BULLETIN OF MARINE SCIENCE, 51(2): 204–217, 1992

GEODIA CORTICOSTYLIFERA (DEMOSPONGIAE, PORIFERA) NEW ASTROPHORID FROM THE BRAZILIAN COAST (SOUTHWESTERN ATLANTIC)

Eduardo Hajdu, Guilherme Muricy, Marcio Custodio, Claudia Russo and Solange Peixinho

ABSTRACT

A new species of *Geodia, G. corticostylifera,* is described from the Cabo Frio Region at the southwest Atlantic. An in situ population study allowed a detailed description of the species. The new species is distinguished from its closest relative, *G. neptuni,* by the presence of a category of cortical styles. A discussion, in which the new species is compared with all the tropical west Atlantic species of *Geodia,* is given, as well as a key to the Brazilian species of the genus.

Brazilian marine sponges are poorly known. An important part of this knowledge is owed to several foreign oceanographic expeditions (CHALLENGER: Poléjaeff, 1884; Ridley and Dendy, 1887; Sollas, 1888. CALYPSO: Boury-Esnault, 1973. FOSTER/LABOREL: Hechtel, 1976, 1983), which have collected sponges principally by dredging our continental shelf. It is easily ascertained that most of these species are not comprehensively described, in the absence of a population approach as well as direct observation in the field. Due to the cryptic habit of many sponge species, which renders them inaccessible to indirect methods of collecting, a greater part of the Brazilian marine sponges remains unknown. This is an important gap in the worldwide knowledge on the biogeography of marine sponges.

Arraial do Cabo, located at the Cabo Frio Region in southeastern Brazil (23°S, 42°W; fig. 1), is a remarkable location by the occurrence of a coastal upwelling phenomenon. Next to an inner shallow tropical bay (mean water temperature normally above 22°C due to the presence of a large shallow sandy bottom, 1 to 9 m deep, with high insolation), there is a subtropical rocky-coast (temperature may be as low as 12°C) running down to 50–70 m depth, and separated from the former by a narrow passage between Cabo Frio Island and the continent (Laborel, 1967; Yoneshigue, 1985).

Sixty species of sponges have been listed for Arraial do Cabo (Muricy et al., 1991). The present paper describes one new species of *Geodia* (*Geodia* n.sp.; Muricy et al., l.c.). Our objectives are to furnish a complete description of the species, with a comparison to other western tropical Atlantic records of *Geodia.*

MATERIALS AND METHODS

Specimens were studied by SCUBA diving during an ecological survey in Arraial do Cabo (Muricy, 1989; Muricy et al., 1991). Extensive population studies were undertaken to ascertain the variability limits of the species. Collected specimens are deposited at the collections of the Laboratório de Poríferos, from the Universidade Federal do Rio de Janeiro (UFRJPOR). Schizotypes were sent to the United States National Museum (USNM), Natural History Museum, London (BMNH) and Zoological Museum of Amsterdam (ZMA). Material from other localities along the Brazilian Coast and the Caribbean, deposited in Rio de Janeiro or in other collections (BMNH, USNM and ZMA; plus the Muséum National d'Histoire Naturelle, Paris, MNHN), have been studied to establish a better characterization of the species in a geographical scale.

Localities from which material was studied are given in Figure 1.

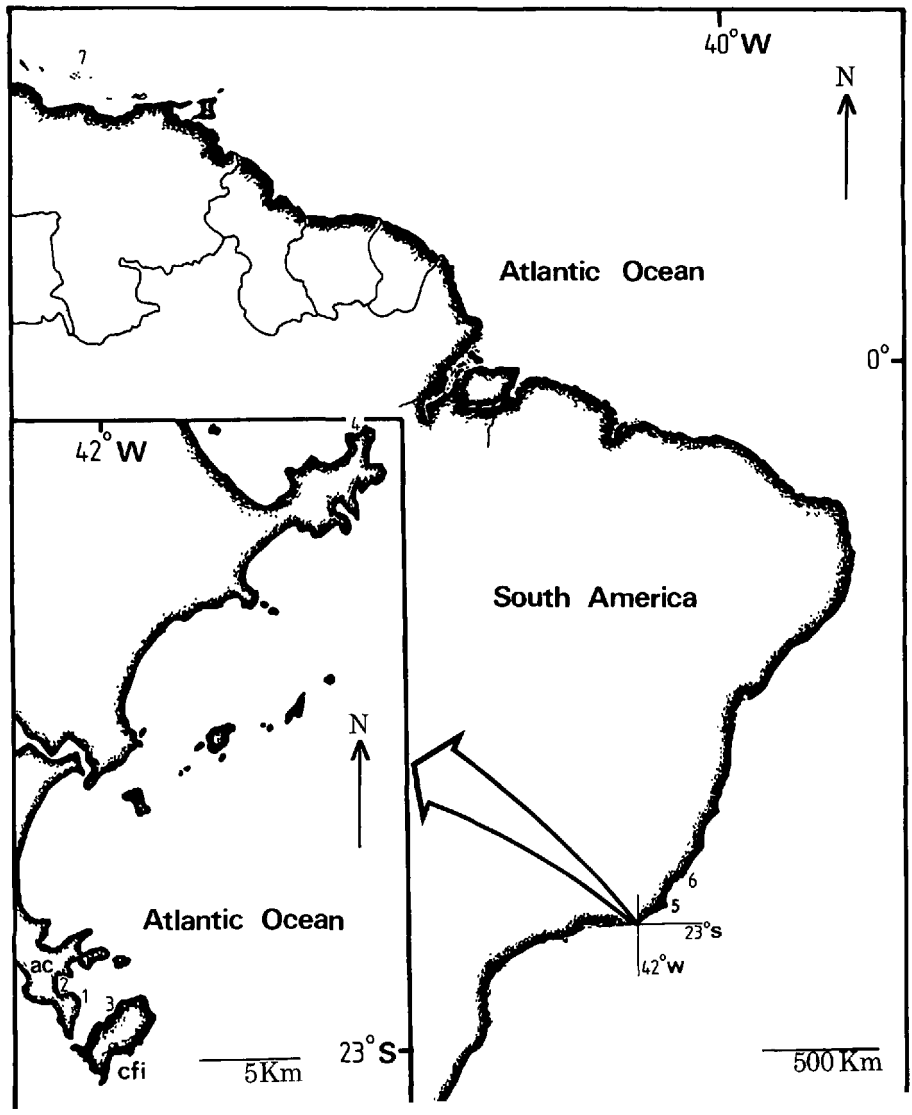

Figure 1. Map of South American Tropical Atlantic Coast with the Cabo Frio Region in detail. 1. Enseada. 2. Praia dos Anjos. 3. Pedra Vermelha. 4. Praia de João Fernandes. 5. Cabo de São Tomé (Calypso Stn. 100.6). 6. Três Ilhas. 7. Los Roques archipelago. "ac." Arraial do Cabo. "cfi." Cabo Frio Island.

Systematic Description

Class Demospongiae Sollas, 1885
Order Astrophorida Lévi, 1973
Family Geodiidae Gray, 1867

Diagnosis.—Astrophorida with triaenes bearing long rhabds and sterrasters in a cortical armor; generally massive and frequently brownish-grey or purplish at the surface (Lévi, 1973: 595).

Genus *Geodia* Lamarck, 1815

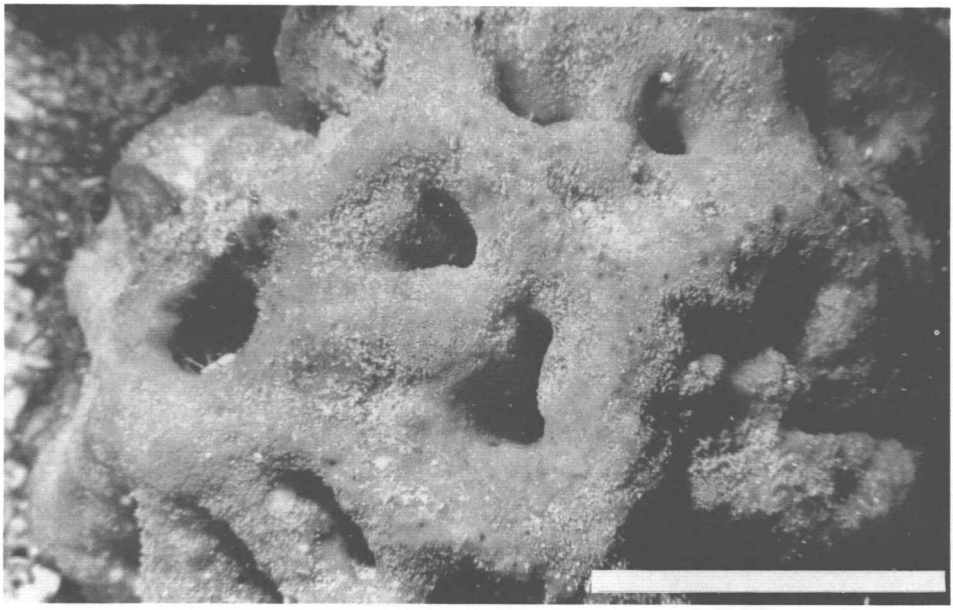

Figure 2. Underwater photograph of a *Geodia cortycostylifera* n.sp. specimen in situ. Scale = 5 cm.

Diagnosis.—Geodiidae with cortical sterrasters and spherasters, and among the megascleres, subcortical orthotriaenes (Van Soest and Stentoft, 1988: 12).

Geodia corticostylifera new species
Figures 2–4; Plate 1

Geodia vosmaeri, Boury-Esnault, 1973:269, fig. 7; Hechtel, 1976:244, 255 and 256 (non *G. vosmaeri* (Sollas, 1888) = *G. neptuni* (Sollas, 1888)).

Type Material.—Holotype. UFRJPOR 3098, Enseada (22°58′48″S, 42°00′36″W; Arraial do Cabo, Rio de Janeiro State; fig. 1, 1) 8 m depth, coll. E. Hajdu, 07/12/86. Paratypes. UFRJPOR 2625, Praia dos Anjos (fig. 1, 2), 3 m depth, coll. E. Hajdu, 15/11/87; UFRJPOR 2906, Pedra Vermelha (fig. 1, 3), 10/05/87; UFRJPOR 3091, Enseada (fig. 1, 1), 06/12/86 (all three from Arraial do Cabo, Rio de Janeiro State); UFRJPOR 3714, Praia de João Fernandes (Búzios, Rio de Janeiro State; fig. 1, 4); 3 m depth, coll. E. Hajdu.

Additional Material.—UFRJPOR 3364 (fragment from MNHN-LBIM-D-NBE 992), 22°12′S, 40°59′W, CALYPSO St. 100.6 (fig. 1, 5), 39 m depth (Boury-Esnault, 1973; as *G. vosmaeri*); UFRJPOR 3815 and 3816 (slides only), 20°36′S, 40°23′W (Três Ilhas, Guarapari, Espírito Santo State; fig. 1, 6) coll. A.M. Solé-Cava (field codes G-20 and G-45, respectively); ZMA 5338 (fragment), Los Roques (Venezuela; fig. 1, 7), 25 m depth (Alvarez and Díaz, 1985; field code, sp. A-22).

Material Studied for Comparison.—*G. neptuni* (Sollas, 1888): UFRJPOR 3728 (fragment from holotype, BMNH 1889:1:1:88), 09°09′S, 34°53′W (off the coasts of Pernambuco/Alagoas States), 58 m depth, red mud; UFRJPOR 3479 (fragment from BMNH 1889:1:1:90), 09°05′S, 34°50′W (off Barra Grande, Alagoas State), 634 m depth, red mud (Sollas, 1888; as *Synops vosmaeri*): UFRJPOR 3363 (fragment from MNHN-LBIM-D-NBE 957), 07°29′S, 34°30′W, CALYPSO St. 1, 45 m depth (Boury-Esnault, 1973); UFRJPOR 3817 (fragment from USNM 30289), Bimini (Bahamas), 15 m depth (Wiedenmayer, 1977); UFRJPOR 3737 (fragment from USNM 34051), 01°40′00″N, 47°55′00″W (off the mouth of the Amazon River), 63 m depth (Collette and Rützler, 1977).

Description (Fig. 2).—Specimens are massive-globose, cerebriform, normally bearing deep grooves at the surface. The holotype (largest specimen) covered an area of more than 60 cm^2 and was 6 cm high. Consistency is firm. Color alive is orange externally and beige internally, turning to a pale yellow in alcohol.

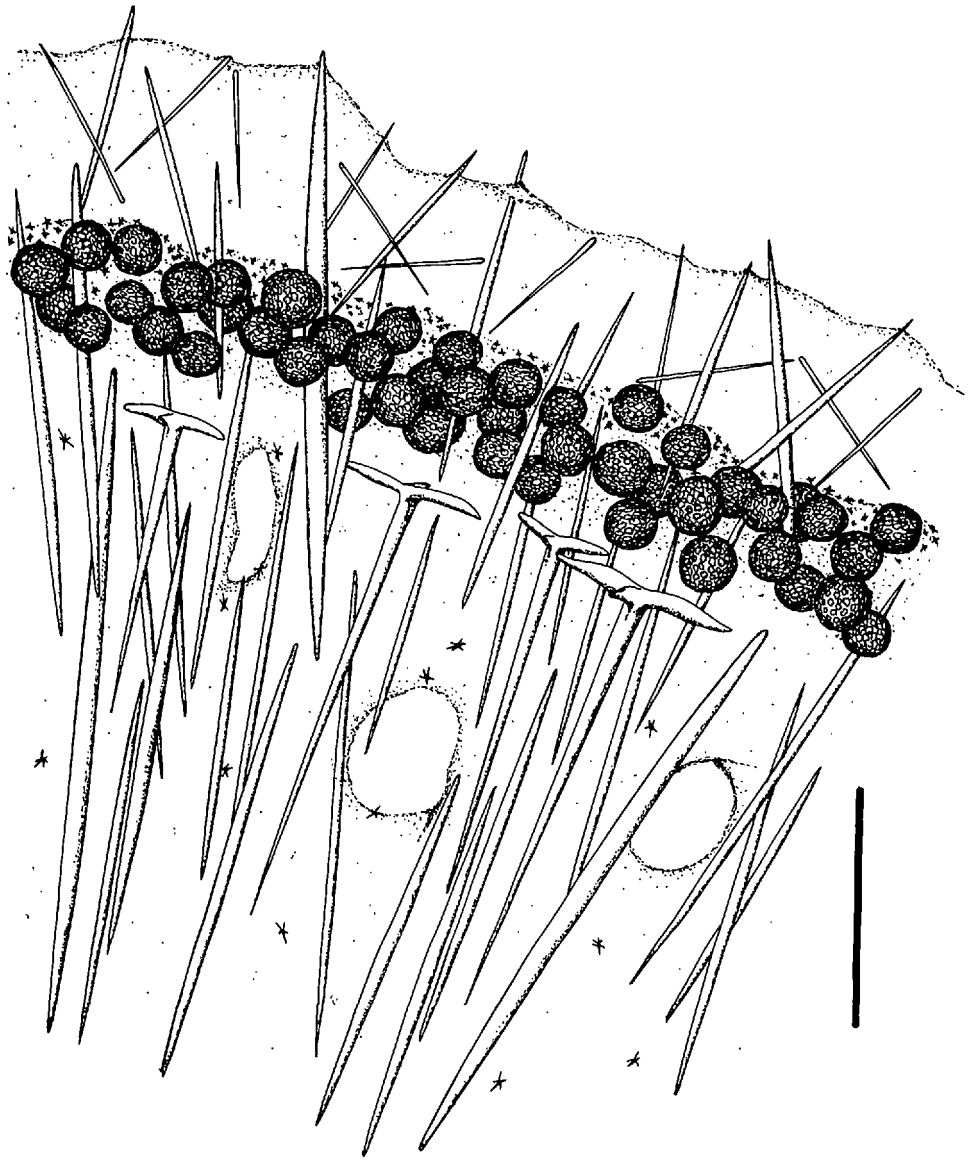

Figure 3. Schematic representation of the skeleton arrangement of *Geodia cortycostylifera* n.sp. The amount of oxeas drawn is much smaller than reality to allow clearer exposition of spicule distribution patterns. Scale = 500 μm.

The surface is minutely hispid, with or without abundant wrinkles. Oscula are approximately 1 mm in diameter, abundant inside some of the calyciform-like grooves of the surface.

Skeleton (Fig. 3).—There is a three-layered cortical skeleton. The upper layer is formed by great amounts of irregularly arranged cortical styles and is characterized by intense pigmentation (alive). The other two layers are collagen-rich. The intermediate one can have large groups of sterrasters which can form a dense layer, decreasing in density towards the interior of the grooves. Large amounts of small

oxyasters (called chiasters by many authors), sometimes forming a well discernible layer, are found among the packed sterrasters groups. The inner layer (between the cladomes of the orthotriaenes and the sterrasters layer) is poor in spicules. The whole cortex is supported by the cladomes of radially arranged orthotriaenes. The cladomes sometimes protrude into the inner layer of the cortex, sometimes are just below it, with the rhabds deeply inserted in the choanosome. Dense radially disposed bundles of large oxeas cross the entire cortex, masking the presence of the cortical styles, sometimes protruding beyond the surface of the sponge. The choanosomal skeleton is formed by large amounts of densely packed large oxeas, radially or confusedly distributed. Between these, there are many canals of the aquiferous system, lined by randomly distributed oxyasters.

Spicules (Fig. 4A–P; Pl. IA–F; Table 1).—MEGASCLERES. Cortical styles (Fig. 4H): Extremely slender or variably robust. Normally bent near the middle part. Dimensions: 231–*404*–515 (SD = 58.7)/3.8–*7*–11.3 μm (SD = 1.7) (N = 100). Subcortical orthotriaenes (Fig. 4I–K): Rather variable in shape and size. Slender or robust. Dimensions: 372–*801*–1,116 (SD = 166)/11.3–*17.2*–25 (SD = 3.8)/cladi 32.5–149–245 μm (SD = 42.5) (N = 100). Choanosomal oxeas (Fig. 4A–G): Extremely variable in shape and size. Slender or robust; straight, variably bent or sinuous, but with no apparent distinct categories. Occasionally styles, styloids or strongyloxeas can be seen. Dimensions: 335–*1115*–2034 (SD = 202)/5.5–*19.6*–33.8 μm (SD = 5.3) (N = 140).

MICROSCLERES. Sterrasters (Fig. 4L, M; Pl. IA, B): Round, sometimes irregularly rounded, spiny developmental forms can be present. Dimensions: 20–*39.8*–50 μm (SD = 6.1) (N = 100). Large oxyasters (mainly concentrated in the choanosome) (Fig. 4N, O; Pl. IC, D): Number of rays variable, between 4 and 10. If ray number is high, they can be confused with the smaller sterraster developmental forms. Confusion can also be made between the smaller choanosomal oxyasters and the cortical ones. Dimensions: 11.3–*17.6*–25 μm (SD = 3.2) (N = 100). Small oxyasters (concentrated in the cortex) (Fig. 4P; Pl. IE, F): Rays (7–12), with terminations variably rounded. Dimensions: 5–*6.8*–8 μm (SD = 0.8) (N = 100).

Etymology.—The name *corticostylifera* refers to the presence of a category of styles in the cortex of the new species.

Ecology.—Dozens of specimens were seen during the ecological survey at Arraial do Cabo. Specimens can be almost totally buried in the sediment at photophilous habitats or be hanging from the roofs of small caves. Sometimes great numbers of ophiuroids can be found in the calyciform grooves of the surface of this species. It is known to occur from 3 to 39 m depths.

Distribution.—Southeastern Brazilian coast and Venezuela.

Discussion.—COMPARISON WITH OTHER BRAZILIAN RECORDS OF *GEODIA*. Six *Geodia* species have been reported for the Brazilian Coast: *G. gibberosa* Lamarck, 1815 (De Laubenfels, 1956 and Hechtel, 1976); *G. neptuni* (Sollas, 1886) (Sollas, 1886; 1888, as *Synops neptuni* and *S. vosmaeri*; Boury-Esnault, 1973; Hechtel,

→

Figure 4. Schematic representation of the spicule complement of *Geodia cortycostylifera* n.sp. A. Small oxea. B. Huge oxea. C, D. Possible terminations of the oxea. E, F. Malformed oxea. G. Intermediary sized oxea. H. Cortical style. I. Underneath view of an orthotriaene cladome. J, K. Orthotriaenes. L. Fully grown sterraster. M. Sterraster developmental stage. N. Fully grown choanosomal oxyaster. O. Developmental stage of choanosomal oxyaster. P. Cortical oxyaster. Scales are in μm.

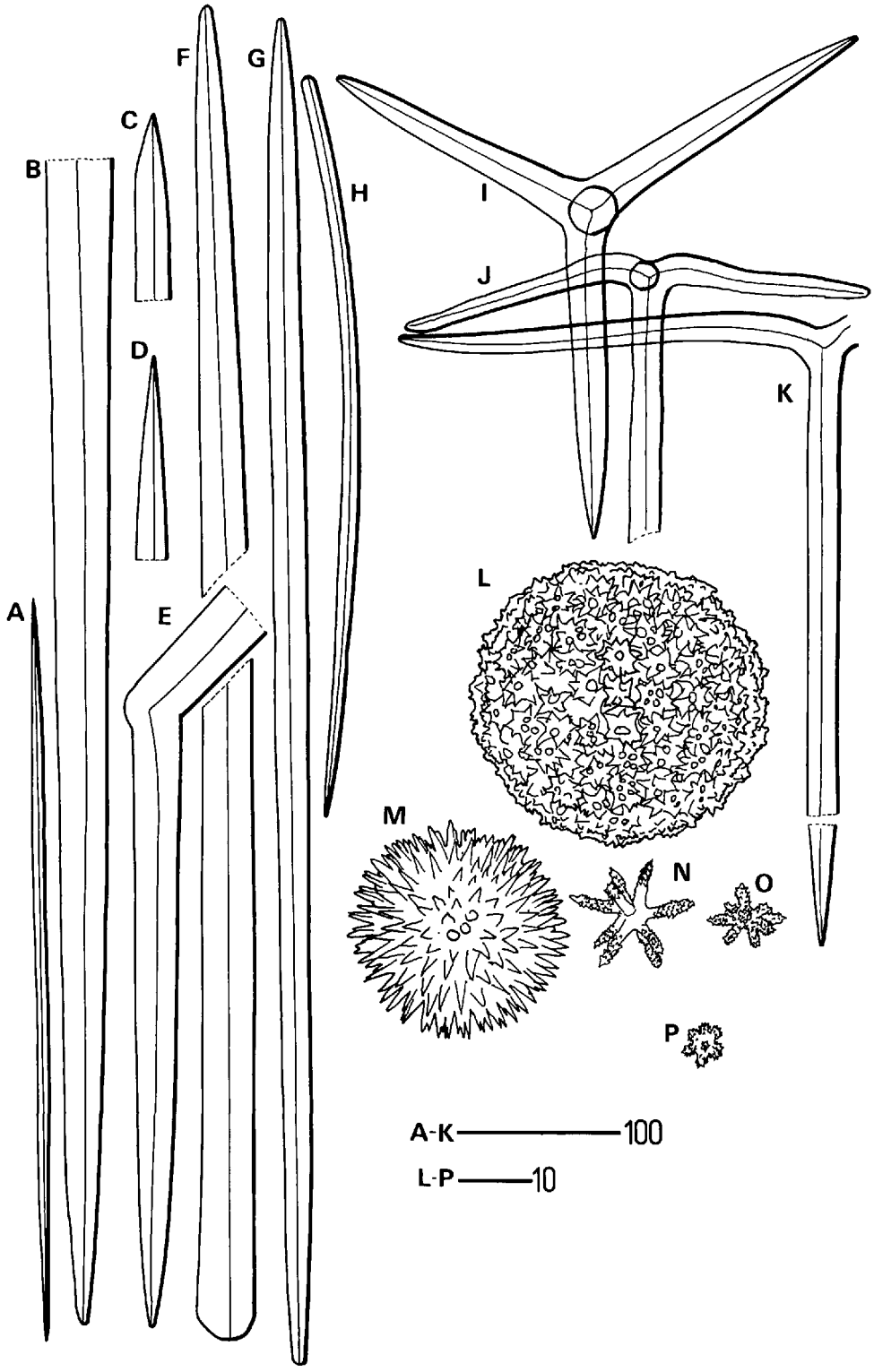
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
A-K 100
L-P 10

Table 1. Comparative data on spicular micrometries of *Geodia cortycostylifera* n.sp. Holotype, paratypes and additional material. Means are in italics. Other values are ranges. The width is given after bars (/). Orthotriaene measures are: shaft length/shaft width/clade length. $\eta = 20$ except for the oxeas of the holotype, Boury-Esnault (1973) and Alvarez and Díaz (1985) specimens, for which N = 100. (*). Cladome. All measures are in μm

	Styles	Orthotriaenes	Oxeas	Sterrasters	Oxyasters	Oxyasters 2	Oxeas 2
Holotype (UFRJPOR 3098)	251–*356*–432/ 3.8–8.8	496–*761*–942/ 12.5–22.5/ 32.5–*151*–245	335–*1071*–2034/ 12.5–33.8	32.5–50	12.5–20	6.3–8	
Paratype (UFRJPOR 2625)	367–*413*–462/ 3.8–9.3	719–*947*–1116/ 12.5–25/ 92.5–*165*–220	942–*1274*–1612/ 15–27.5	35–50	12.5–25	5–7.3	
Paratype (UFRJPOR 2906)	312–*393*–452/ 6.8–9.8	372–*811*–1066/ 15–26.3/ 118-*163*–195	397–*1105*–1587/ 15.8–27.5	20–46	11.3–20	6–8	
Paratype (UFRJPOR 3091)	231–*412*–462/ 4.5–8.8	490–*728*–956/ 11.3–21.3/ 110–*145*–193	546–*1083*–1339/ 5.5–*17.8*–25	32.5–46.3	15–18.8	6.3–8	
Paratype (UFRJPOR 3714)	373–*452*–515/ 5–11.3	490–*718*–980/ 12.5–27/ 45–*122*–215	662–*985*–1201/ 10–22.5	30–42.5	13.8–25	5–7.8	
Geodia vosmaeri; Boury-Esnault, 1973	–	1000–2000/ 300–355*	810–1370/ 20–35/	31–50 12–38	12–25	6–9	60–130/ 1.5–3
(remeasured)	352–*409*–452/ 7.3–10	645–*873*–992/ 15–27.5/ 50–*141*–168	595–*1066*–1215/ 16.3–28.8	35–55	17.5–25	6.5–11	90–151/ 1.3–5
Geodia neptuni; Alvarez and Díaz, 1985	258–*435*–1131/ 3–9	325–1027/ 3–18/ 26–156	416–1183/ 6–18	21–36	9–18	3–9	51–416/
(remeasured)	240–*308*–371/ 2.8–5.6	305–*681*–872/ 5.6–18.2/ 39.2–*131*–160	660–*1206*–1980/ 5.6–*9.8*–19.6	28–48	9.8?–21	7?	

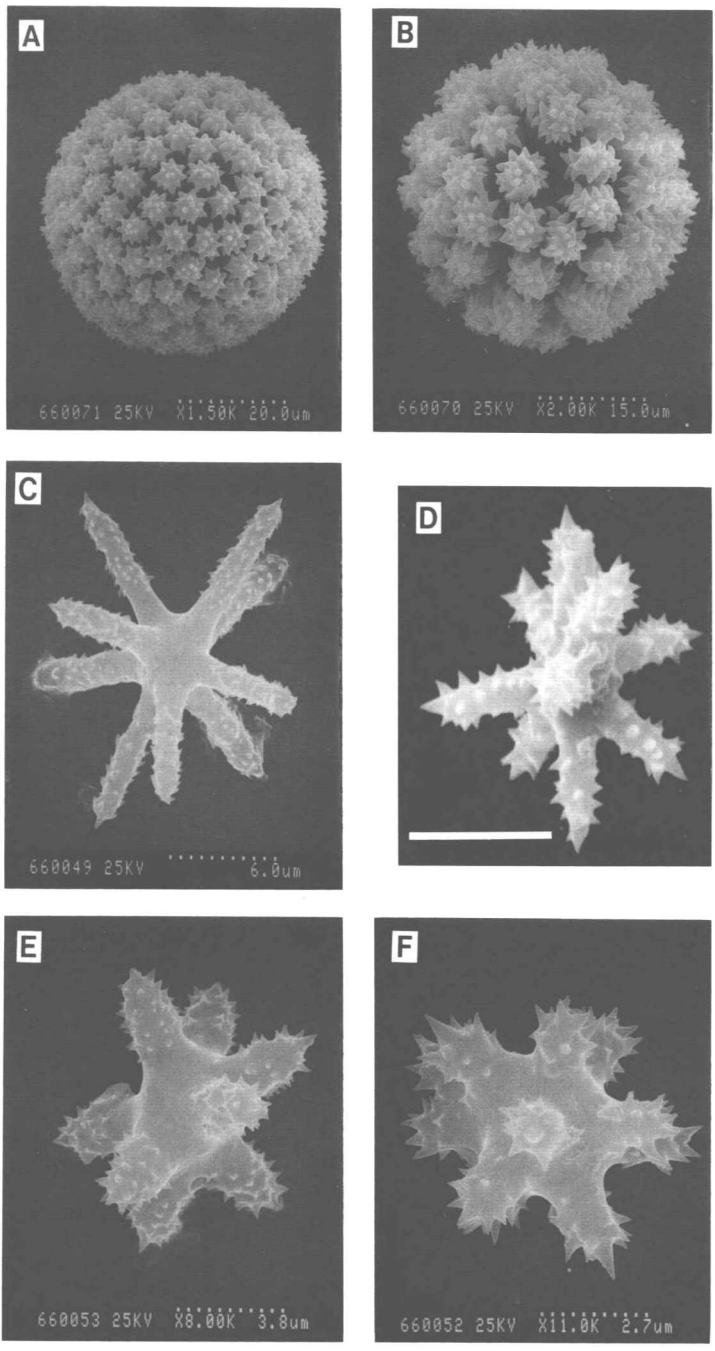

Plate I. SEM photographs of *Geodia cortycostylifera* n.sp. microscleres. A, B. Sterrasters. C. Fully grown choanosomal oxyaster. D. Choanosomal oxyaster developmental stage. E, F. Cortical oxyasters.

1976; Collette and Rützler, 1977); *G. glariosa* (Sollas, 1886) (Sollas, 1886; 1888; Volkmer-Ribeiro and Mothes de Moraes, 1975; as *Cydonium glariosus*; Hechtel, 1965; 1976); *G. eosaster* (Sollas, 1886) (Mothes de Moraes, 1978; as *Cydonium*); *G. papyracea* Hechtel, 1965 (Burton, 1940 as *G.* sp.; Hechtel, 1976) and *G. tylastra* Boury-Esnault, 1973 (Boury-Esnault, 1973; Hechtel, 1976).

Geodia neptuni is closest to our material. The fragment of the holotype used in our comparisons differs from the present species in having two categories of oxeas, the smaller one restricted to the cortex, but no styles category. The cortical oxeas of *G. neptuni* in general are smaller than the cortical styles in our material. An exception is found in the material collected off the mouth of the Amazon River (Collette and Rützler, 1977; Table 2 in this paper). *G. neptuni* as described from population studies in the Bahamas (Wiedenmayer, 1977) has a beige to brown color (see also color photograph in Vacelet, 1990) and vaseform shape (Sollas, 1888; Wiedenmayer, l.c.; Vacelet, l.c.).

The synonymization of *G. vosmaeri* and *G. neptuni* as suggested by Wiedenmayer (1977), is here upheld after examination of fragments of both holotypes. The cortical oxeas category mentioned by Sollas (1888) only for *G. vosmaeri,* was here found to occur also on the type of *G. neptuni* (156–231 μm; see Table 2).

The specimen described by Boury-Esnault (1973) as *G. vosmaeri,* is here regarded as conspecific with the presently described new species. Remarkably, besides the cortical styles characteristic of the present species, it presents a category of very small oxeas ("microxes" in Boury-Esnault, l.c.) which is here regarded as non-homologous to the one in *G. neptuni.* These small oxeas demonstrate a peculiarly bent and irregular shape (as opposed to fusiform shape in *G. neptuni* type), as well as a smaller size 90–151 μm (as opposed to 156–231 μm in *G. neptuni* type). More specimens must be studied before the taxonomic significance of this character is understood.

Geodia neptuni as described by Alvarez and Díaz (1985; and here reexamined on the basis of a fragment: ZMA POR 5338, see Table 1), is ascribed to the new species based on the possession of cortical styles, reddish-orange color and cerebriform shape. Nevertheless, its styles are rare and anatriaenes (also rare) can be found. These last ones cannot be considered autochthonous with certainty. Larger styles reported by Alvarez and Díaz (l.c.) are here assumed to be malformed oxea.

Presently, it is concluded that *G. neptuni* and the present species must be closely related. They have a wide overlapping distribution; nevertheless, both species have not yet been found in sympatry.

Geodia gibberosa as described by Hechtel (1965), differs from the present species in shape, color and spicular complement. It has plagiotriaenes, cortical oxeas and much larger sterrasters (53–108 μm). This species as it appears from descriptions in the literature, is rather polymorphic. A comprehensive study is needed in order to properly evaluate its variability limits.

Geodia glariosa as in Sollas (1888) and Volkmer-Ribeiro and Mothes de Moraes (1975), *G. eosaster* as in Sollas (l.c.) and Mothes de Moraes (1978), and *G. papyracea* as in Hechtel (1965), all differ from the present species in the possession of additional triaene categories.

Geodia eosaster as in Mothes de Moraes (1978) presents some important differences when compared with the original description of Sollas (1888). It has much larger choanosomal oxeas (up to 5,796 μm, against 2,856 μm in the type), dichotriaenes (up to 6,164 μm, against 3,570 μm in the type), protriaenes (up to 7,544 μm, against 5,000 μm in the type) and oxyasters (up to 60 μm, against 39 μm in the type). The disjunct distribution (Brazil and west Australia) of both populations makes the conspecificity hypothesis even more improbable.

Table 2. Comparative data on spicular micrometries of *Geodia neptuni* (Sollas, 1886). Means are in italics. Other values are ranges. The width is given after bars (/). Orthotriaene measures are: shaft length/shaft width/clade length. N = 100 for all new oxeas measurements. For other new measurements N = 20. (*). Cladome. All measures are in μm. Pulitzer-Finali's (1986) specimen is the only one not remeasured

	Cortical oxeas	Orthotriaenes	Oxeas	Sterrasters	Oxyasters	Oxyasters ("chiasters")	?Spher-asters
Geodia neptuni (Sollas, 1886)	—	964/16/180	1227/19.3	44.8	11.8–16	6.8	16
(holotype remeasured)	156–*196*–231/ 2.3–3.3	384–*790*–1042/ 10–*18*–25/ 75–*143*–193	868–*1102*–1538/ 10–*16.7*–22.5	32.5–52.5	12.5–23.8	5–7.5	
Geodia vosmaeri (Sollas, 1886)	± 300/4	1107/38.7/286	1321–1680/ 8–16	39.4	25.6	4	
(holotype remeasured)	176–*205*–392/ 2–4.5	471–*881*–1215/ 8.8–23.8/ 130–*183*–258	546–*1131*–1389/ 2.5–*9.5*–17.5	22.5–42.5	12.5–22.5	4.5–7.5	
Geodia neptuni; Boury-Esnault, 1973	—	500–1000/ not given/ 75–380*	750–970/ 9–15	30–40	12–22	5–8	16–30
(remeasured)	240–290/ 2.5–3.8	595–*719*–942/ 7.5–20/ 38–*98*–183	608–*878*–1091/ 7.5–13.8	27.5–42.5	12.5–20.8	5.3–7.8	?12.5
Geodia neptuni; Wiedenmayer, 1977	75–220/ 1–3	not given	850–1460/ 7–25	40–60	15–21	5–7	
(remeasured)	120–*180*–224/ 2	one clade was 70 μm long	770–*1166*–1460/ 9.8–27	52–59	11.2–*18*–31	4.2–7	
Geodia neptuni; Collette and Rützler, 1977 (new data)	352–*483*–572/ 3.3–6.3	341–*742*–937/ 11–*22.4*–36/ 62–*146*–286	836–*1379*–1760/ 12.5–22.5	42–62	14–*23*–31	4.8–7.6	
Geodia neptuni; Pulitzer-Finali, 1986	230/3	±1000/ 24/160	1000–1600/ 8–38	57–70	14.5–23	4–8	

G. sp. (Burton, 1940) was reexamined and is here tentatively assigned to *G. papyracea.* Differences are the larger size attainable by the clades of the orthotriaenes (190 μm) and occurrence of only one smaller thin-rayed oxyaster category (14–23 μm). The study of the *G. papyracea* specimen cited for the Pernambuco Coast by Hechtel (1976) could clarify the relationships between the Brazilian and Jamaican populations of this species.

Geodia tylastra as originally described by Boury-Esnault (1973), differs from the present species in possessing smaller hastate oxeas, as well as tylasters instead of oxyasters (the type of this species could not be found in the Paris Museum and is assumed to be lost).

CARIBBEAN RECORDS. Twelve *Geodia* species were listed for the Caribbean by Pulitzer-Finali (1986): *G. cariboea* Duchassaing and Michelotti, 1864 (which is generally considered a synonym of *G. gibberosa*; see de Laubenfels, 1936; Hechtel, 1965; Van Soest and Stentoft, 1988); *G. cumulus,* Schmidt, 1870 (synonymized with *G. gibberosa* by de Laubenfels (1936), but here retained as a separate species in view of Burton's (1946) statement that it has anatriaenes); *G. exigua* Thiele, 1898 (in Uliczka, 1929; this record has later been ascribed to *G. cumulus* by Burton (1946); *G. flexisclera* Pulitzer-Finali, 1986 (here considered a synonym of *G. gibberosa*); *G. gibberosa*; *G. media leptoraphes* Uliczka, 1929 (Hechtel (1965) ascribes this citation to *G. gibberosa*); *G. neptuni*; *G. papyracea* (only marginally distinct from *G. cumulus* (two oxyaster categories as opposed to no oxyasters (?)); *G. spherastrea* Lévi, 1964; *G. thomsoni* Schmidt, 1870 (perhaps good species, de Laubenfels, 1936; dubious identity, Van Soest and Stentoft, l.c.); *G. tuberculosa* Bowerbank; and *G. tumulosa* Bowerbank, 1872.

Thirteen other species were cited by Pulitzer-Finali (1986) as belonging to other genera of the Geodiidae. Three of them are here assumed to belong to *Geodia.* These are: *G. pachydermata* (Sollas, 1886; as *Isops*), *G. apiarium* (Schmidt, 1870; as *Pachymatisma,* and originally as *Caminus*) and *G. stromatodes* (Uliczka, 1929; as *Sidonops*). Bowerbank (1873) cited also *G. dysoni* (here assigned to *G. gibberosa*) and *G. media* [synonym of *G. gibberosa,* de Laubenfels (1936)]. These two species were described from Honduras and Mexico, respectively, but with no mention whether from the Caribbean or Pacific Coast. Van Soest and Stentoft (1988) described *G.* cf. *megastrella* Carter, 1876 from Barbados deep-water.

Of the list provided above, three species were already discussed (*G. gibberosa, G. neptuni, G. papyracea*), and seven are synonyms or highly probable ones (*G. cariboea, G. dysoni, G. exigua, G. flexisclera, G. media, G. media leptoraphes, G. stromatodes*). Of the remaining eight species, six are distinguished from the present material in having different categories of triaenes (*G. cumulus, G. spherastrea, G. thomsoni, G. tuberculosa, G. tumulosa* and *G.* cf. *megastrella*). *G. pachydermata* as in Sollas (1888), differs from the present species by the much larger size of its sterrasters (240 μm) and oxyasters (64 μm), and by its depth distribution, restricted to deep-water habitats (1,075 fathoms). *G. apiarium* as in Sollas (1888; as *Isops*) differs from the present species by the much larger size of its sterrasters (213 μm).

Subgeneric Classification

The splitting of *Geodia* into genera or subgenera *Cydonium* Fleming, 1828, *Synops* Vosmaer, 1882, *Isops* Sollas, 1888 and *Sidonops* Sollas, 1888 (Sollas, 1888), based on the arrangement of the openings of the aquiferous system, is here regarded as inconsistent. De Laubenfels (1936: 173) already suggested that these, and many other genera, are synonyms of *Geodia.* It is the authors' opinion that the arrangement of the openings of the aquiferous system may be a character

extremely dependent on field conditions as water currents, sedimentation rate, availability of nutrients and presence of endo- and/or ectobionts. Strong evidence to support this idea lies in the fact that rather closely related species, with respect to spicular complement and skeletal arrangement (as understood from the literature) have to be assigned in different "genera" or "subgenera" (p.e. *G. dysoni, G. media leptoraphes, G. stromatodes*; all of which are currently considered synonyms of *G. gibberosa*; de Laubenfels, l.c.; Hechtel, 1965; Van Soest and Stentoft, 1988). The first two were originally described under *Geodia*. Nevertheless, Hechtel (l.c.). cited as unique difference to *G. gibberosa* the fact that *G. dysoni* was originally described with dispersed oscules (as in "*Synops*"). *G. media leptoraphes* was described by Uliczka (1929) with oscules organized in three different patterns: terminally arranged, arranged in a queue or grouped in depressions, pointing to extreme instability in the arrangement of the openings of the aquiferous system.

We formally propose to abandon the use of these names, both as genera or subgenera, as artificial or paraphyletic taxa.

Conclusion

In view of the above given discussion, the present material clearly has been demonstrated to be a new species, which is easily distinguished from other *Geodia* species occurring in the tropical west Atlantic by its normally cerebriform shape, orange color and cortical styles.

Key to the *Geodia* Species Occurring along the Brazilian Coast

1a. Triaenes ortho- or plagio-, in only one variable category of size and shape 2
1b. Triaenes ortho-, plagio-, ana-, pro- or dicho-; in more than one category 5
2a. With a rather common (rare in one specimen) and constant size and shape category of cortical styles, normally less than 500 μm, besides an extremely size and shape variable oxeas category ..... *G. corticostylifera* sp.n.
2b. No special category of cortical styles. Styles may occur only as rare malformed oxeas 3
3a. With only one category of oxea, rather constant, smaller than 1,000 μm; asters are tylasters ..... *G. tylastra*
3b. With one or two categories of oxeas variable in size and shape; when a smaller category of oxeas is present it is restricted to the cortex 4
4a. Shape normally massive-globose, color normally white; sterrasters can be up to 100 μm; surface normally smooth and easily detachable ..... *G. gibberosa*
4b. Color beige to brown; shape normally vaseform (up to 50 cm high and 100 cm wide); surface with deep calyciform grooves and not easily detachable; sterrasters normally <60 μm ..... *G. neptuni*
5a. Triaenes ortho- or plagio-, ana- (these can be rare), normally less than 1,000 μm in length ..... *G. papyracea*
5b. Triaenes in three categories, the larger normally much more than 1,000 μm in length 6
6a. Triaenes pro-, ana- and dicho-; length exceeds 2,000 μm ..... *G.* aff. *eosaster*
6b. Ortho- or plagiotriaenes, less than 2,000 μm; pro- and ana-, over 3,000 μm long ..... *G. glariosa*

Acknowledgments

The authors wish to thank Dr. A. M. Solé-Cava (Rio de Janeiro) for loan of the Espírito Santo specimens, Dr. K. Rützler (Washington) for sending fragments from the USNM collections, Dr. N. Boury-Esnault (Marseille) for sending fragments of the Calypso material, Dr. S. Stone (London) for sending fragments of the Challenger material and Dr. R. W. M. van Soest (Amsterdam) for revision of the manuscript and loan of ZMA material. Mme. C. Bezac (Marseille) is thanked for help in taking the SEM-photos a, b, c, e and f. This work has been supported by grants from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Conselho de Ensino para Graduados da Universidade Federal do Rio de Janeiro (CEPG-UFRJ) and Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ, Brazil).

LITERATURE CITED

Alvarez, B. and M. C. Díaz. 1985. Las esponjas de un arrecife coralino en el Parque Nacional Arquipiélago de los Roques. I.—Taxonomia. II.—Estructura ecológica. Licenciature thesis. Universidad Central de Venezuela. 216 pp.

Boury-Esnault, N. 1973. Campagne de la Calypso au large des côtes atlantiques de l'Amérique du Sud (1961–1962) I, 29. Spongiaires. Rés. sci. Camp. Calypso 10: 263–295, 49 figs., 3 pls.

Bowerbank, J. S. 1872. Contributions to a General History of the Spongiadae. Parts 1–111. Proc. Zool. Soc. London, 1872, 115–129, 196–202, 626–635, pls. V–VI, X–XI, XLV–XLIX.

———. 1873. 2. Contributions to a General History of the Spongiadae. Part V. Proc. Zool. Soc. London, 1873, p. 319–333, pls. XXVII–XXXI.

Burton, M. 1940. Las esponjas marinas del Museo Argentino de Ciencias Naturales. An. Mus. Argent. Cienc. Nat., XL: 95–121.

———. 1946. Notes on certain species of *Geodia* described by Oscar Schmidt. Ann. Mag. Nat. Hist. 13(11): 856–860.

Collette, B. and K. Rützler. 1977. Reef fishes over sponge bottoms off the mouth of the Amazon River. Proc. IIIrd Int. Coral Reef Symp., Univ. Miami: 305–310.

Hechtel, G. 1965. A systematic study of the Demospongiae of Port Royal, Jamaica. Bull. Peabody Mus. Nat. Hist., 20: i-iv + 1-103, 8 pls., 15 figs.

———. 1976. Zoogeography of Brazilian marine Demospongiae. Pages 237–260 *in* F. W. Harrison and R. R. Cowden, eds. Aspects of sponge biology. Academic Press, New York.

———. 1983. New species of marine Demospongiae from Brazil. Iheringia. Sér. Zool., Porto Alegre (63): 59–89.

Laborel, J. 1967. Madreporaires des Côtes du Brésil. These Doct. Sci. Univ. Aix-Marseille, Marseille, France. 312 pp.

Laubenfels, M. W. de. 1936. A discussion of the sponge fauna of the Dry Tortugas in particular and the West Indies in general, with material for a revision of the families and orders of the Porifera. Publ. Carnegie. Inst. Wash., 467, Pap. Tortugas Lab., 30, pp. 1–225.

———. 1956. Preliminary discussion of the sponges of Brazil. Contr. Avulsas Inst. Oceanogr. Univ. São Paulo, Oceanogr. Biol. 1: 1–4.

Lévi, C. 1964. Spongiaires des zones bathyale, abyssale et hadale. Galathea Rep. 7: 63–112, 10 pls.

Mothes de Moraes, B. 1978. Esponjas tetraxonidas do litoral sul-brasileiro: II—Material coletado pelo N/Oc. "Prof. W. Besnard" durante o programa RGS. Bol. Inst. Oceanogr., São Paulo 27(2): 57–78.

Muricy, G. 1989. Sponges as pollution-biomonitors at Arraial do Cabo, Southeastern Brazil. Rev. Bras. Biol. 49(2): 347–354.

———, E. Hajdu, M. Custodio, M. Klautau, C. Russo and S. Peixinho. 1991. Sponge distribution at Arraial do Cabo, SE Brazil. Coastal Zone '91. Proc. VII Symp. Coast. Ocean Manag., ASCE Publs. 2. Pages 1183–1196. O. T. Magoon, H. Converse, V. Tippie, L. T. Tobin and D. Clark, eds. Long Beach 8–12 July 1991.

Poléjaeff, N. N. 1884. Report on the Keratosa collected by H.M.S. Challenger during the years 1873–1876. Rep. Sci. Res. Voyage H.M.S. Challenger, Zoology. XI (XXXI): 1–88, pls. 1–10.

Pulitzer-Finali, G. 1986. A collection of West Indian Demospongiae (Porifera). In appendix, a list of Demospongiae hitherto recorded from the West Indies. Ann. Mus. Civ. Sto. Nat. Gen., 86, p. 65–216.

Ridley, S. and A. Dendy. 1887. Report on the Monaxonida collected by H.M.S. Challenger during the years 1873–1876. Rep. Sci. Res. Voyage H.M.S. Challenger, Zoology, XX (LIX): 1–275, figs. 1–11, pls. 1–51.

Soest, R. W. M. van and N. Stentoft. 1988. Barbados deep-water sponges. Stud. Fauna Curaçao Caribb. Isl. 70: 1–175, 12 pls.

Sollas, W. J. 1886. Preliminary account of the Tetractinellid sponges dredged by H.M.S. "Challenger," 1872–1876. Part 1. The Choristida. Sci. Proc. R. Dublin Soc. (n.s.) 5: 177–199.

———. 1888. Report on the Tetractinellida collected by H.M.S. Challenger, during the years 1873–1876. Rep. Sci. Res. Voyage H.M.S. Challenger, Zoology, XX (LXIII):i–clxvi, 1–458, pls. 1–44.

Uliczka, E. 1929. Die Tetraxonen Schwämme Westindiens. Zool. Jahrb. Abt. Syst., Suppl. 16: 36–62, 76 figs., 1 pl.

Vacelet, J. 1990. Les spongiaires. *In* C. Bouchon, ed. La Grande Encyclopédie de la Caraïbe. Le Monde Marin. Sanoli. pp. 16–33.

Volkmer-Ribeiro, C. and B. Mothes de Moraes. 1975. Esponjas tetraxonidas do litoral sul-brasileiro. I—Redescrição de *Cydonium glariosus* Sollas, 1886 e *Erylus formosus* Sollas, 1886. Iheringia, Sér. Zool., Porto Alegre (47): 3–22.

Wiedenmayer, F. 1977. A monograph of the shallow-water sponges of the western Bahamas. Birkhäuser Verlag, Basel und Stuttgart, pp. 1–287, pls. 1–43 (Esperientia Supplementum 28).

Yoneshigue, Y. 1985. Taxonomie et écologie des algues marines de la région de Cabo Frio (Brésil). These Doct. Sci., Univ. Aix-Marseille II, Marseille, France. 466 pp.

DATE ACCEPTED: December 9, 1991.

ADDRESSES: (E.H., G.M., M.C., C.R.) *Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro. Cep. 21941, Cidade Universitária, Rio de Janeiro, Brazil*; (S.P.) *Departamento de Zoologia, Instituto de Biologia, Universidade Federal da Bahia. Cep. 40010, Campus de Ondina, Salvador, Bahia, Brazil*; *Present address:* (E.H.) *Instituut voor Taxonomische Zoologie, Universiteit van Amsterdam, Postbus 4766, 1009 AT, Amsterdam, The Netherlands.*