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NEW OBSERVATIONS AND NEW RECORD OF *NAUSITHOE AUREA* (SCYPHOZOA, CORONATAE)

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ABSTRACT

The work deals with observations on coronal musculature (position in relation to coronal groove and gonads) and morphological variation (number and position of structures) of Nausithoe aurea *medusae reared for 82 days in the laboratory, and compares it with avaiable data for other species of the genus. A new occurrence of* Nausithoe aurea *is reported for the coast of Bahia State, Brazil.*

Keywords: Scyphozoa, Coronatae, Nausithoe aurea*, systematics, Brazil.*

INTRODUCTION

The order Coronatae is represented by polyps with a firm periderm tube enclosing the soft body, and by medusae with a coronal furrow in the exumbrella and, below, pedalia in equal numbers to the tentacles and rhopalia (Russell, 1970). Jarms (1997) recognized about 40 species of coronate medusae. In the South Atlantic, Mianzan & Cornelius (1999) listed 10 species of coronates. Goy (1979) is the only record of a coronate medusa in Brazilian waters. The other records of this group in Brazil refer to the polyp stage and medusae reared in laboratory (Silveira & Morandini, 1996; 1997; 1998a; 1998b).

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Most Coronatae are metagenetic cnidarians, except for the benthic parthenogenetic *Thecoscyphus zibrowii* Werner, 1984 (Sötje & Jarms, 1999) and the holoplanktonic planula-polyp lacking *Periphylla periphylla* (Péron & Lesueur, 1809) (Jarms *et al.,* 1999). Life cycle studies are needed in order to accomplish a meaningful systematic treatment of any coronate species. In order to study the gametogenesis and embryonic development of *Nausithoe aurea* Silveira & Morandini, 1997 (Morandini, 1999) we had to repeat the rearing of adult medusae starting from the scyphistomae. The original description of *Nausithoe aurea* does not mention the musculature arrangement and morphological variation of the medusae (Silveira & Morandini, 1997). The scyphistomae distribution is restricted to the type locality in São Sebastião Channel (São Paulo State - Brazil) in tropical-subtropical waters (according to Boltovskoy *et al.,* 1999). This study adds complementary information on *Nausithoe aurea* coronal musculature, as well as, morphological variation, and updates the known distribution of the species.

Material and Methods

The scyphistomae of *Nausithoe aurea* were sampled in the São Sebastião Channel by SCUBA diving on 6/Aug/1997 at Ponta do Urubu (23°51'06"S - 45°24'77"W) (São Sebastião Island) São Paulo State, Brazil. They were growing on the calcareous debris of the coral *Mussismilia hispida* (Verrill, 1902) at 3-7 m deep. The 24 polyps were reared in the laboratory for 92 days to obtain the medusa stage. The 232 medusae obtained were reared for 82 days (55 days releasing eggs = mature medusae). For details on the rearing techniques see Silveira & Morandini (1997; 1998a: 784). Mature medusae were anaesthetised with tricaine (3-aminobenzoic acid ethyl ester methane sulfonate salt - $C_{10}H_{15}NO_5S$) and preserved in 4% formaldehyde solution in seawater.

Specimens were deposited in: Invertebrate Collection of the Museu de Zoologia, Universidade de São Paulo (MZUSP 12979: 2 typical medusae, 1 male and 1 female; MZUSP 12980: 1 scyphistoma), and Cnidarian Collection of the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ 3362-3364: 5 irregular male medusae). The typical and irregular medusae were photographed, and the line art drawings made from them.

Results and Discussion

Musculature and gonads

The observed musculature, in preserved and live specimens, is laid outside the coronal groove near the gonads. Sometimes, the coronal groove is near the adaxial portion of the gonads. The gonads are between the coronal groove and musculature (Figure 1). The musculature is organised in 16 fields corresponding in position to the 8 tentacles/gonads (adradial) and 8 rhopalia (per and interradial). In the tentacular fields, the musculature is extended to the base of the tentacles. The thickness of the rhopalial musculature field is almost half the lappets length (oral or aboral view).

The extension of the musculature into the bases of the tentacles might be related to their positions in live specimens (held upwards beside the umbrella). This behaviour is widespread in coronates (Wrobel & Mills, 1998) and Narcomedusae (Hydrozoa) (Larson *et al.*, 1989) and is related to the feeding behaviour of the species (Larson, 1979; Hunt & Lindsay, 1998).

The observations on live and preserved specimens of *Nausithoe aurea* showed that the position of gonads in relation to the coronal groove and coronal muscle does not vary. From the photographs and drawings of Russell (1956a) for *Paraphyllina ransoni* Russell, 1956, and Russell (1956b) for *Nausithoe atlantica* Broch, 1914 and *Nausithoe globifera* Broch, 1914, we observed that this "character" (relative position of gonads) is another character useful in separating species in the same genus, in addition to other characters. So far, available data on the relative position of gonads in relation to coronal groove can be ascertained to 4 species of Nausithoe (from a total of 20 species, following Jarms, 1991) (see Table 1).

Morphological variation

The medusae reared in laboratory present some variation in the number and position of certain structures (Figure 2). We observed some medusae with fusion of 2 adradial gonads into an interradial one. Sometimes a medusa has 7 or 9 gonads, with one that does not develop in the adradius or an extra gonad appearing in the interradius. We also observed medusae with the ocellus or the statocyst developing some way inside the pedalia. Extra tentacles (2 and 3) developed from the same base, absence of lappet and rhopalium were recorded. The shape of the gonads is another character in which variation has been observed ("box glove" and triangular shape). The number of gastric filaments also varies - up to 13, but it was in general 12 (3 per gastric septa). These character variations are restricted to few animals and not combined.

The only variation reported by Silveira & Morandini (1997) were in

Table 1. Relative position of gonads in relation to the coronal groove (CG) in *Nausithoe* species following different authors.

Species	Gonad position to CG	Author
Nausithoe atlantica	under	Russell, 1956b; 1970
Nausithoe aurea	outside	this work
Nausithoe globifera	inside	Russell, 1956b; 1970
Nausithoe punctata Kölliker, 1853	outside	Segura-Puertas, 1984
Nausithoe werneri Jarms, 1990	under	Jarms, 1990

the absence of the yellow pigment spot in some lappets, and the number of gastric filaments. Komai (1935) is the only paper concerning variation in coronate medusae, on the coast of Japan. Hartlaub (1909) used the shape of gonads to distinguish *Nausithoe* species in addition to other characters, and commented that in their periphery they reach the musculature fields. Russell (1956a, b) also used the shape of gonads, as one of the characters to distinguish between species of the genera *Paraphyllina* Maas, 1903 and *Nausithoe* Kölliker, 1853.

New Record

Five solitary scyphistomae of a coronate species (coded 1-5) were collected in Parcel das Paredes, Pedra do Leste (17°46'05"S - 39°01'89"W) (south coast of Bahia State) by SCUBA diving on 10/Dec/1996 by F.L. da Silveira and D.O. Pires. They were growing on dead *Mussismilia hispida*. Two scyphistomae were deposited in the Invertebrate Collection of the Museu de Zoologia, Universidade de São Paulo (MZUSP 13008). These specimens were brought to São Paulo and reared in the laboratory until 22/Jul/1997. Table 2 presents the morphological data on the scyphistomae from Bahia. The polyps produced either ephyrae or planuloids. The observations on the medusa stage reared confirmed the identification of species as *Nausithoe aurea*.

In Table 2 we present a comparison on the morphological data of scyphistomae collected in different localities at different times, and we observed that the data from Bahia and August 1997 matches with the original description of the species and expand some values (Dbd, Db, $D/L_{2mm)}$. These data are similar to the ones for *Nausithoe maculata* Jarms, 1990 (Jarms, 1990; 1991). The number of internal cusps is the same (16) in all whorls of *Nausithoe aurea* and *Nausithoe maculata* scyphistomae, and the only difference is observed in the medusa stage. These data reinforce the importance of life cycle studies to the better understanding of the systematics of Coronatae and specially to the genus *Nausithoe*.

Table 2. Measurements and *Formquotient* (proportions), *sensu* Jarms (1990; 1991), of *Nausithoe aurea* scyphistomae from Bahia (1-5) in comparison with scyphistomae from São Sebastião Channel (original description and Aug 1997). Dbd = diameter of basal disc; Db = diameter of tube just above the basal disc; Ltot = total length of tube; D/L_{2mm} = *Formquotient* at 2mm ($D_{2mm}/2$); D/L_{5mm} = *Formquotient* at 5mm ($D_{5mm}/5$); Do = diameter of opercular aperture; D/Ltot = *Formquotient* (Do/Ltot); original descr. = summary of data from the original description of Silveira & Morandini (1997); Aug/1997 = summary of data from 24 scyphistomae collected in August 1997 (Morandini, 1999).

scyphistoma	Dbd (mm)	Db (mm)	Ltot (mm)	D/L_{2mm}	D/L_{5mm}	Do (mm)	D/Ltot
1	0,516	0,138	2,88	0,21	—	0,6	0,2083
2	0,318	0,156	4,65	0,189	—	0,516	0,1109
3	—	0,15	3,0	0,189	—	0,63	0,21
4	0,498	0,174	2,79	0,228	—	0,492	0,1763
5	—	0,204	6,84	0,24	0,1032	0,66	0,096
original descr.	0,3-0,85	0,12-0,27	1,4-9,18	0,127-0,24	0,07-0,14	0,34-1,02	0,078-0,32
Aug/1997	0,19-0,49	0,09-0,26	2,4-7,54	0,15-0,29	0,10-0,14	0,45-0,85	0,08-0,205

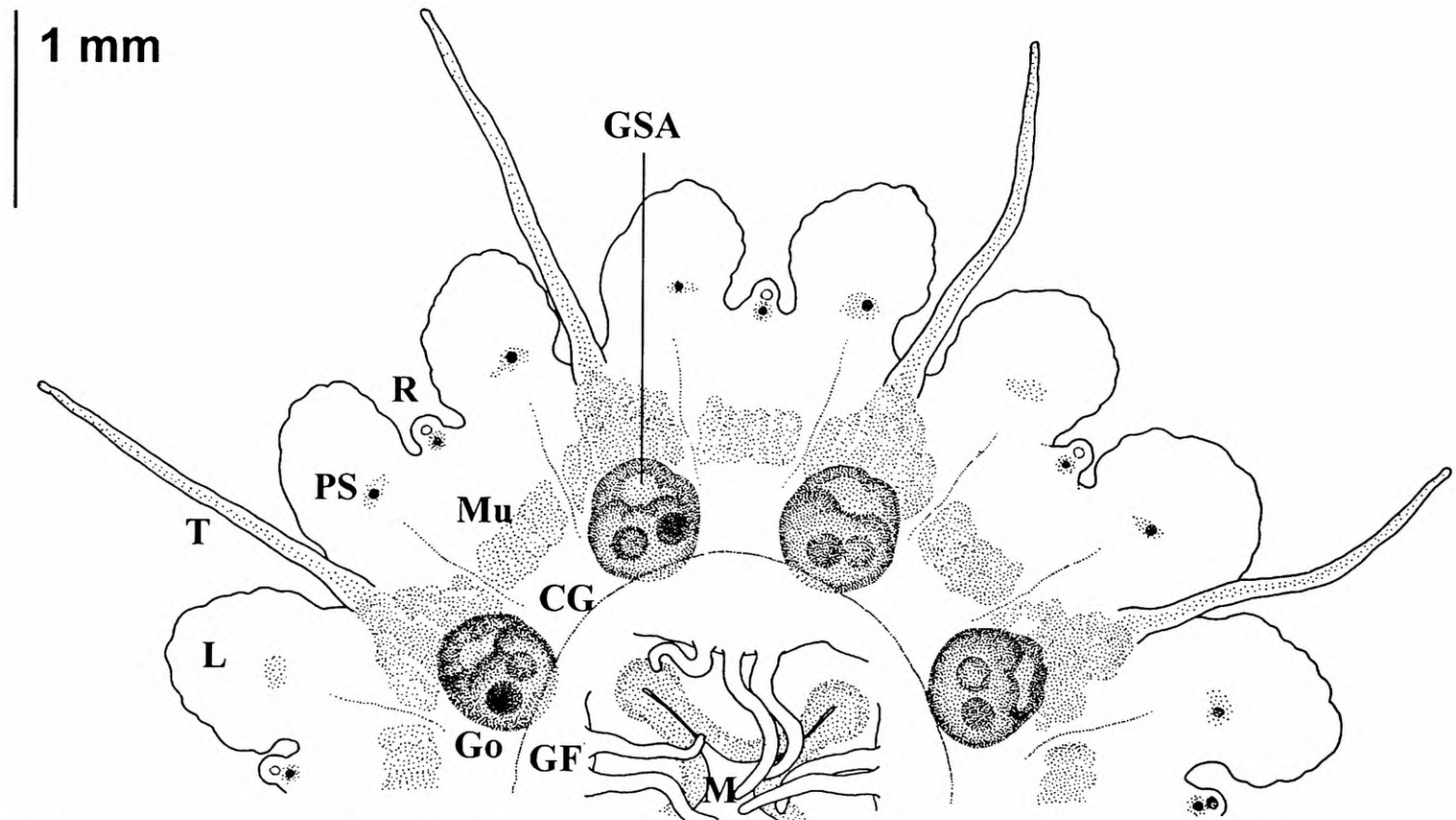

Figure 1. Schematic view of half typical medusa of *Nausithoe aurea*. In the drawing are represented the most conspicuous structures of the medusae. Note: musculature, gonads, coronal groove and their spatial relation; the position of the genital sinus aperture. CG = coronal groove; GF = gastric filaments; Go = gonad; GSA = genital sinus aperture; L = marginal lappet; M = mouth; Mu = musculature; PS = pigment spot; R = rhopalium; T = tentacle.

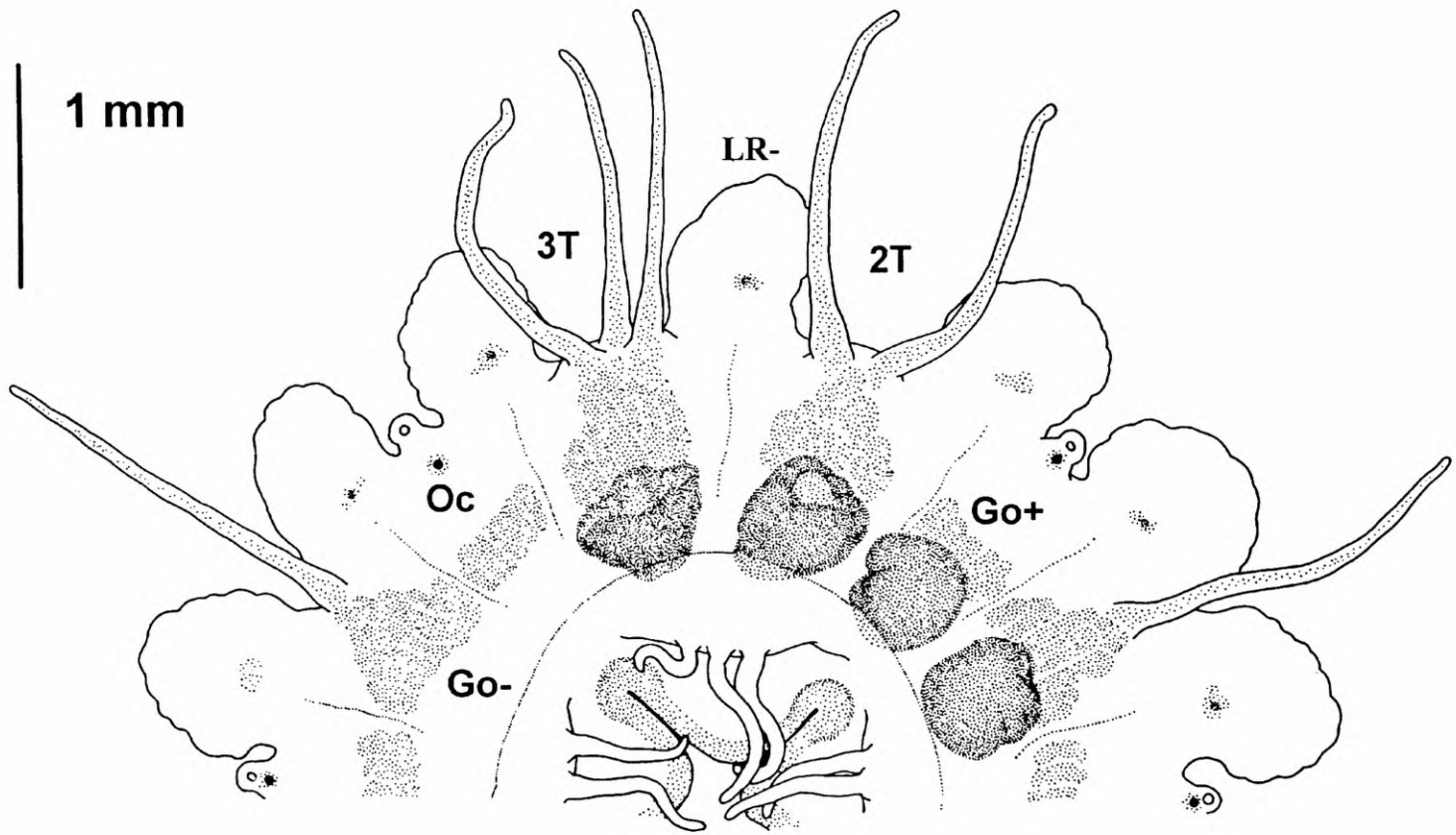

Figure 2. Schematic view of half irregular medusa of *Nausithoe aurea* (composition of several irregular specimens). Several atypical structures from different medusae are represented in the drawing. Note: the absence, addition and morphology of gonads; variation in the number of marginal tentacles; absence of marginal lappet and rhopalium; position of ocellus in rhopalium. 2T = 2 tentacles; 3T = 3 tentacles; Go+ = additional gonad; Go- = absent gonad; LR- = marginal lappet and rhopalium absents; Oc = ocellus in different position in rhopalium.

Thus, with this new record, the distribution of the scyphistomae of *Nausithoe aurea* is expanded to the coast of Bahia State, northern to the type locality and in typical tropical waters (according to Boltovskoy *et al.*, 1999).

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References

Boltovskoy, D.; M.J. Gibbons; L. Hutchings & D. Binet, 1999. General biological features of the South Atlantic. 1-42. In: Boltovskoy, D. (ed.), *South Atlantic Zooplankton, Vol. 1*. Backhuys Publishers, Leiden. 868 p.

Goy, J. 1979. Campagne de la Calypso au large des côtes atlantiques de l'Amérique du Sud (1961-1962) - 35. Méduses. *Résumé scientifique de la campagne de la Calypso au large des côtes atlantiques de l'Amérique du Sud (1961-1962)*, *11*: 263-296.

Hartlaub, C., 1909. Méduses. *Croisière Océanographique, Mer du Grönland 1905*: 464-478.

Hunt, J.C. & D.J. Lindsay, 1998. Observations on the behavior of *Atolla* (Scyphozoa: Coronatae) and *Nanomia* (Hydrozoa: Physonectae): use of the hypertrophied tentacle in prey capture. *Plankton Biology and Ecology*, *45*(2): 239-242.

Jarms, G., 1990. Neubeschreibung dreier Arten der Gattung *Nausithoe* (Coronata, Scyphozoa) sowie Wiederbeschreibung der Art *Nausithoe marginata* Kölliker, 1853. *Mitteilungen aus dem hamburgischen zoologischen Museum und Institut*, *87*: 7-39.

Jarms, G., 1991. Taxonomic characters from the polyp tubes of coronate medusae (Scyphozoa, Coronatae). *Hydrobiologia*, *216-217*: 463-470.

Jarms, G., 1997. The polyps of Coronatae (Scyphozoa), a review and some new results. 271-278. In: den Hartog, J.C. (ed.), *Proceedings of the 6th International Conference on Coelenterate Biology 1995*. Nationaal Natuurhistorisch Museum, Leiden. 542 p.

Jarms, G.; U. Båmstedt; H. Tiemann; M.B. Martinussen & J.H. Fosså, 1999. The holopelagic life cycle of the deep sea medusa *Periphylla periphylla* (Scyphozoa, Coronatae). *Sarsia*, *84*(1): 55-65.

Komai, T., 1935. On *Stephanoscyphus* and *Nausithoe*. *Memoirs of the College of Science, Kyoto Imperial University, Series B*, *10*(5): 290-339.

Larson, R.J., 1979. Feeding in coronate medusae (Class Scyphozoa, Order Coronatae). *Marine Behaviour and Physiology*, *6*: 123-129.

Larson, R.J.; C.E. Mills & G.R. Harbison, 1989. In situ foraging and feeding behaviour of Narcomedusae (Cnidaria, Hydrozoa). *Journal of the Marine Biological Association of the United Kingdom*, *69*: 785-794.

Mianzan, H.W. & P.F.S. Cornelius, 1999. Cubomedusae and Scyphomedusae. 513-559. In: Boltovskoy, D. (ed.), *South Atlantic Zooplankton, Vol. 1*. Backhuys Publishers, Leiden. 868 p.

Morandini, A. C., 1999. *Gametogênese e desenvolvimento embrionário de* Nausithoe aurea *(Scyphozoa, Coronatae) do Canal de São Sebastião - SP*. Unpublished MSc. Dissertation. Instituto de Biociências. Universidade de São Paulo, São Paulo. 136 p.

Russell, F.S., 1956a. On a new scyphomedusa, *Paraphyllina ransoni* n.sp.. *Journal of the Marine Biological Association of the United Kingdom, 35*: 105-111.

Russell, F.S., 1956b. On the scyphomedusae *Nausithoë atlantica* Broch and *Nausithoë globifera* Broch. *Journal of the Marine Biological Association of the United Kingdom, 35*: 363-370.

Russell, F.S., 1970. *The medusae of the British Isles II. Pelagic Scyphozoa with a supplement to the first volume on hydromedusae*. Cambridge University Press. London. 284 p.

Segura-Puertas, L., 1984. Morfología, sistemática y zoogeografia de las medusas (Cnidaria: Hydrozoa y Scyphozoa) del Pacífico tropical oriental. *Instituto de Ciencias del Mar y Limnología Universidad Nacional Autónoma de México, Publicaciones Especiales, 8*: 1-320.

Silveira, F.L. da & A.C. Morandini, 1996. *Stephanoscyphistoma corniformis* (Komai, 1936) (Cnidaria, Scyphozoa, Coronatae) from the north coast of São Paulo, Brazil. *Semina, Ciências Biológicas/Saúde, 17*(2): 137-145.

Silveira, F.L. da & A.C. Morandini, 1997. *Nausithoe aurea* n. sp. (Scyphozoa, Coronatae, Nausithoidae), a species with two pathways of reproduction after strobilation: sexual and asexual. *Contributions to Zoology, 66*(4): 235-246.

Silveira, F.L. da & A.C. Morandini, 1998a. Asexual reproduction in *Linuche unguiculata* (Swartz, 1788) (Scyphozoa: Coronatae) by planuloid formation through strobilation and segmentation. *Proceedings of the Biological Society of Washington, 111*(4): 781-794.

Silveira, F.L. da & A.C. Morandini, 1998b. New observations on dormancy mechanisms in *Linuche unguiculata* (Swartz, 1788) (Scyphozoa: Coronatae). *Boletim do Museu Nacional, Nova Série, Zoologia, 393*: 1-7.

Sötje, I. & G. Jarms, 1999. Detailed description of *Thecoscyphus zibrowii* Werner, 1984 (Scyphozoa, Coronatae) with remarks on the life cycle. *Mitteilungen aus dem hamburgischen zoologischen Museum und Institut, 96*: 5-13.

Wrobel, D. & C.E. Mills, 1998. *Pacific coast pelagic invertebrates. A guide to the common gelatinous animals*. Sea Challengers & Monterey Bay Aquarium, Monterey. 108 p.

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