C. gutzui* in the diver-deployed and retrieved artificial habitats (see description in Modlin 1984) from the FMG.

Caribbean Sea

Guana Island, BVI. About 30 specimens from different shallow water (≤ 10 m) localities around this small island were collected. Most of the specimens examined for this report came from Station 12, Vc0944, of the Zimmerman and Martin survey, for which the collecting data are: Long Point, about 70 m southeast of dock (18º29.153'N, 64º34.971'W), above crest of reef, in more protected area in furrow on the bottom, covered with fine algae growing on small pebbles. Collected by T. Zimmerman and G. Hendler, 5 Jul 2000, depth about 3.5 to 4.5 m. The covering of algae was dominated by *Amphiroa fragilisima* with interwoven *Spyridia*, *Centroceras*, *Griffithsia lobifera*, and *Gelidium pusillum*.

Grand Cayman, Cayman Islands.—18 spec., 29 Aug 1996.—29 spec., 1 Sep 1996.—4 spec., between fringing reef and "The Edge" south shore, depth ~1 m, carbonate rock washings 23 May 1998 (see map in Price et al. 2002).

Pine Cay, Turks and Caicos.—3 females, Rack Cay, Caicos Banks about 1 km east of Pine Cay (refer to map in Schotte et al. 1991), rock washings, ~1 m depth, 12 Apr 1988.

COMMENTS

Morphology

Female specimens from Guana Island were examined using SEM (Figure 3) and agreed strongly with the original description (Băcescu and Muradian 1977). With the use of SEM, we confirmed many of the fine details mentioned in their text and illustrations, including such features as the minute sculpturing and scales on the carapace and appendages. One feature not depicted or mentioned in their account is the fine suture line extending along the dorsal midline of the carapace (Figure 3).

Habitat and Distribution

Based on the information collected during this study, the genus *Cubanocuma* is widely distributed in the shallow

waters of the American Mediterranean, i.e., Bermuda, Bahamas, South Florida, GOM, and northeastern and northwestern Caribbean. Based on the above observations, and assuming that all known records of the genus are of the same species (*C. gutzui*), the microhabitat varies widely as well. Although the species was originally reported from Cuba from muddy sand, Markham and Sterrer (1986) reported it from "silty bottoms in inland seawater caves" where they stated that it was "not uncommon." One of us (RWH) recently (Aug 2004) collected specimens from rock washings at a depth of about 1 m at the opening of Harrington Sound, Bermuda. This species has been found associated with algal mats and sponges on Grand Cayman and Pine Cay (R. Heard, pers. obser.). Most of the specimens from Guana Island came from a relatively protected area containing gravel covered by a layer of fine algae. Thus, it appears that *C. gutzui* thrives in a variety of shallow, warm water habitats, and therefore one might expect to encounter this species on or adjacent to shallow, live bottom habitats having carbonate sediments in many areas within the American Mediterranean.

ACKNOWLEDGMENTS

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LITERATURE CITED

Băcescu, M. 1992. Part 8. Cumacea II (Fam. Nannastacidae, Diastylidae, Pseudocumatidae, Gynodiastylidae et Ceratocumatidae). In: Gruner, H.E. and L.B. Holthuis, eds. Crustaceorum Catalogus, SPB Academic Publishing, The Hague. p. 175–468.

Băcescu, M. and Z. Muradian. 1977. *Cubanocuma gutzui* gen. et sp. n. (Cumacea, Nannastacidae) from the tropical western Atlantic.Revue Roumaine de Biologie Série de Biologie Animale 22(1):3–9.

Markham, J.C, and W. Sterrer. 1986. Order Cumacea. In: W. Sterrer, ed. Marine Fauna and Flora of Bermuda. John Wiley & Sons, New York, NY, USA, p. 362–364.

Modlin, R.F. 1984. Mysidacea from the Florida Middle Ground, northeast Gulf of Mexico, with descriptions of three new species of *Heteromysis* and a key to the Heteromysini of the western Atlantic. Journal of Crustacean Biology 4:278–297.

Ortiz, M. and R. Labrana R. l988. Lista de especies y bibliografía de los crustáceos de Cuba. II. Cirripedia, Phyllocarida, Pancarida, Mysidacea, Tanaidacea y Cumacea Revista de Investigaciones Marinas 9(2):11–19.

Petrescu, I, 1996. Cumacean (Crustacea: Cumacea) from Abaco Island (Bahamas). Travaux du Muséum d'Histoire naturelle "Grigore Antipa" 36:157–183.

Petrescu, I. 2003. Cumacea (Crustacea: Peracarida) from western tropical Atlantic. Travaux du Muséum d'Histoire naturelle "Grigore Antipa" 45:117–128.

Petrescu, I. 2004. New mentions of cumaceans (Crustacea: Cumacea) in Cuba. Travaux du Muséum d'Histoire naturelle "Grigore Antipa" 47:89–95.

Petrescu, I. and W. Sterrer. 2001. Cumacea from the shallow waters of Bermuda. Annalen der Naturhistorisches Museum Wien 103B:89–128.

Petrescu, I., T.M. Iliffe, and S. Sarbu. 1993. Contributions to the knowledge of Cumacea (Crustacea) from the littoral waters of Jamaica Island, including the descriptions of three new species. (I). Travaux du Muséum d'Histoire naturelle "Grigore Antipa" 33:373–395.

Petrescu, I. and R.W. Heard. 2001. *Normjonesia danieli*, a new genus and species of nannastacid cumacean (Malacostraca: Peracarida) form the Southwest Florida Continental Shelf. Journal of Crustacean Biology 21(2):469–474.

Price, W., R.W. Heard, J.T. Harris, and C.M.R. McCoy. 2002. Crustacea of the Cayman Islands, British West Indies. I. Records of mysids from shallow water non-reef habitats. Gulf and Caribbean Research 15:35–52.

Schotte, M., R.W. Heard, and B. Kensley. 1991. Studies on the Crustacea of the Turks and Caicos Islands, British West Indies. III. Records of marine Isopoda from Pine Cay, Fort George Cay, Water Cay, and adjacent waters. Gulf Research Reports 8:251–257.

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