

FIRST RECORD OF *Fritillaria venusta* LOHMANN, 1896 (TUNICATA: APPENDICULARIA) IN SOUTH BRAZIL BIGHT (23° S - 28° 40' S)

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ABSTRACT. *Fritillaria venusta* Lohmann, 1896 was collected in South Brazil Bight in summer, autumn and spring 1976 and summer 1993 for the first time. This species occurred in 13 of 269 sampling stations, from 68 m to 200 m in depth and water temperatures between 13 °C and 26 °C. Seasonal out of size variations of *F. venusta* were observed, being adults significantly larger in summer 1993.

Keywords: Appendicularia, New occurrence, Brazil, South Atlantic.

Primer registro de *Fritillaria venusta* Lohmann, 1896 (Tunicata: Appendicularia) en la plataforma sur de Brasil (23° S - 28° 40' S)

RESUMEN. *Fritillaria venusta* Lohmann, 1896 es registrada por primera vez en la plataforma sur de Brasil en verano, otoño e invierno de 1976 y verano de 1993. La especie fue encontrada en 13 de las 269 estaciones de muestreo, en profundidades de 68 m a 200 m y agua con temperaturas entre 13 °C y 26 °C. El tamaño de los organismos adultos de *F. venusta* varió estacionalmente, de 1.54 mm a 2.54 mm, los de mayor talla fueron encontrados en el verano de 1993.

Palabras clave: Appendicularia, Nuevo registro, Brasil, Atlántico Sur.

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INTRODUCTION

Appendicularians are minute pelagic tunicates with trunk rarely exceeding 5 mm and a tail many times longer than the trunk. They have a wide distribution in the oceans, occurring in profusion from both poles to the Equator, where they can be found mainly from the surface to 100 m depth (Berril, 1950; Esnal, 1981).

Class Appendicularia is represented by three families: Oikopleuridae, Kowalevskiidae and Fritillariidae, which are quite distinct in their anatomical structure. In Fritillariidae family the trunk is slendered and flatter, and the tail is shorter and broader (Essenberg, 1926; Alldredge, 1976). A total of 29 Fritillariidae species are recognized, from these 20 have been recorded from South Atlantic Ocean (Fenaux, 1993; Esnal, 1999). Between these species, *Fritillaria venusta* (= *F. bicornis* Lohmann 1896, and *F. inverta* Essenberg 1926) is considered a rare species because its low abundance in zooplankton samples. It has been recorded from the Atlantic, Pacific, Indian, Arctic, and Antarctic Oceans, at

depths not exceeding 200 meters (Essenberg, 1926; Thompson, 1948; Fenaux, 1963).

At Southwestern Atlantic Ocean this species has been found in the oceanic region, near 20° S and between 27° S and 29° S by Lohmann & Hentschel (1939). The only additional record of *F. venusta* was made by Fenaux (1968), who reported few specimens from Bahia, Brazil (13° S).

This paper focuses on the first record of *F. venusta* in South Brazil Bight (SBB), between Cabo Frio (23° S) and Cabo de Santa Marta Grande (28° 40' S), which corresponds to the most western distribution of the species in this region. Data on size variations of *Fritillaria venusta* specimens are also provided.

MATERIALS AND METHODS

Zooplankton samples were collected during survey cruises carried out on the R/V "Prof. W. Besnard" of the Oceanographic Institute of University of São Paulo, in the summer (January 1976 and 1993), autumn (May 1976)

and spring (September-October 1976). Survey grids of 70 (1976) and 60 (1993) sampling stations were established in the study area (Fig. 1). Oblique hauls were made with a Bongo net fitted with two different mesh sizes (0.333 mm and 0.505 mm) and equipped with flowmeter (General Oceanics Inc.), from a maximum depth of 200 m to the surface. After each tow, zooplankton samples were preserved in buffered formaldehyde with a final concentration of 4 %. Temperature and salinity data of the water column were obtained at each sampling station using a Nansen bottle in 1976 and a CTD in 1993. In the first case, temperature values were measured with thermometers coupled to the Nansen bottle. Salinity values were obtained using a conductivity salinometer. For this work, a total of 269 zooplankton samples collected with 0.333 mm mesh size were analyzed.

The identification of *F. venusta* was accomplished using descriptions provided by Thompson (1948), Bückmann & Kapp (1975) and Esnal (1999). All specimens were removed from the samples and counted. The abundance was expressed as number of individuals per m³. Measurements of trunk height; trunk, tail and total lengths of adults of *F. venusta* were made according to Esnal & Castro (1985). One-way analysis of variance (ANOVA), at a 5 % level of significance, was applied to the statistical comparisons.

The study area is characterized by the presence of three water masses: Coastal Water over (CW), with temperature 20 °C and salinity 35 psu. The Tropical Water (TW) has temperature and salinity over 20 °C and 36.4 psu. The South Atlantic Central Water (SACW), has temperature and salinity below 20 °C and 36.40 psu (Emilsson, 1961; Matsuura, 1978).

The water mass distribution pattern is closely related to the winds and to the influence of the Brazilian Current. During summer and spring the upper layer is occupied mainly by CW which mixes with TW offshore. These two types of water masses are oligotrophic, with low concentrations of nutrients salt, mainly at the mixing layer. The intrusion of SACW

toward the coast in the bottom layer is more intense during late spring and summer, reaching depths very close to the coastline, helping in the development of the seasonal thermocline. On the other hand, during autumn and winter winds blowing from the southwest are frequent and intense but no predominant. As a consequence there is weakening of the thermocline and retreat of the SACW toward the shelf break (Matsuura, 1986; Castro & Miranda, 1998). Seasonal upwards movement of SACW into the euphotic zone represents a frontal zone with a consequent natural eutrophication process (Aidar *et al.*, 1993).

RESULTS

Hydrographic conditions

During the study period the highest values of temperature were obtained in summer 1976 (24.86 °C) and summer 1993 (26.54 °C), at the surface layer (0-10 m depth), whereas the lowest values were in autumn 1976 (20.92 °C) and spring/1976 (20.83 °C). The water temperature decreased significantly in depth especially in spring 1976 and summer 1993 indicating the stratification of the water column, due to the presence of SACW near the bottom (Matsuura, 1978). In general the salinity varied little in the surface layers (Table 1).

Occurrence and distribution of *Fritillaria venusta*

This is the first occurrence of *F. venusta* in the study area between Cabo Frio (RJ) and Cabo de Santa Marta Grande (SC). During the survey, the species was found in 13 from 269 sampling stations, located between out of 82 m and 204 m isobaths, mainly at night. In spring 1976, *F. venusta* occurred in four stations off the Paranaguá region, whereas in summer 1976 and autumn 1976 it was recorded in only one station located at the North (Cabo Frio) and South (Florianópolis) of the study area, respectively. This species was found near Cabo Frio (five stations) and São Sebastião region (two stations) in summer 1993 (Fig. 1). These 13 stations were under the influence of SACW in deep layers.

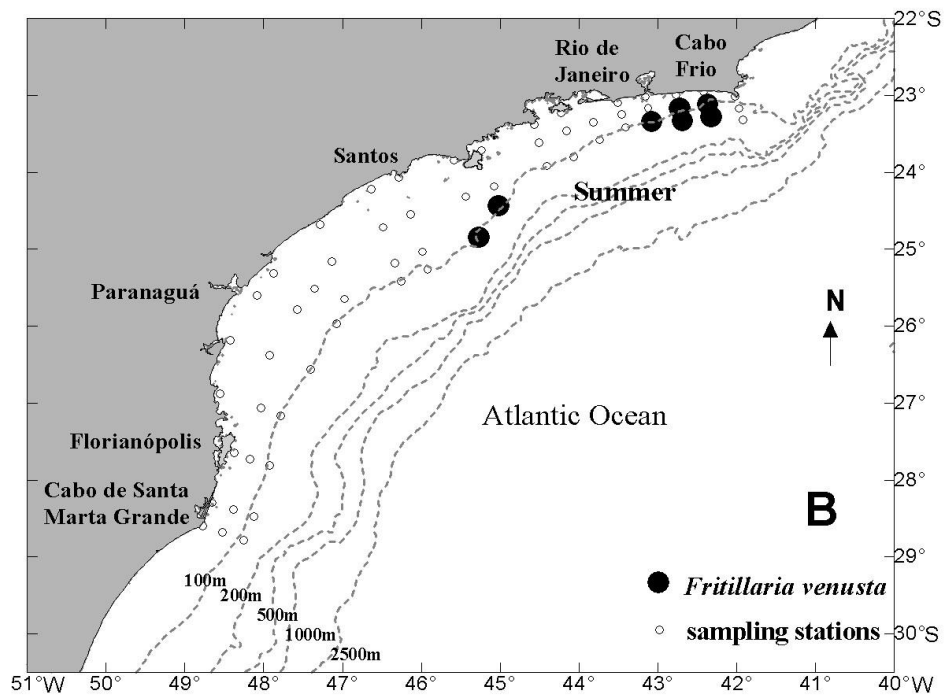
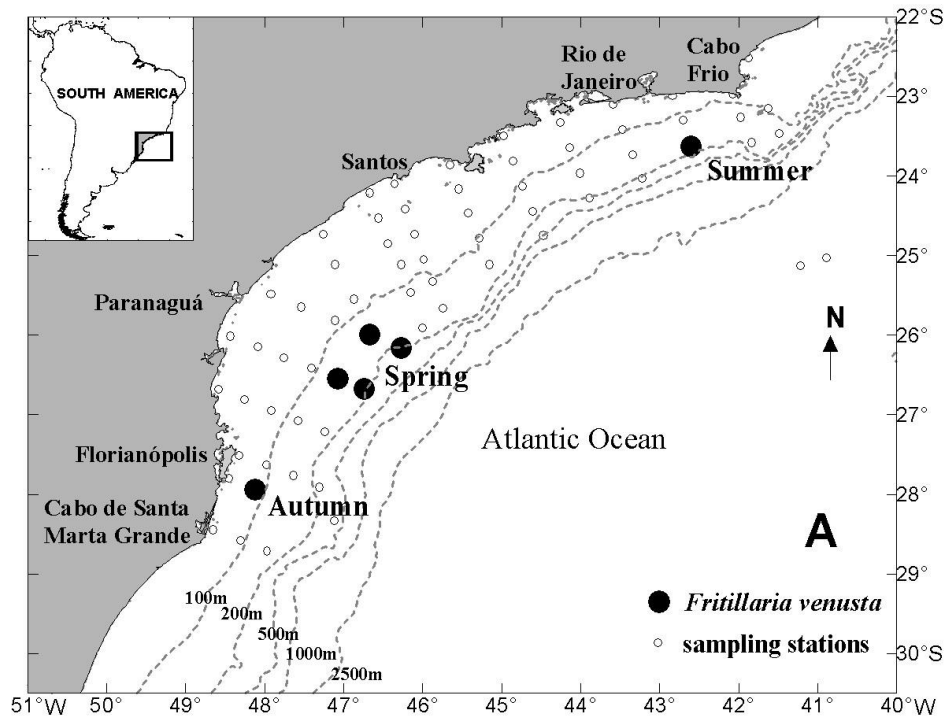


Figure 1. Map of the study area with the sampling stations and the *F. venusta* occurrence in 1976 (A) and 1993 (B).

Figura 1. Mapa del área de estudio con las estaciones de muestreo y la ocurrencia de *F. venusta* en 1976 (A) y 1993 (B).

Table 1. Position, date and hydrographic data of sampling stations, and *F. venusta* abundance (ind.m⁻³) from 1976 and 1993.**Tabla 1.** Localización de las estaciones de muestreo, hidrografía y abundancia (ind.m⁻³) de *F. venusta* en los años de 1976 y 1993.

Sampling Station	Lat. (° ' ")	Long.(° ' ")	Season	Year	Local time	Local depth (m)	Sampling depth (m)	Temperature (°C)			Salinity		<i>F. Venusta</i> ind.m ⁻³
								0 m	10 m	Near the bottom	0 m	10 m	
1	23.38.0	42.36.0	Summer	1976	22:10	128	123	24.86	24.00	-	36.20	36.40	1.26
2	27.56.8	48.07.3	Autumn	1976	03:20	88	83	20.92	21.01	17.46	34.59	34.59	0.38
3	26.06.7	46.20.3	Spring	1976	19:12	204	200	20.83	20.84	13.07	35.16	35.16	0.69
4	25.57.9	46.44.0	Spring	1976	21:55	120	115	20.9	20.99	13.92	35.42	35.42	0.14
5	26.41.1	46.44.2	Spring	1976	01:00	194	189	21.55	21.57	13.35	36.21	36.20	3.25
6	26.32.9	47.05.0	Spring	1976	03:38	138	133	21.25	21.01	14.05	35.10	35.27	0.99
7	23.17.2	42.19.0	Summer	1993	21:32	122	80	26.54	25.79	16.66	36.17	36.40	0.29
8	27.07.3	42.22.0	Summer	1993	22:45	101	74	25.94	24.20	14.68	36.24	36.93	0.50
9	23.10.0	42.43.5	Summer	1993	04:09	82	82	25.58	23.25	14.00	36.07	36.75	0.09
10	23.20.0	42.41.0	Summer	1993	05:30	108	100	25.84	24.55	16.15	36.19	36.62	0.27
11	23.20.29	43.03.77	Summer	1993	08:15	106	100	23.60	21.60	13.42	35.83	36.51	0.21
12	24.26.3	45.01.0	Summer	1993	04:17	92	68	25.55	25.54	16.29	35.63	35.72	0.20
13	24.51.0	45.16.3	Summer	1993	21:00	104	75	25.34	24.20	15.64	35.36	35.82	0.24

F. venusta abundance was in general very low during the study period (Table 1). The highest values were obtained in spring 1976 (3.25 ind.m⁻³) and summer 1976 (1.26 ind.m⁻³) whereas the lowest density was recorded in summer/1993 (0.09 ind.m⁻³) specially in Cabo Frio.

During the surveys *F. venusta* population was composed mainly of adults and few young stages. The total length of mature individuals ranged from 1.54 ± 0.19 mm to 2.54 ± 0.11 mm. The tail length varied from 1.41 ± 0.17 mm to 2.39 ± 0.11 mm, the trunk length from 0.58 ± 0.11 mm to 1.19 ± 0.04 mm and the trunk height from 0.14 ± 0.02 mm to 0.23 ± 0.02 mm (Table 2). The results obtained showed that the specimens collected in summer 1993 were larger and significantly different from those of 1976 ().

DISCUSSION

Appendicularia distribution pattern was outlined by early expeditions to the South Atlantic Ocean and some subsequent reviews (Esnal, 1999). *F. venusta* was found in the main oceans and seas (Fenaux, 1966). It has been considered a common species in tropical oceanic waters in the Pacific Ocean (Tokioaka, 1960) and rare in other places (Essenberg, 1926). In the present study *F. venusta* was recorded in the South Brazil Bight for the first time.

According to Fenaux (1968) *F. venusta* is a thermophile and eurythermic species. Thompson (1948) stated that it is restricted to

Table 2. Variation of maximum and minimum lengths and trunk height values of *F. venusta* from South Brazil Bight in 1976 and 1993.

Tabla 2. Variaciones máxima y mínima de la longitud y altura del tronco de *F. venusta* colectada en la plataforma sur de Brasil en 1976 y 1993.

Season		Trunk height (mm)	Trunk length (mm)	Tail length (mm)	Total length (mm)
Summer / 1976	Min.	0.14	0.73	1.41	1.54
	Max.	0.19	0.97	1.97	2.12
	Mean	0.16	0.82	1.69	1.86
	SD	0.02	0.07	0.17	0.19
Autumn / 1976	Min.	0.14	0.73	1.43	1.56
	Max.	0.19	1.04	1.97	2.14
	Mean	0.17	0.86	1.80	1.97
	SD	0.02	0.10	0.15	0.17
Spring / 1976	Min.	0.14	0.58	1.51	1.64
	Max.	0.21	0.97	1.97	2.18
	Mean	0.16	0.79	1.72	1.88
	SD	0.02	0.11	0.15	0.17
Summer / 1993	Min.	0.15	1.00	2.04	2.23
	Max.	0.23	1.19	2.39	2.54
	Mean	0.18	1.12	2.18	2.37
	SD	0.02	0.04	0.11	0.11

warm waters with temperatures between 24.1 °C to 26.5 °C and less than 200 m in depth;

Table 3. One-way analysis of variance -ANOVA- (α=0.05) applied to *F. venusta* sizes collected in 1976 and 1993.

Tabla 3. ANOVA (α=0.05) aplicada a las medidas de *F. venusta* colectada en 1976 y 1993.

	Trunk height (mm)	Trunk length (mm)	Tail length (mm)	Total length (mm)
Summer-Autumn/1976	p>0.70	p>0.20	p>0.10	p>0.10
Summer-Spring/1976	p>0.40	p>0.20	p>0.50	p>0.60
Summer1976/1993	p<<0.01	p=0.000	p=0.000	p=0.000
Autumn-Spring/1976	p>0.30	p>0.05	p>0.10	p>0.10
Autumn/1976-Summer/1993	p<0.05	p=0.000	p=0.000	p=0.000
Spring/1976-Summer/1993	p<0.005	p=0.000	p=0.000	p=0.000

whereas Essenberg (1926) mentioned its occurrence in surface waters with 15.2 °C, from Southern California. On the other hand, it is wellknown that appendicularians are more common around the upper ocean layers (Esnal, 1999). This tendency to congregate in a specific depth could be attributed to the greatest biological productivity in the surface layer, and to the appendicularians herbivorous feeding habits (Capitanio & Esnal, 1998). Nevertheless, Fritillariidae species seem to prefer deeper and colder waters, avoiding coastal regions due to their low resistance to hydrographic variations (Forneris, 1965; Acuña & Anadón, 1992). Information obtained in this work confirms the records of these authors, since *F. venusta* was registered only in sampling stations under strong influence of SACW (13 °C – 17 °C) in deeper layers.

Lohmann & Hentschel (1939) and Fenau (1963) found *F. venusta* in samples obtained by vertical hauls from layers deeper than 50 m, while Essenberg (1926) found this species also at surface during an upwelling episode. However, there are no records of *F. venusta* in samples from horizontal hauls (Thompson, 1948). In this study this species was present only in 13 zooplankton samples obtained with oblique hauls, from surface to 200 m depth, mainly at night. Similar results were obtained by Fenau (1968).

According to Tokioka (1960) fritillariid scarcity in many zooplankton studies may be due to the fact that the samples were collected by a wide-mesh net. Esnal *et al.* (1997) reported that juvenile stages of many appendicularian species may be underestimated when nets with large mesh size are used. The plankton net type used during this survey (0.333 mm mesh aperture) may have not quantitatively estimated *F. venusta* abundance, selecting only the mature specimens.

Thompson (1948) reported that trunk length of mature *F. venusta*, collected with N70 net (fine silk: 0.170 mm mesh width), varied from 1.1 mm to 1.5 mm and tail length from 1.6 mm to 2.2 mm, while Esnal (1999) found minimum trunk length as 1.5 mm for this species. In the present study the specimen

lengths for individuals collected in summer 1993 were similar to those registered by these authors. However, the specimens obtained during 1976 were smaller (Table 2).

F. venusta was captured in all seasons analyzed in the present work suggesting that it is an inhabitant of South Brazil Bight. More studies must be done using thinner nets to achieve a better knowledge of the distribution of this species in Brazilian waters.

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