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HYPERIIDS (AMPHIPODA: HYPERIIDAE) FROM NORTH-NORTHEAST COAST OF BRAZIL

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ABSTRACT

A total of 101 stations were sampled during the North-Northeast II Cruise (6°N-8°S/32-52°W), from April to June 1968 on board the Brazilian Navy R/V "Almirante Saldanha". Zooplankton was collected in horizontal and vertical hauls, with a 125 μm mesh size net. The family Hyperiidae which comprised about 45% of the Amphipoda collected, was chosen to be studied. Seventy percent of the stations were located in coastal waters. Five species were identified: *Hyperietta vosseleri* (Stebbing, 1904), *Lestrigonus bengalensis* Giles, 1887, *L. macrophthalmus* (Vosseler, 1901), *L. schizogeneios* (Stebbing, 1888) and *Themistella fusca* (Dana, 1853). *Lestrigonus bengalensis* was the most abundant (84%) in the area, followed by *Hyperietta vosseleri*, confirming their tendency to occur in the coastal zone. Taxonomic problems caused by the juveniles are discussed.

Keywords: planktonic amphipods, Hyperiidae, Western South Atlantic, Brazil.

INTRODUCTION

The suborder Hyperiidea (Crustacea:Amphipoda) comprises most of the pelagic amphipods. The family Hyperiidae is holoplanktonic and is included in the superfamily Physocephalata, which is a significant component of the epipelagic and mesopelagic communities in the tropical ocean (Vinogradov, 1991). A great part of them spend part of their life-cycle inside jelly-organisms. Associations between hyperiid species can be found only if they shared the same host. The known hosts of hyperiids are summarized by Laval (1980) and Thurston (1977). Studies with the stomach contents of hakes (*Merluccius merluccius hubbsi)*, mackerels (*Scomber japonicus marplatensis)*, salmons (*Salmo salar*) (Ramirez &Viñas,1985; Jensen & Lear, 1980) show their presence, demonstrating their importance to the high trophic levels. In this way, they can provide a source of food for several species of economical value, as it is demonstrated for *Themisto gaudichaudii,* the most abundant and widely distributed hyperiid amphipod in the Argentine shelf waters (Colombo & Viñas, 1994).

Very little data is available on the distribution and abundance of hyperiids from the Western South Atlantic Ocean. Ramirez &Viñas (1985) began to fill this gap by studying samples from shelf Argentina waters off. The studies on

systematics and distribution in the Southern Atlantic Ocean refer mostly to high latitudes where hyperiids usually have a great biomass concentration (Vinogradov, 1991). This study is also worthwhile because the sampling area was basically in the neritic region that was less explored by the great oceanographical expeditions ("Challenger", "Plankton", "Terra Nova", "Discovery") that passed through the coast of Brazil. This scarce literature on the group is a worldwide situation . In the last 25 years, we have had a general revision of Hyperiidea (Bowman, 1973) and about some families as Hyperiidae (Bowman & Gruner, 1973) and Shih (1969) for Phronimidae. Zeidler (1978,1984, 1990, 1991,1992, 1992b) has also added significant knowledge about the Australian fauna and the systematics of hyperiids in general. Vinogradov *et al.*(1982) published a catalogue, very well illustrated with keys to families, genera and species but, unfortunately, the text is in Russian, which restricts its use.

Vinogradov *et al.* (1982) recognized 44 species to the family Hyperiidae, of which 5 are represented in the present collection. The last new described species to this family was *Lestrigonus ducrayi* Zeidler, 1992.

In Brazilian waters, Fontes (1974) studied the occurrence of the family Pronoidae using the "North-Northeast-II" cruise material. Montú (1994) and Duarte (1994) published brief notes, giving qualitative results from northern and southern areas, respectivelly.

This is the first study specifically on the family Hyperiidae in Brazil. It aims at analysing its occurrence, contributing to extending its known distribution, to improving our understanding of the overall pattern of distribution of the pelagic amphipods. An attempt was made to find a relationship between species abundance, temperature and salinity data collected at the same time. Juvenile forms are discussed.

MATERIAL AND METHODS

One hundred and one oceanographic stations were sampled from April to June 1968 during the "Norte-Nordeste II"cruise, aboard the Brazilian Navy Ship R/V "Almirante Saldanha", in the north-northeast region of Brazil (6^{o}N-8^{o}S; 32^{o}-52^{o}W). Data and more complete information are available, on request, at the "Diretoria de Hidrografia e Navegação Data Center, Rio de Janeiro - Brazil".

The area comprised three groups of stations. The first group (area A) was in the Northeast area, with 5 profiles, the second group (area B), near the Amazon river mouth, with 6 profiles. Between area A and B, 23 isolated stations were distributed in the area C (Fig. 1).

Zooplankton was sampled using a conical net of 125 μm mesh size, $1m^2$ mouth diameter, 2 meters long, equipped with a calibrated flowmeter. Two types of hauls were performed: horizontally by the 200m displacement of the ship and vertically, just above the thermocline (depth ranged from 17m to 102 m).

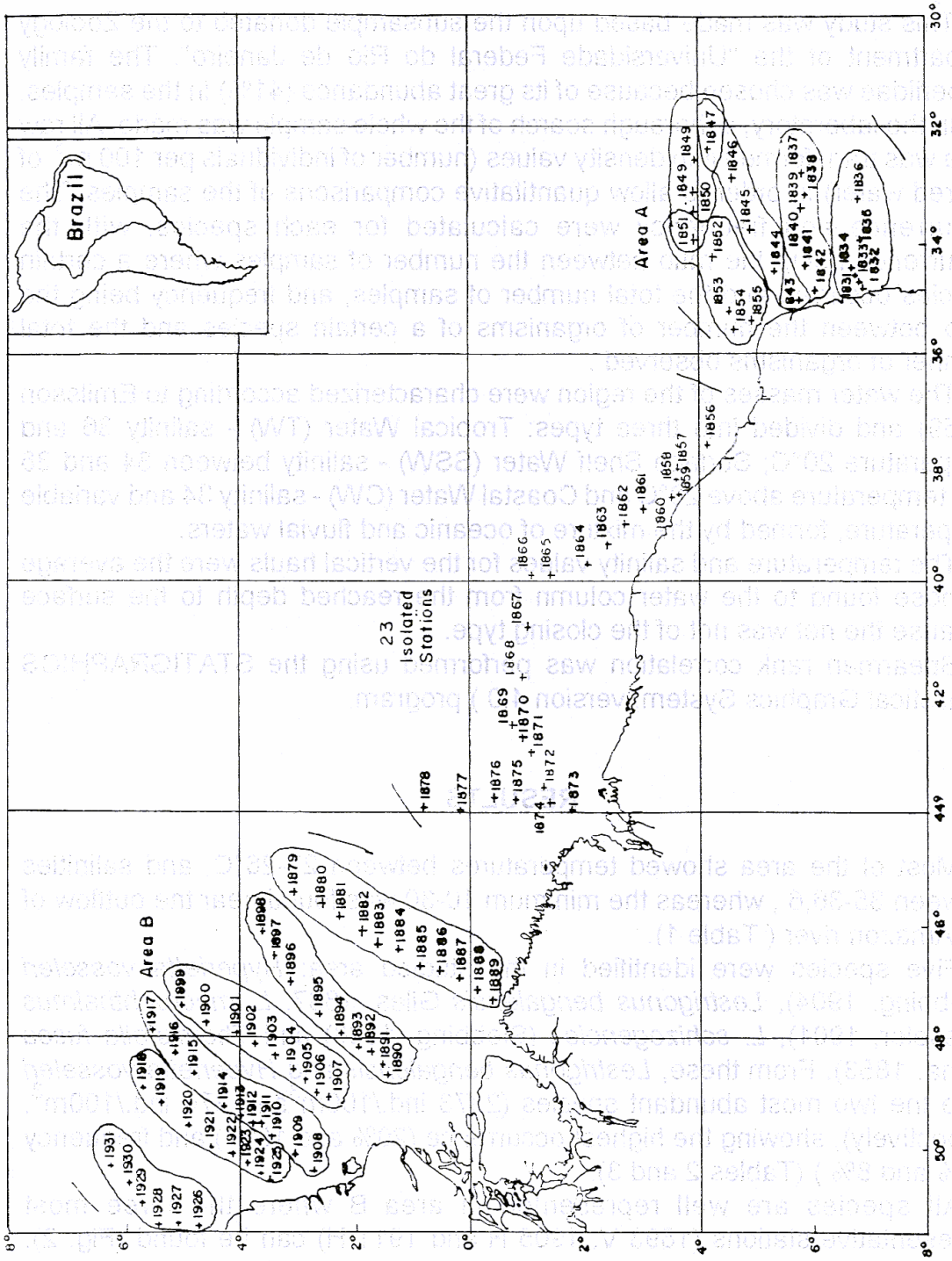

Fig. 1 - Sampling Area - Hauls Stations

The biovolume of samples was measured on board by the settling method (Table 1). They were preserved in 4% buffered formaldehyde for laboratory analysis.

This study was made based upon the subsample donated to the Zoology Department of the "Universidade Federal do Rio de Janeiro". The family Hyperiidae was chosen because of its great abundance (41%) in the samples.

In the laboratory, a thorough search of the whole sample was made. All raw data was transformed into density values (number of individuals per 100 m^3 of filtered water) in order to allow quantitative comparisons of the samples. The occurrence and frequency were calculated for each species, with the occurrence being the ratio between the number of samples where a certain species occurred and the total number of samples, and frequency being the ratio between the number of organisms of a certain species and the total number of organisms observed .

The water masses of the region were characterized according to Emilsson (1959) and divided into three types: Tropical Water (TW) - salinity 36 and temperature 20°C; Surface Shelf Water (SSW) - salinity between 34 and 36 and temperature above 20°C and Coastal Water (CW) - salinity 34 and variable temperature, formed by the mixture of oceanic and fluvial waters.

The temperature and salinity values for the vertical hauls were the average of those found to the water column from the reached depth to the surface because the net was not of the closing type.

Spearman rank correlation was performed using the STATIGRAPHICS (Statistical Graphics System, version 4.0) program.

RESULTS

Most of the area showed temperatures between 27-28°C, and salinities between 35-36,6 , whereas the minimum 10-30 was found near the outflow of the Amazon river (Table 1).

Five species were identified in the studied area: *Hyperietta vosseleri* (Stebbing, 1904), *Lestrigonus bengalensis* Giles, 1887, *L. macrophthalmus* (Vosseler, 1901), *L. schizogeneios* (Stebbing, 1888) and *Themistella fusca* (Dana, 1853). From these, *Lestrigonus bengalensis* and *Hyperietta vosseleri* were the two most abundant species (2873 ind./100$m^3$and 270 ind./100m^3, respectively), showing the highest occurrence (20% and 15%) and frequency (84% and 8%) (Tables 2 and 3).

All species are well represented in area B where the three most representative stations (1893 V, 1905 H and 1911 H) can be found (Fig. 2). These stations are located in coastal water area. These five species can be roughly placed into three groups regarding their abundance and the variation of the temperature and salinity parameters: Tropical water - *Themistella fusca, L. macrophthalmus* and *L. schizogeneios;* Surface Shelf water - *L. schizogeneios* and *Hyperietta vosseleri* and Coastal water - *L. bengalensis* and *Hyperietta vosseleri* (Fig. 2).

Table 1 - Position and Hydrographical Data of the Oceanographical Stations "Norte-Nordeste II" *1 Average Time of the Horizontal and Vertical hauls *2 Filtered water volume - H : 100 m^3 H- horizontal haul V- vertical haul

stations & date	*position*	*time (h) *1*	*vertical haul depth (m)*	*filtred water volume -V (m^3) *2*	*plankton biovolume (cm^3)*	*temperature (^oC)*	*salinity (S)*
1831	06°50.0'S	17:15			24-H	28.57-H	36.64-H
10/04	034°44.0'W		17	12.5	34-V	28.56-V	36.65-V
1833	06°45.5'S	21:38			40-H	28.04-H	36.52-H
11/04	034°32.0'W		21	15	20-V	28.05-V	36.60-V
1834	06°40.0'S	04:25			32-H	28.31-H	36.33-H
11/04	034°21.0'W		32	22.5	20-V	28.31-V	36.52-V
1836	06°51.0'S	18:25			20-H	28.30-H	36.25-H
11/04	033°15.0'W		61	35	10-V	27.67-V	36.26-V
1837	05°49.0'S	04:35			20-H	28.14-H	36.15-H
12/04	032°50.0'W		69	45	18-V	27.55-V	36.23-V
1838	05°53.7'S	08:35			17-H	28.18-H	36.07-H
12/04	033°00.0'W		69	40	07-V	27.50-V	36.11-V
1840	05°46.5'S	18:35			25-H	28.23-H	36.05-H
12/04	033°55.0'W		69	40	15-V	27.36-V	36.09-V
1842	06°00.0'S	05:05			110-H	28.30-H	36.34-H
13/04	034°41.0'W		51	30	35-V	27.25-V	36.61-V
1843	05°46.0'S	11:20			85-H	28.64-H	36.27-H
13/04	035°01.4'W		36	22.5	35-V	28.27-V	36.47-V
1853	04°29.5'S	00:54			40-H	28.05-H	35.89-H
16/04	035°06.0'W		55	35	10-V	27.80-V	36.10-V
1856	04°03.5'S	01:50			30-H	28.00-H	36.10-H
17/04	037°24.5'W		74	37.5	20-V	27.04-V	36.40-V
1861	03°05.1'S	14:20			45-H	28.43-H	36.18-H
20/04	038°39.5'W		53	30	20-V	26.58-V	36.40-V
1862	02°42.0'S	18:10			80-H	28.45-H	35.75-H
20/04	038°54.0'W		61	42.5	70-V	26.84-V	36.20-V
1863	02°26.0'S	23:08			50-H	28.06-H	35.69-H
21/04	039°14.0'W		44	45	40-V	26.84-V	36.05-V
1867	01°01.5'S	00:14			55-H	27.89-H	35.59-H
22/04	040°41.5'W		38	30	35-V	27.59-V	35.93-V
1868	00°50.0'S	07:58			30-H	27.86-H	35.70-H
22/04	041°32.5'W		78	60	20-V	26.12-V	36.10-V
1870	00°55.0'S	19:45			55-H	28.24-H	35.87-H
22/04	042°37.0'W		84	45	25-V	26.81-V	36.20-V
1871	01°03.0'S	23:20			75-H	27.97-H	35.81-H
23/04	042°55.0'W		68	45	50-V	25.96-V	36.18-V
1873	01°42.0'S	09:46			120-H	28.52-H	35.18-H
23/04	043°57.0'W		39	25	90-V	28.48-V	35.15-V
1882	01°45.5'S	22:08			40-H	28.05-H	35.99-H
26/04	046°03.0'W		72	47.5	25-V	27.14-V	36.15-V
1883	01°27.5'N	02:12			120-H	27.75-H	35.64-H
26/04	046°14.0'W		81	50	40-V	26.68-V	35.94-V
1884	01°12.5'N	05:31			140-H	27.69-H	35.00-H
26/04	046°23.5'W		52	30	100-V	27.38-V	35.62-V

TABLE 1 - Cont.

stations & date	*position*	*time (h) *1*	*vertical haul depth (m)*	*filtered water volume -V (m^3) *2*	*plankton biovolume (cm^3)*	*temperature (^oC)*	*salinity (S)*
1886	00°31.8'N	11:33			45-H	28.19-H	34.62-H
26/04	046°43.9'W		39	27.5	50-V	28.14-V	34.62-V
1892	01°45.0'N	19:05			350-H	27.74-H	22.70-H
01/05	048°18.0'W		53	30	100-V	27.70-V	32.23-V
1893	01°57.0'N	00:06			200-H	27.33-H	30.84-H
02/05	048°08.0'W		39	35	80-V	27.54-V	34.40-V
1894	02°11.0'N	03:48			100-H	27.57-H	35.76-H
02/05	047°57.0'W		70	50	60-V	27.32-V	35.81-V
1899	05°01.0'N	18:40			75-H	27.45-H	35.83-H
03/05	047°30.0'W		69	53	50-V	27.17-V	35.90-V
1900	04°36.0'N	23:18			60-H	27.27-H	35.86-H
04/05	047°44.0'W		62	40	30-V	26.59-V	36.04-V
1905	02°54.0'N	18:35			60-H	27.74-H	35.59-H
04/05	048°48.5'W		74	45	55-V	26.70-V	35.86-V
1906	02°40.5'N	21:08			75-H	27.76-H	33.87-H
05/05	049°00.0'W		46	30	40-V	27.47-V	34.94-V
1910	03°28.5'N	18:25			80-H	27.81-H	25.30-H
05/05	049°52.0'W		64	75	15-V	27.02-V	34.03-V
1911	03°39.0'N	23:30			85-H	27.65-H	29.15-H
06/05	049°46.0'W		46	70	40-V	27.45-V	34.10-V
1912	03°49.0'N	02:33			20-H	27.65-H	35.67-H
06/05	049°40.0'W		85	50	10-V	27.44-V	35.83-V
1913	03°59.0'N	05:55			25-H	27.68-H	35.84-H
06/05	049°35.0'W		98	70	15-V	27.25-V	35.86-V
1915	04°51.0'N	19:00			30-H	27.37-H	35.76-H
06/05	048°44.0'W		70	50	13-V	26.90-V	35.83-V
1920	04°56.0'N	04:05			40-H	27.19-H	35.68-H
08/05	049°40.0'W		94	55	25-V	25.98-V	35.87-V
1922	04°10.0'N	12:33			120-H	27.85-H	33.54-H
08/05	050°10.4'W		78	60	50-V	27.52-V	35.39-V
1923	03°55.5'N	15:28			30-H	27.84-H	28.07-H
08/05	050°20.0'W		71	60	10-V	27.12-V	34.57-V
1924	03°43.0'N	18:10			120-H	27.88-H	22.15-H
08/05	050°30.0'W		42	25	25-V	27.07-V	30.83-V
1926	04°44.0'N	09:35			220-H	27.45-H	22.45-H
08/05	051°33.0'W		29	30	50-V	26.76-V	32.44-V
1927	05°06.0'N	15:10			45-H	27.98-H	25.82-H
09/05	051°26.0'W		56	55	10-V	27.23-V	33.78-V
1928	05°28.0'N	19:40			85-H	27.83-H	33.53-H
09/05	051°28.5'W		69	45	20-V	27.07-V	35.26-V
1929	05°41.5'N	00:13			30-H	27.51-H	35.79-H
10/05	051°01.0'W		77	50	20-V	27.36-V	35.84-V

Table 2 - Hyperiids Total Density (individuals.100m^{-3}) - North-Northeast II cruise.

	Hyperietta vosseleri	*Lestrigonus bengalensis*	*L. macrophthalmus*	*L. schizogeneios*	*Themistella fusca*
1831 H		20			
1831 V		48			
1833 H	2		2		
1833 V		13	13		27
1834 H	4		2		
1836 H		4		6	
1837 H	8	8	22	2	
1837 V	4				
1838 V		5			
1840 H	4				
1842 H		2			
1843 V				9	
1853 H	16			4	
1856 V	11			32	
1861 V		7		7	
1862 H	14				
1863 H				2	
1867 H	4				
1867 V	13	7			
1868 H				4	
1870 H		6			
1871 H	2				
1873 V		8			
1882 H	6	4			
1882 V	21			4	
1883 H	50	32	16	2	
1884 V		153			
1886 V		145			
1892 H	6	38			
1892 V		93			
1893 V	11	526			
1894 H		18	2		
1894 V	8	88	16	4	
1899 H	10	4	4	6	2
1900 H	2	2		2	
1905 H		238	2		
1905 V	4	71			
1906 H	20	16			
1906 V	13	133		7	

Table 2 - Cont.

	Hyperietta vosseleri	*Lestrigonus bengalensis*	*L. macrophthalmus*	*L. schizogeneios*	*Themistella fusca*
1910 V		59	8		
1911 H	4	320			
1911 V	3	191	11		
1912 H		34			
1912 V	4	160			
1913 V		6			
1915 H	4		4		
1920 H			2	2	
1922 H		80			
1922 V	3	80		3	
1923 H		38			
1923 V			3		
1924 V		24			
1926 H		2			
1926 V	7	47			
1927 H		108			
1927 V		33			
1928 H	10	2	2		
1929 H	2				

Table 3 - General Comparative Data about the identified species.

SPECIES	TOTAL DENSITY (ind.100m^{-3})	OCCURRENCE (%)	FREQUENCY (%)	JUVENILES (ind.100m^{-3})
Lestrigonus bengalensis	2837	20	84	79 M 165 F
Hyperietta vosseleri	270	15	8	8 M
L. schizogeneios	109	8	3	2 M
L. macrophthalmus	96	7	3	-
Themistella fusca	29	1	1	-

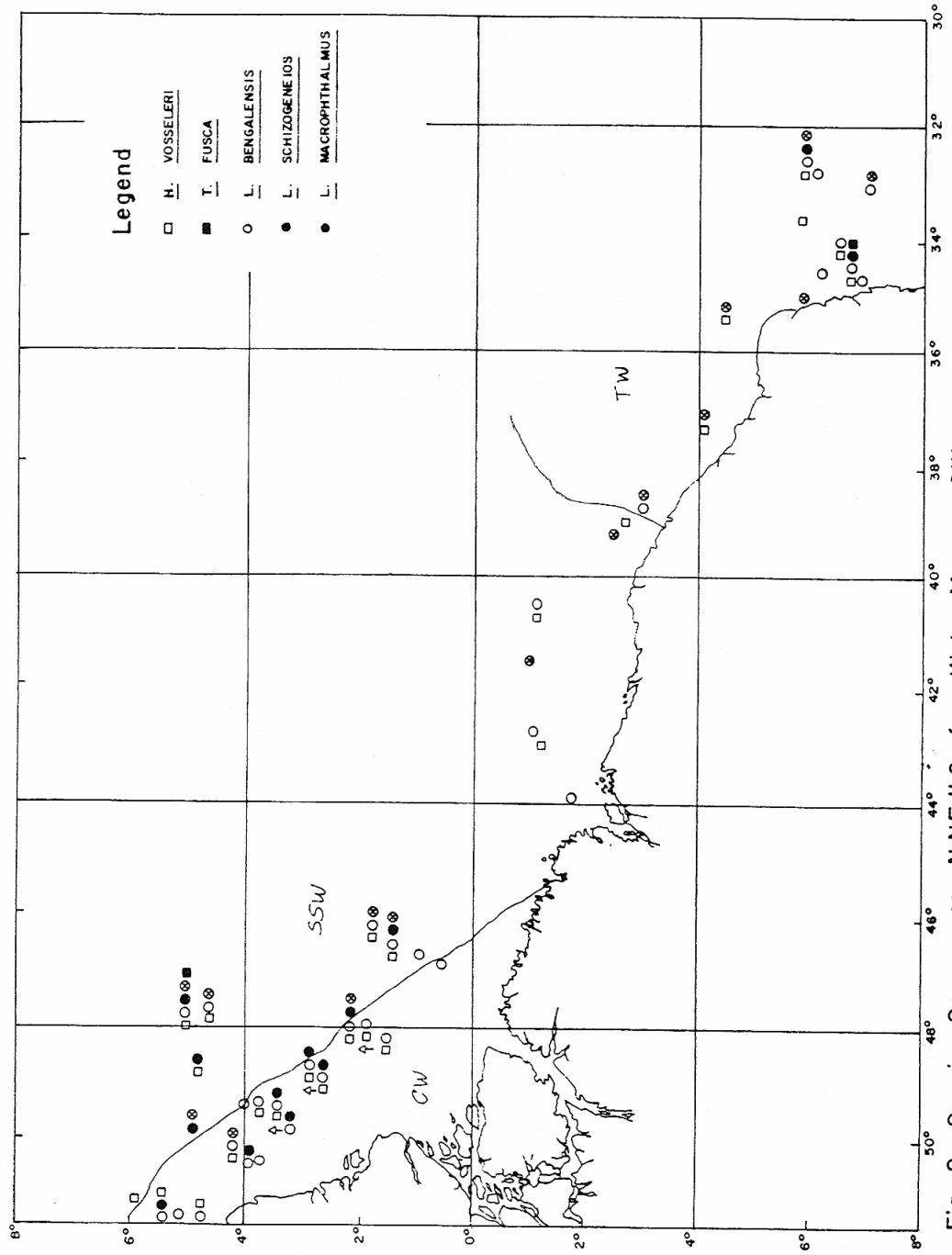

Fig. 2 – Species Occurrence – N NE II Surface Water Masses: CW– Coastal water; SSW–Shelf water; TW – Tropical water; ↟ Most abundant stations.

So far, besides the five species of the present study, *Themisto gaudichaudii* Guérin-Méneville, 1825 - Duarte, 1994; *Hyperoche martinezi* (F. Müller, 1864) - Pereira, 1962; *Hyperietta luzoni* (Stebbing, 1888) - Stewart, 1913 and *Hyperioides longipes* Chevreux, 1900 - Stewart, 1913 (near Tristão da Cunha Island) were assigned to the Brazilian waters.

The T/S diagram of the horizontal hauls (Fig.3) shows two main groups: coastal water species on the left side and surface shelf and tropical ones on the right side.

L. bengalensis showed a negative correlation (r_s = -0.43; $p < 0.05$) with salinity data for horizontal and also for vertical hauls (r_s = -0,49; $p < 0.05$). No significant values were found to *Hyperietta vosseleri*.

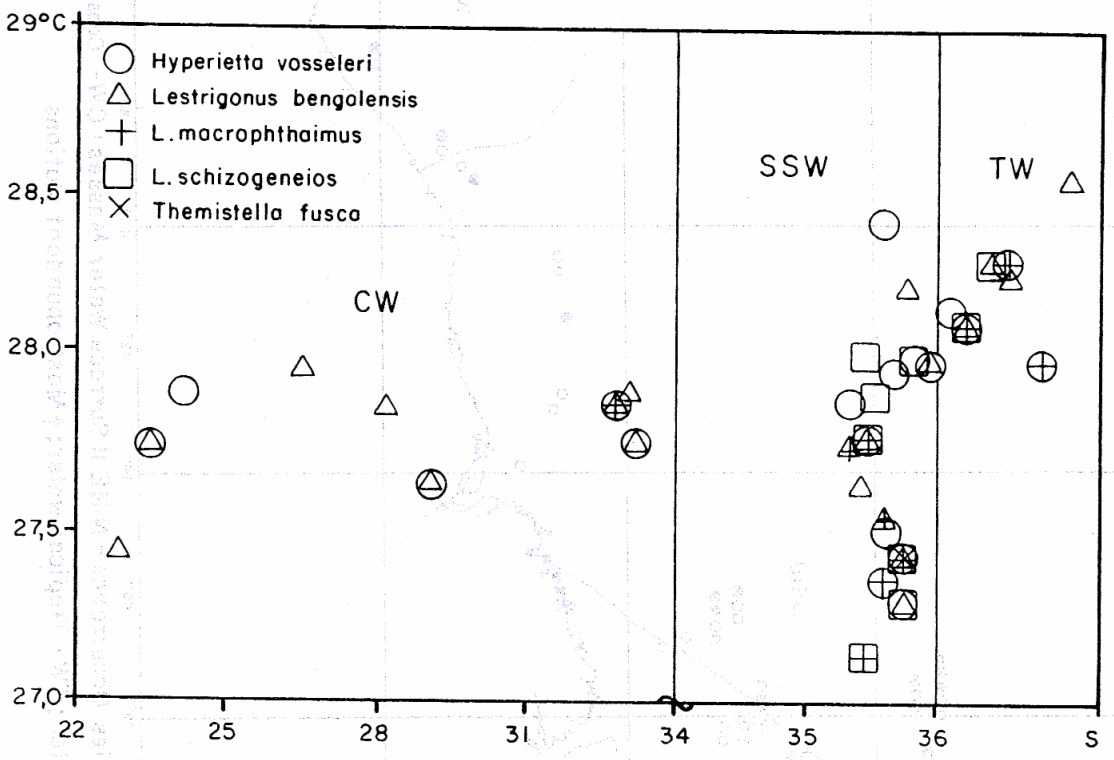

Fig.3 – Species distribution according to temperature and salinity values – Horizontal hauls.

Young specimens were identified (254 ind.100m^{-3}-7,5%) according to Laval (1968) and Bowman (1973). Two stages of *Lestrigonus bengalensis* male juveniles (pereonites 1-5 fused) were found: one with antenna 1 2-segmented, antenna 2 1-segmented and 1-segmented mandibular palp, whereas the other stage presents antennas 1 and 2 with a segmented flagellum less than half as long as the pereon with a 3-segmented mandibular palp conspicuous to the adult forms (Fig. 4), the latter would be the stage 8 (prepuberty). Juveniles males of *Lestrigonus schizogeneios* however have pereonites 1 to 5 fused only in the 2-5 juvenile stages when they measured just 1,3 mm, changing to 4 fused pereonites and measuring 1,5 mm in the stage 6. So, males of these two species can not be mistaken.

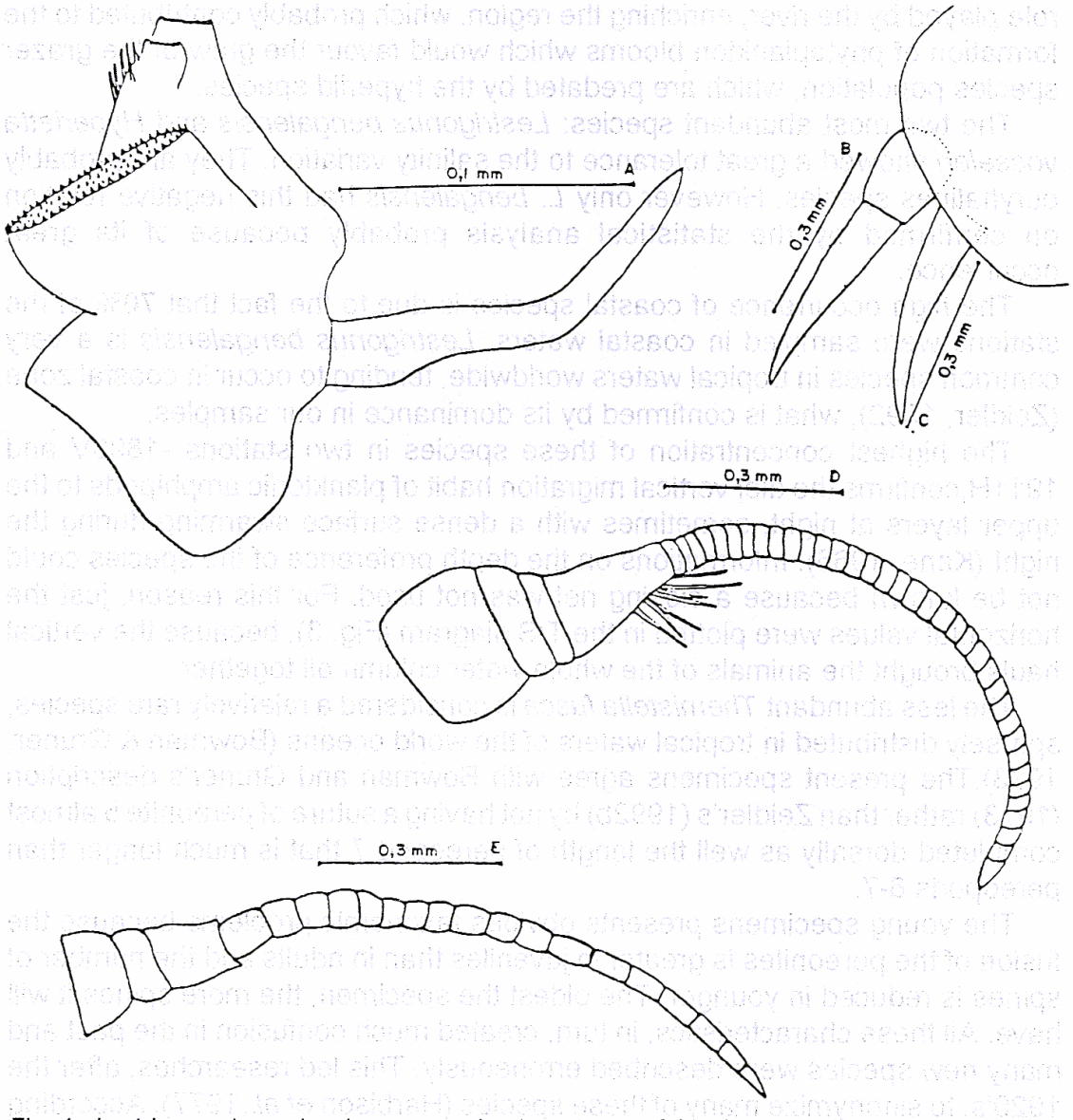

Fig. 4 - Lestrigonus bengalensis young male - two stages of development A - Md; B - A1; C - A2; D - A1; E - A2; D/E - more developed stage.

DISCUSSION

The dominance of the family Hyperiidae in the samples can be explained by the range in depth, as the deepest sample was made in 94 m, characterizing its preference for the epipelagic zone. There are very few samples available from deep water (greater than 1000 m), which is said to be dominated by most of the other superfamily of hyperiid, Physosomata, which represents about one third of the world fauna of about 240 species (Zeidler, 1992).

The low values of salinity in area B (Fig. 1) were influenced by a great flood period of the Amazon river which had occurred right before the sampling period. The highest density values found in this area can demonstrate the remarkable role played by the river, enriching the region, which probably contributed to the formation of phytoplankton blooms which would favour the grow of the grazer species population, which are predated by the hyperiid species.

The two most abundant species: *Lestrigonus bengalensis* and *Hyperietta vosseleri* showed a great tolerance to the salinity variation. They are probably euryhalines species. However only *L. bengalensis* had this negative relation on confirmed by the statistical analysis probably because of its great occurrence.

The high occurrence of coastal species is due to the fact that 70% of the stations were sampled in coastal waters. *Lestrigonus bengalensis* is a very common species in tropical waters worldwide, tending to occur in coastal zone (Zeidler, 1992), what is confirmed by its dominance in our samples.

The highest concentration of these species in two stations -1893V and 1911H,confirms the diel vertical migration habit of planktonic amphipods to the upper layers at night, sometimes with a dense surface swarming during the night (Kane, 1966). Informations on the depth preference of the species could not be known because a closing net was not used. For this reason, just the horizontal values were plotted in the T/S diagram (Fig. 3), because the vertical hauls brought the animals of the whole water column all together.

The less abundant *Themistella fusca* is considered a relatively rare species, sparsely distributed in tropical waters of the world oceans (Bowman & Gruner, 1973).The present specimens agree with Bowman and Gruner's description (1973) rather than Zeidler's (1992b) by not having a suture of pereonite 5 almost completed dorsally as well the length of pereopod 7 that is much longer than pereopods 6-7.

The young specimens presents obvious taxonomic problems because the fusion of the pereonites is greater in juveniles than in adults and the number of spines is reduced in younger. The oldest the specimen, the more spines it will have. All these characteristics, in turn, created much confusion in the past and many new species were described erroneously. This led researches, after the 1920's, to sinonymize many of these species (Harbison *et al.*,1977). According to Laval (1968) who studied the development of *Lestrigonus schizogeneios,* females attain maturity in stage 7 and males stage 9, counting the first molt of the protopleon larvae of the larval phase.

Bowman & McGuinness (1982) published results of the Indian Ocean Expedition (IIOE) - 1959/1965, regarding the Hyperiidae collection which comprised about 45% of the amphipoda collected. Many considerations are made about the fifteen species found. The five species here recorded were found in that area.

In order to conclude distributional patterns, the study of the group has to be extended in the Western South Atlantic, gathering information with other areas of the world.

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