HYPERIID AMPHIPODS FOUND IN ARGENTINE SHELF WATERS*

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RESUMEN

Los anfípodos planctónicos del mar argentino y adyacencias

Este trabajo trata sobre la composición sistemática y distribución de los anfípodos hipéridos en aguas de la plataforma argentina. Las muestras provienen de las campañas "Walter Herwig" I y II (mayo y junio de 1978 respectivamente) y "Capitán Cánepa" 05 y 07 (mayo y junio de 1981 respectivamente). Fueron halladas las siguientes especies: ***Cyllopus magellanicus, Hyperiella antarctica, Hyperoche nedusarum, Themisto gaudichaudii, Phronima sedentaria*** *y* ***Primno macropa.*** ***Themisto gaudichaudii*** *apareció ampliamente distribuida en sectores de plataforma e inmediaciones del talud;* ***Primno macropa*** *e* ***Hyperiella antarctica*** *fueron halladas casi exclusivamente en aguas oceánicas; las especies* ***Hyperoche medusarum*** *y* ***Cyllopus magellanicus*** *fueron halladas en latitudes intermedias; dado su escaso número, la distribución de estas dos especies se considera provisoria. Debido a limitaciones metodológicas del muestreo, los datos de abundancia están expresados en forma porcentual.*

INTRODUCTION

This is the first study on planktonic amphipods, their distribution, and their relation with some environmental factors carried out in Argentine shelf waters; although the sampling methodology and the limited data are not adequate, the available information has almost met the objectives of the present study which are:

a) to contribute to the knowledge on systematics of the group in waters on the Argentine shelf and adjoining sectors of the slope; b) to relate the general features of their distribution with the oceanograpic information available from published works; c) to provide a key on systematics and its application.

The knowledge on planktonic amphipods from Argentine sea waters is limited to scarcy references, especially on its role as food for fishes. The works on the systematics and distribution in the Southern Ocean refer mostly to high latitudes; in this connection, the works by Bovallius (1889), Walker (1907), Chevreux (1913), Spandl (1927), Barnard (1930 and 1937), and Hurley (1960) are worth mentioning.

With reference to austral latitudes in our country, results were obtained throughout the various cruises conducted by the Instituto Antártico Argentino; Dinofrio (1977), Ramírez and Viñas (1983), and De Diego (pers. com.) which referred to Weddell sea, areas near to the Antartic Peninsula and the sector of the Georgias, Sandwich and Southern Orkney Islands.

IMPORTANCE OF THE GROUP IN THE MARINE TROPIC CHAIN

Amphipods include in their diet copepods; fish larvae and chaethognaths were also observed. The genus *Themisto*[1] is probably one of the important predators of fish larvae and competes with them in the ingestion of other zooplankters (Sheader and Evans, 1975). With

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1 In the present work, the mencioned genus is used in place of *Parathemisto* Boeck, according to Bowman *et al.*, 1982.

reference to high trophic levels, they are an important part in the diets of some of the mammals and sea birds, as well as fishes and some predators of commercial importance. In spite of their importance, only very few works refer to this aspects. The paper by Repelin (1978) on western and central areas of the Pacific Ocean states that amphipods constituted the main diet of the micronecton, with fluctuating percentages varying from 50 to 100% of the total stomach contents; adult amphipods from 10 to 37 mm length formed an important part of the diet of Thunnidae and Alepisauridae of that region (*op. cit.*).

Although Antarctic krill (*Euphausia superba*) is considered as the main food of the austral whale, other organisms form part of its diet, among which amphipods are the most conspicuous ones. The importance assigned by Nemoto (1970) in the stomach contents of the "blue", "fin", and Sei whales, deserves to be mentioned.

In the tropic chain of the Southern Ocean (El-Sayed, 1971), this group directly links with squid, fishes and birds; through them, with mammals (seals, sea elephants and toothed whales, etc.). References on the role of amphipods in the diet of Argentine fishes are rare. The works of Angelescu and Cousseau (1969) and Cordo (1981) refer to stomach contents of the hake (*Merluccius merluccius hubbsi*); Angelescu (1979) also found hyperiid amphipods in the diet of adult mackerel (Scomber japonicus *marplatensis*) and anchoita (*Engraulis anchoita*) (Angelescu and Anganuzzi, 1981). During summer, this species predates on meso and macroplankton, which include hyperiid amphipods in great number. In the stomach content of 306 specimens of *Stromateus brasiliensis* (Pisces, Stromateidae) collected from the Mar del Plata coastal waters, about 50% included pelagic amphipods (Olivier *et al.*, 1968).

MATERIAL AND METHODS

The samples were obtained from the cruises "Walther Herwig" I and II (May and June 1978) and "Capitán Cánepa" 05 and 07 (May and June 1981) conducted in shelf and adjacent waters of Argentina (see tables 1, 2 and 3). During the "Walther Herwig ' cruises, a Bongo net with a mouth diameter of 60 cm and a filterin mesh of 330 um was used, provided with a Time Depth Recorder; on the R/V "Capitán Cánepa" a biconical net was used with a mouth diameter of 48 cm and a 300 μm filtering mesh. In the "Walter Herwig" cruises, oblique hauls were made, from different depths to the surface, never exceeding 100 m; temperature and salinity were obtained by means of a BT and Nansen bottles in "W. Herwig" cruises. Amphipods from 72 stations (fig. 1) were fixed in 5% formaldehyde; their identification was based on appendages of diagnostic value, especially antennae, pereopods and uropods (see taxonomic key). The following abbreviations are given in the taxonomic key: P (pereopod), A (antenna), U (uropod). Drawings on systematics were made with a camera lucida, indicating the total size of the specimen. Due to the varying sampling methodology employed in the cruises, quantitative results are considered provisional.

As previously detailed the abundance of the species are shown as percentage values in each station. The planktonic amphipods, due to their size and swimming capacity, require high speed sampling nets, in order to obtain reliable quantitative results. Besides, their swarming demands a sampling strategy in order to cover as much possible area one can cover within a short time. Finally, they are migrating species which, according to the hours of the day, occupy different levels, not always reached by the net; Kane (1966) points out that *T. gaudichaudii* has a migration range up to 100 m, with dense surface swarmings during the night, and disperse towards deep levels during the day; these observations were recently amplified by Williams and Robins (1981) who refer vertical migrations of about 200 m in the eastern sector of the North Atlantic Ocean.

Among methodological limitations for estimating hyperiid abundance, their association with organisms of the gelatinous zooplankton (ctenophores, jelly fishes, salpids and syphonophores) must be mentioned. Three species of this work (*Hyperoche medusarum, Themisto gaudichaudii* and *Phronima sedentaria*) and of the genus *Primno* (without specification) have been found by other authors in association with gelatinous organisms (Laval, 1980; Sheader, 1977). This implies the distribution of many amphipod species when the envi-

TABLE 1.– Cruise "Walther Herwig" I: Real and percentage abundance of the recorded species by station.

WALTHER HERWIG I			SPECIES					
Station	Position		*T. gaudichaudii*	*P. macropa*	*H. antarctica*	*H. medusarum*	*C. magellanicus*	*P. sedentaria*
	Lat. (S)	Long. (W)						
502	41°09′	57°05′	143 (67%)	25 (12%)	44 (21%)	–	–	–
506	41°35′	57°53′	2969 (94%)	–	178 (6%)	–	–	–
509	41°37′	59°36′	1734 (100%)	–	–	–	–	–
510	41°41′	60°54′	158 (79%)	–	–	40 (20%)	3 (1%)	–
513	41°56′	62°54′	6 (100%)	–	–	–	–	–
515	42°17′	61°54′	3 (9%)	–	–	29 (91%)	–	–
518	42°51′	58°48′	6 (9%)	36 (54%)	25 (37%)	–	–	–
520	42°34′	59°23′	708 (99%)	3 (1%)	–	–	–	–
524	43°30′	63°31′	35 (100%)	–	–	–	–	–
526	44°57′	63°05′	384 (100%)	–	–	–	–	–
528	44°47′	61°24′	693 (98%)	–	–	–	15 (2%)	–
531	45°59′	59°57′	195 (47%)	171 (41%)	49 (11%)	–	1 (0.5%)	1 (0.5%)
535	46°52′	62°36′	510 (100%)	–	–	–	–	–
537	46°49′	63°45′	2826 (100%)	–	–	–	–	–
539	45°37′	64°25′	1880 (100%)	–	–	–	–	–
541	45°47′	66°14′	352 (100%)	–	–	–	–	–
544	48°06′	64°13′	307 (100%)	–	–	–	–	–
546	47°52′	62°58′	1414 (100%)	–	–	–	–	–
548	48°31′	61°14′	109 (99%)	1 (1%)	–	–	–	–
550	49°26′	61°43′	125 (100%)	–	–	–	–	–
552	48°22′	59°14′	7 (3%)	232 (97%)	–	–	–	–
554	48°38′	60°23′	39 (54%)	23 (31%)	11 (15%)	–	–	–
557	49°12′	64°15′	684 (100%)	–	–	–	–	–
559	49°02′	65°49′	1000 (100%)	–	–	–	–	–
562	51°06′	67°11′	83 (100%)	–	–	–	–	–
569	50°58′	61°41′	95 (82%)	21 (18%)	–	–	–	–
573	49°52′	58°53′	68	3	–	–	–	–

TABLE 1.– Cont.

WALTHER HERWIG I			SPECIES					
Station	Position		*T. gaudichaudii*	*P. macropa*	*H. antarctica*	*H. medusarum*	*C. magellanicus*	*P. sedentaria*
	Lat. (S)	Long. (W)						
575	50°46′	56°01′	(96%) 53	(4%) 235	1	–	–	–
577	50°52′	56°51′	(19%) 93	(80.5%) 1	(0.5%) –	–	–	–
579	51°46′	56°45′	(99%) 14	(1%) 27	1	–	–	–
581	52°15′	57°29′	(33%) 59	(64%) 13	3%) –	–	–	–
584	54°18′	56°10′	(82%) 7	(18%) 58	1	–	–	–
586	54°11′	57°09′	(10.5%) 15	(88%) 12	(1.5%) –	–	–	–
590	54°39′	61°44′	(56%) 13	(44%) 34	–	–	–	–
593	54°12′	62°57′	(28%) 22	72%) 47	–	–	–	–
596	53°02′	61°44′	(32%) 10	(68%) 5				
601	54°06′	64°54′	(67%) 229	(33%) 10				
			(96%)	(4%)				

ronmental conditions are replaced by the host, specially in their first stages of development.

RESULTS

1) List on systematics.

The species are mentioned according to Bowman's classification (1973) for the suborder HYPERIIDEA.

Infraorder PHYSOCEPHALATA
Superfamily VIBILIOIDEA
Family VIBILIIDAE
Genus *Cyllopus* Dana, 1852
Species *Cyllopus magellanicus* Dana, 1852
Superfamily PHRONIMOIDEA
Family HYPERIIDAE
Genus *Hyperiella* Bovallius, 1887
Species *Hyperiella antarctica*
Genus *Hyperoche* Bovallius, 1887
Species *Hyperoche medusarum* Kroyer, 1838
Genus *Parathemisto* Boeck, 1870
Species *Themisto gaudichaudii* Guérin-Méneville, 1836
Family PHRONIMIDAE
Genus *Phronima* Latreille, 1802
Species *Phronima sedentaria* Forskal, 1775
Family PHROSINIDAE
Genus *Primno* Guérin-Méneville, 1836
Species *Primno macropa* Guérin-Méneville, 1836

2) Taxonomic key for the identification of the species of this work.

The works of Bowman (1973, 1978), Kane (1966), Shih (1969) and Barnard (1930) were considered for the elaboration of the present key and for the morphological descriptions.

TABLE 2.– Cruise "Walther Herwig" II: Real and percentage abundance of the recorded species by station.

WALTHER HERWIG II			SPECIES					
Station	Position		*T. gaudichaudii*	*P. macropa*	*H. antarctica*	*H. medusarum*	*C. magellanicus*	*P. sedentaria*
	Lat. (S)	Long. (W)						
602	53°27′	65°36′	96 (95%)	5 (5%)	–	–	–	–
604	53°00′	66°43′	289 (100%)	–	–	–	–	–
609	52°23′	64°54′	76 (75%)	25 (25%)	–	–	–	–
612	52°07′	62°44′	56 (68%)	26 (32%)	–	–	–	–
614	51 49′	61°45′	9 (100%)	–	–	–	–	–
619	51°16′	65°36′	35 (100%)	–	–	–	–	–
623	50°21′	66°50′	604 (100%)	–	–	–	–	–
628	49°56′	63°31′	16 (100%)	–	–	–	–	–
631	50°16′	61°34′	50 (98%)	–	1 (2%)	–	–	–
633	49°51′	60°34′	73 (96%)	3 (4%)	–	–	–	–
636	49°23′	56°37′	3 (17%)	14 (78%)	1 (5%)	–	–	–
637	49°03′	55°59′	7 (78%)	–	2 (22%)	–	–	–
643	48°32′	62°53′	113 (100%)	–	–	–	–	–
650	46°35′	63°59′	151 (100%)	–	–	–	–	–
655	46°57′	61°14′	229 (99.5%)	1 (0.5%)	–	–	–	–
658	47°02′	60°21′	21 (50%)	12 (29%)	9 (21%)	–	–	–
666	45°17′	64°26′	519 (94%)	–	–	34 (6%)	–	–
668	44°32′	64°07′	963 (100%)	–	–	–	–	–
670	43°56′	62°35′	1911 (100%)	–	–	–	–	–
673	44°03′	60°46′	782 (100%)	–	–	–	–	–
676	43°48′	59°32′	31 (53%)	15 (25%)	13 (22%)	–	–	–
680	42°13′	60°19′	642 (99.5%)	–	–	–	4 (0.5%)	–
682	42°40′	61°31′	1649 (100%)	–	–	–	–	–
689	40°40′	60°15′	358 (100%)	–	–	–	–	–
691	40°27′	58°12′	541 (100%)	–	–	–	–	–
693	40°24′	56°07′	26 (20%)	102 (76%)	5 (4%)	–	–	–
698	40°19′	56°48′	590 (96%)	25 (4%)	–	–	–	–

TABLE 3.– Cruises "Capitán Cánepa" 05-81 and 07-81: Real and percentage abundance of the recorded species by station

	Station 2		Station 4		Station 5		Station 6	
Lat. (S)	38°20′		38°47′		39°05′		39°23′	
Long. (W)	56°59′		56°14′		55°43′		55°12′	
SPECIES	N	%	N	%	N	%	N	%
CANEPA 05-81								
T. gaudichaudii	–	–	3	100	280	98,5	70	84,5
P. macropa	–	–	–	–	5	1,5	13	15,5
H. antarctica	–	–	–	–	–	–	–	–
CANEPA 07-81								
T. gaudichaudii	37	100	6	86	344	94	65	51
P. macropa	–	–	1	14	20	5,5	59	46
H. antarctica	–	–	–	–	1	0,5	4	3

1. Uropods composed of single leaflike segments only. Pereopod 5 with much developed carpus, dentate on its anterior margin . . . . . Genus *Primno*
P. Macropa (fig. 10)

1′. Uropods composed of peduncle and two rami. P5 otherwise 2

2. P3 and P4 with dilated carpus, forming with the propus a prehensile organ. Strong dorsal spines present in adults . . . . . Genus *Themisto*
T. gaudichaudii (fig. 7)

2′. P3 and P4 with normal carpus. Adults without dorsal spines 3

3. P7 with basipod longer than the remaining segments combined, the latter comprising 3 or 5 segments; A2 inserted on ventral surface of the head . . . . . Genus *Cyllopus*
C. magellanicus (fig. 2)

3′. P7 otherwise; A2 inserted on anterior surface of head 4

4. P5 with carpus markedly widened distally; anterodistal angle forming strong pointed process; anterior margin smooth. Head subconical, widest dorsally . . . . . Genus *Phronima*
P. sedentaria (fig. 9)

4′. P5 otherwise. Head globular 5

5. P1 and P2 distinctly chelate; carpal process laterally compressed, knife-shaped . . . . . Genus *Hyperoche*
H. medusarum (fig. 6)

5′. P1 subchelate; P2 chelate; carpal process spoon-shaped, with marginal spines . Genus *Hyperiella*
H. antarctica (fig. 4)

3) Description and distribution of the species.

Cyllopus magellanicus Dana, 1852
(Fig. 2)

Head large, almost globular with large eyes which occupy almost total head surface. Flagellum of antenna 1, slender and conical. Antenna 2 inserted on ventral surface of head. P7 with a normal basipod, longer than the remaining 3 to 5 segments. Second segments of P5 oviform rarely elongate. Protopod of U3 longer or shorter than that of U1.

Distribution. Species of *Cyllopus* are confined to southern hemisphere, not being found to the north of 30°S, towards south waters they are present up to 71°S. *C. magellanicus* has been recorded in the Atlantic, Pacific and Indian Oceans between latitudes 30° and 63°S. During the present study, 23 specimens

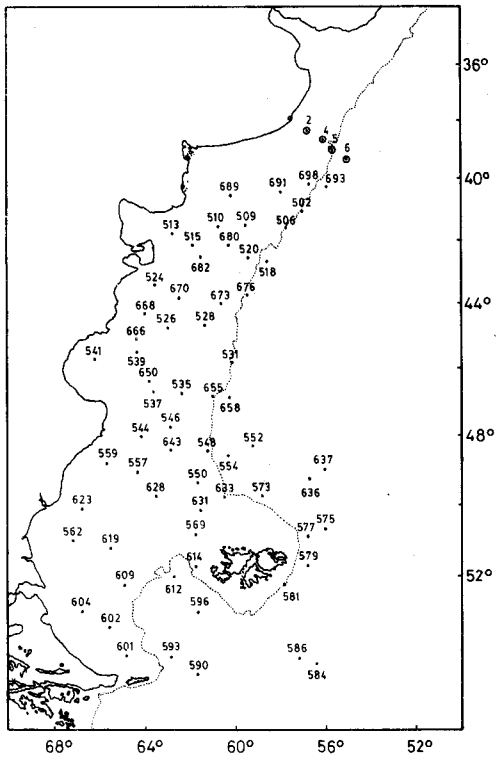

Fig. 1.— Positive stations of hyperiid amphipods of the analyzed cruises.

were found, from 4 samples collected between latitudes 41° to 46°S and longitudes 60° to 61°W.

Hyperiella antarctica Bovallius, 1887 (Fig. 4)

Body small. Antenna 1 and 2 of female 4-segmented. Pereon rather plump. P1 subchelate, P2 chelate. Posterior margin of propus P1 to P4 serrate; carpus of p3 and P4 with a few slender spines. P5 much longer than P3 and P4; P6-7 subequal to P3-4. Dactyl of P3-5 very long. Peduncle of U3 more than twice as long as telson.

Note on systematics. *H. antarctica* was originally described by Bovallius, based on specimens from Drake passage. Stebbing (1888), in his work on the Indian sector of the Antarctic Ocean, described *H. dilatata*. According to Bowman (1973), the differences used by previous workers to separate these two species "are not altogether convincing". His observations can be summarized as follows: a) descriptions were made on a few number of specimens; b) the two described species were based on only one sex, the male for *H. antarctica* and the

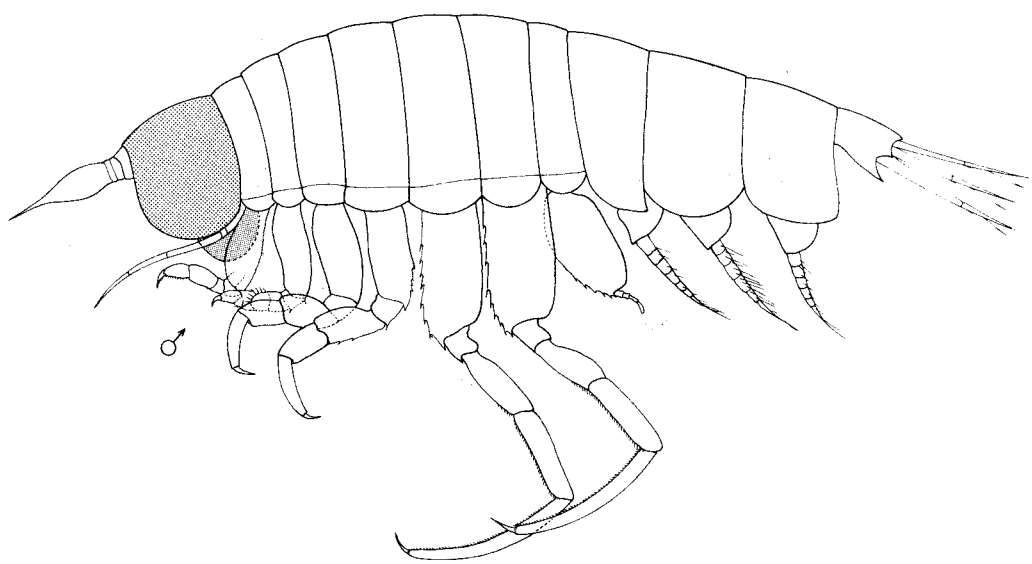

Fig. 2.— *Cyllopus magellanicus*, specimen of 12 mm length.

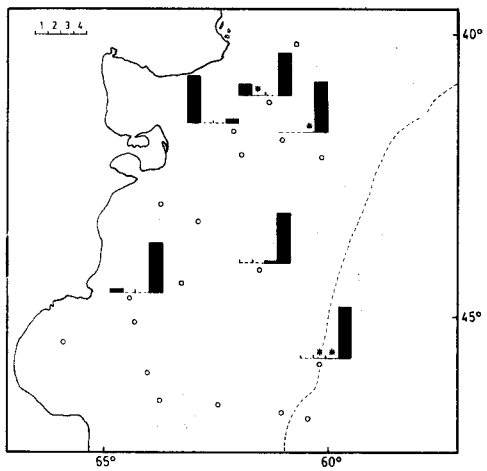

Fig. 3.— Percentage abundance of: 1. *Hyperoche medusarum,* 2. *Cyllopus magellanicus,* 3. *Phronima sedentaria,* 4. Other species, --- No specimens, (*) up to 1%.

female for *H. dilatata;* c) the appearance of some important appendages could be affected by the action of the preservative; d) specific differences were based on morphological characters (projection of pleonal epimera, corners of pereopods, forms of the endopods, etc.) "when nothing is known about its variability" (sic). Considering that "none of the characters said to be useful in distinguishing between *H. antarctica* and *H. dilatata"* (sic) specimens recorded during the present study are treated as *H. antarctica.*

Distribution. If the two above mentioned species are the same, its distribution is restricted to the region between the subtropical convergence and the Antarctic continent. A total of 346 specimens were found in 16 samples from different latitudes towards the slope.

Hyperoche medusarum Kroyer, 1838
(Fig. 6)

Peduncle of antenna 1 with 3 segments. Coxae not fused with pereonite. P1 and 2 distinctly chelate; carpal process laterally compressed, knife-shaped; P3-7 subequal; posterior margin of carpus of P3 and 4 produced into thin ridge. Posterior margin of segments 5-6 of P1 and 2 serrate.

Distribution. The records on its distribution are limited to a region between the Antarctic

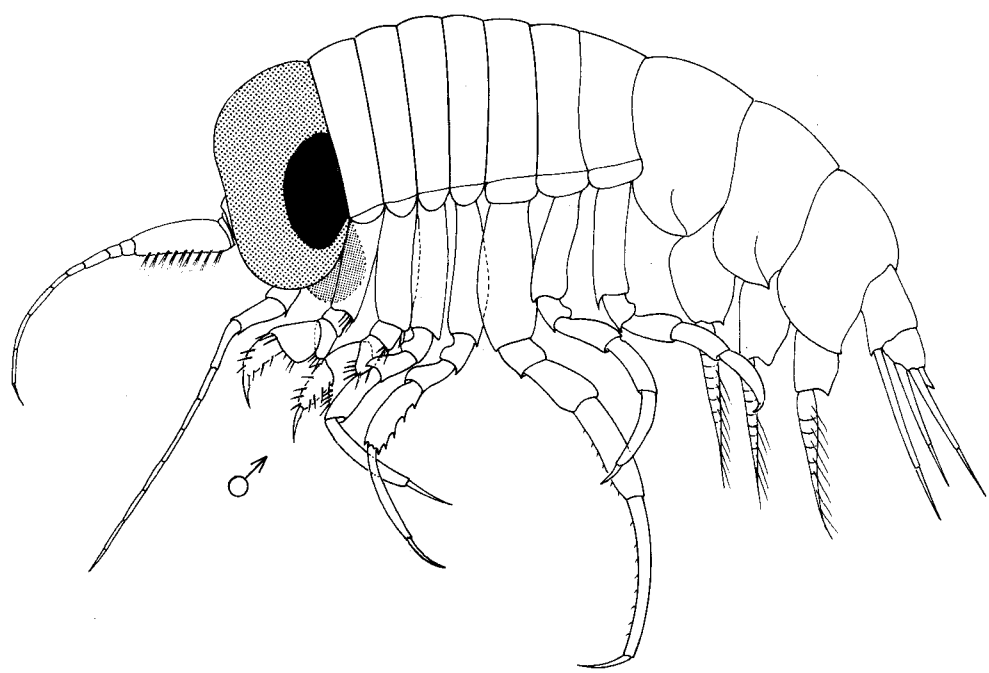

Fig. 4.— *Hyperiella antarctica,* specimen of 7 mm length.

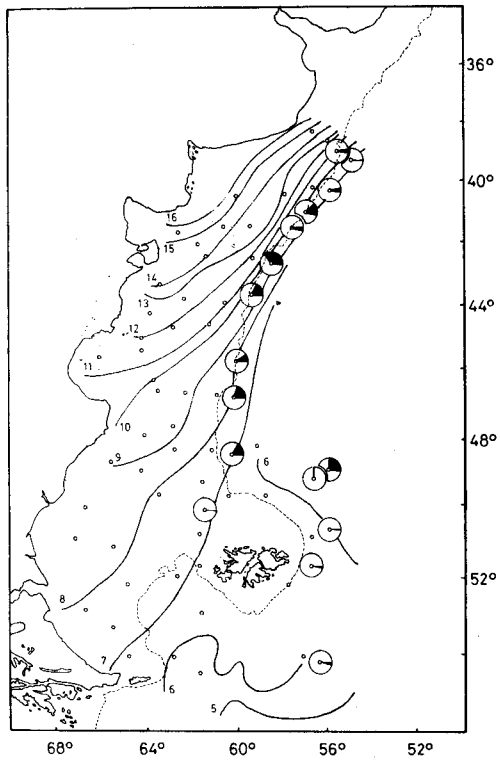

Fig. 5.— Percentage abundance of *Hyperiella antarctica*. Surface isotherms as in May 1978.

continent and the subtropical convergence. A total of 103 specimens were found at 3 shelf stations.

Themisto gaudichaudii Guérin-Méneville, 1825 (Fig. 7)

Body lenghth 7 to 25 mm, with strong dorsal spines in specimens bigger than 10 mm. Carpus of P3 in male wider proximally (almost 1/2 of length) and provided with numerous spines on surface and posterior margin; in female, ovoid and wider proximally (2/3 length) with numerous fine spines on its surface. Carpus of P4 in male with 12 strong spines on its posterior margin; in female, with 18 spines on its surface. In both sexes, P3 and 4 with dilated carpus, forming prehensile organ with propus. P5-7 longer than P3 and 4. P1 simple, P2 chelate. Outer ramus of U2 corresponds to 3/5 length of the inner.

Distribution. This oceanic species is mainly distributed in high latitudes on both the hemispheres; in the south Atlantic Ocean, it inhabits antarctic and temperate waters. In this work a total of 27,693 specimens were found. This was the only species present in

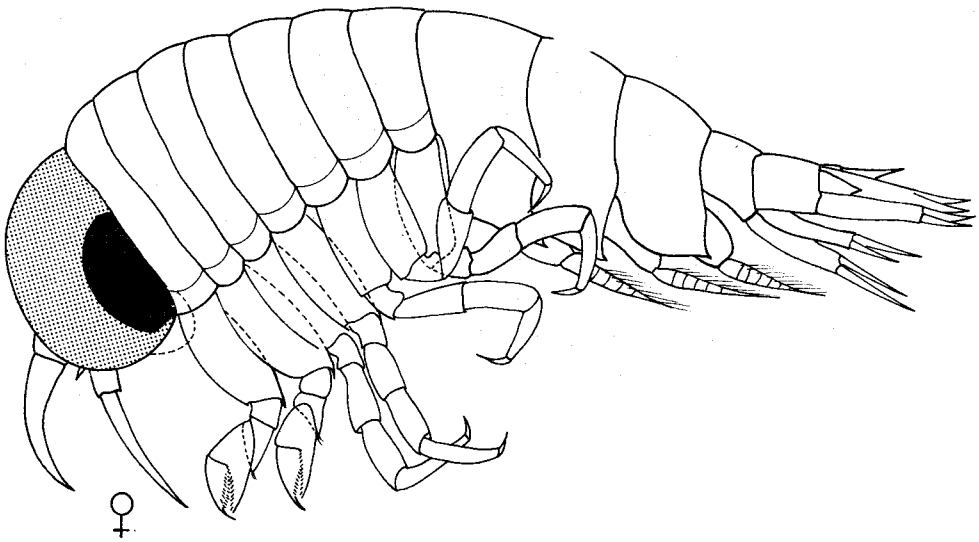

Fig. 6.— *Hyperoche medusarum*, specimen of 6 mm length.

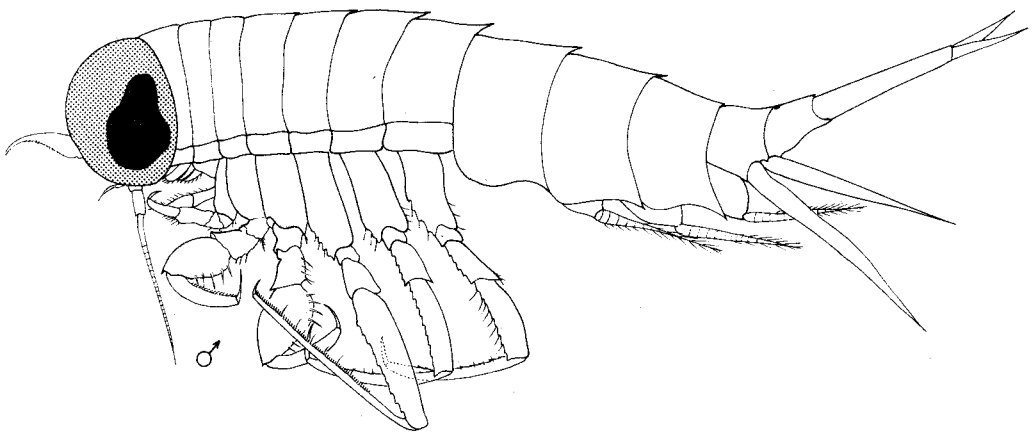

Fig. 7.– *Themisto gaudichaudii*, specimen of 18 mm length.

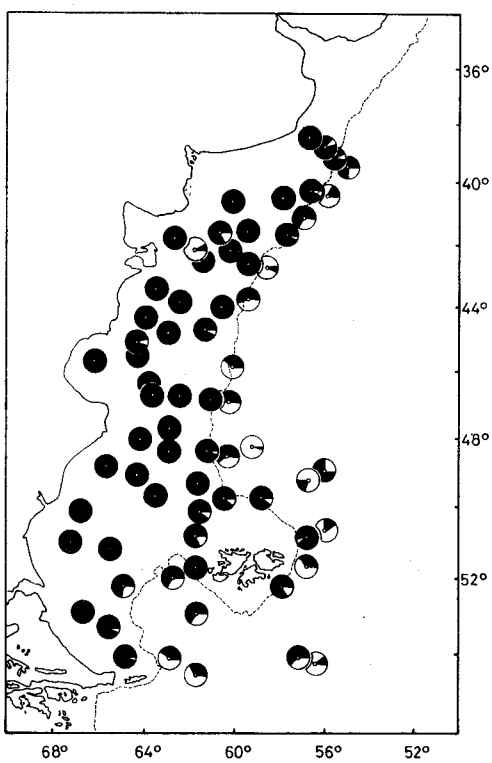

Fig. 8.– Percentage abundance of *Themisto gaudichaudii.*

all the stations and it outnumbered all the other species.

Phronima sedentaria Forskal, 1775
(Fig. 9)

Body moderately slender. Pereonites all free. P5 with carpus wider distally, produced into a strong pointed process; anterior margin smooth. U2 present; its endopod sometimes reduced but never missing. Male A1 7-jointed, in female 2-jointed. Male A2 very rudimentary; contains only a 2-jointed peduncle; in female reduced to a tubercle. Length: male 8.5-12; female 25-42 mm.

Distribution. Hurley (1969) groups it with the "near cosmopolitan species"; Shih (1969) refers it as one of the widely distributed Phronimidae, found in the Pacific and Atlantic Oceans and also in the Indian Ocean and Red Sea (Hurley, 1969). No record is made from Antarctic waters. Only a single specimen was recorded during the present study from the shelf waters (45°59'S - 59°57'W).

Primno macropa Guérin-Méneville, 1836
(Fig. 10)

Body slender, up to 21 mm length. Female A1 1-segmented, in male with long filiform flagellum. Female A2 rudimentary, in male similar to A1. Pereonites 1 and 2 separate. Pereonite 7 and pleonites 1 and 2 produced posteriorly into mid-dorsal spines. P3, 4 and 6 simple, with some teeth on the margin of carpus. P5 prehensile, anterior margin of carpus dentate, with

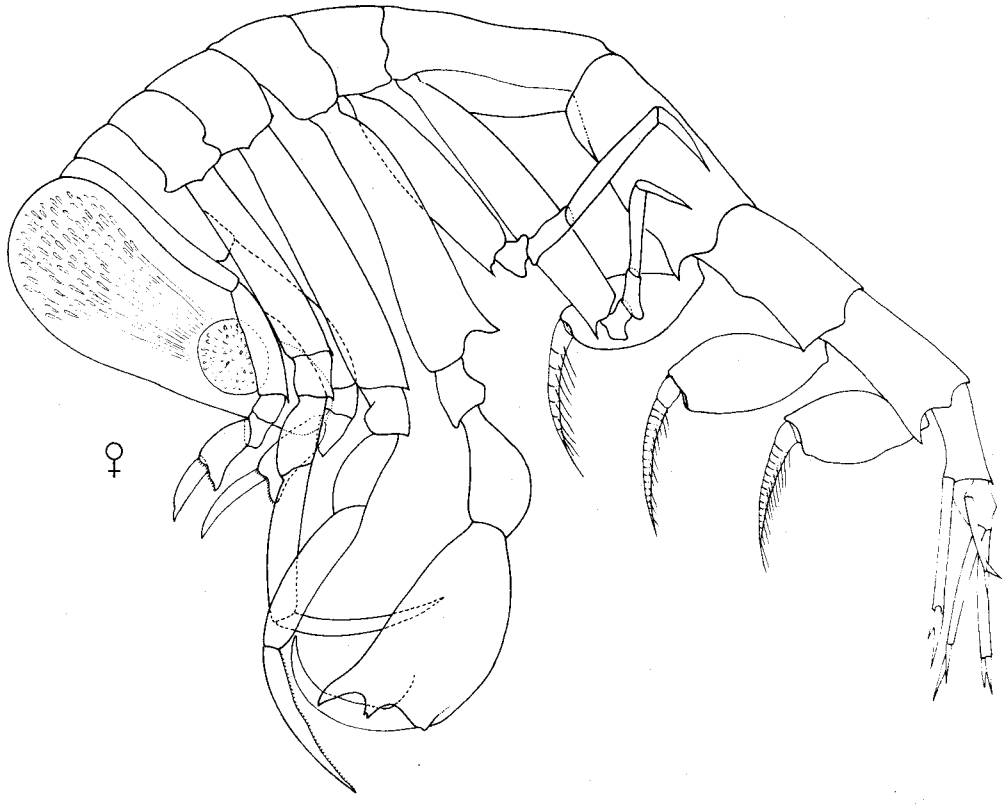

Fig. 9.— *Phronima sedentaria,* specimen of 26 mm length.

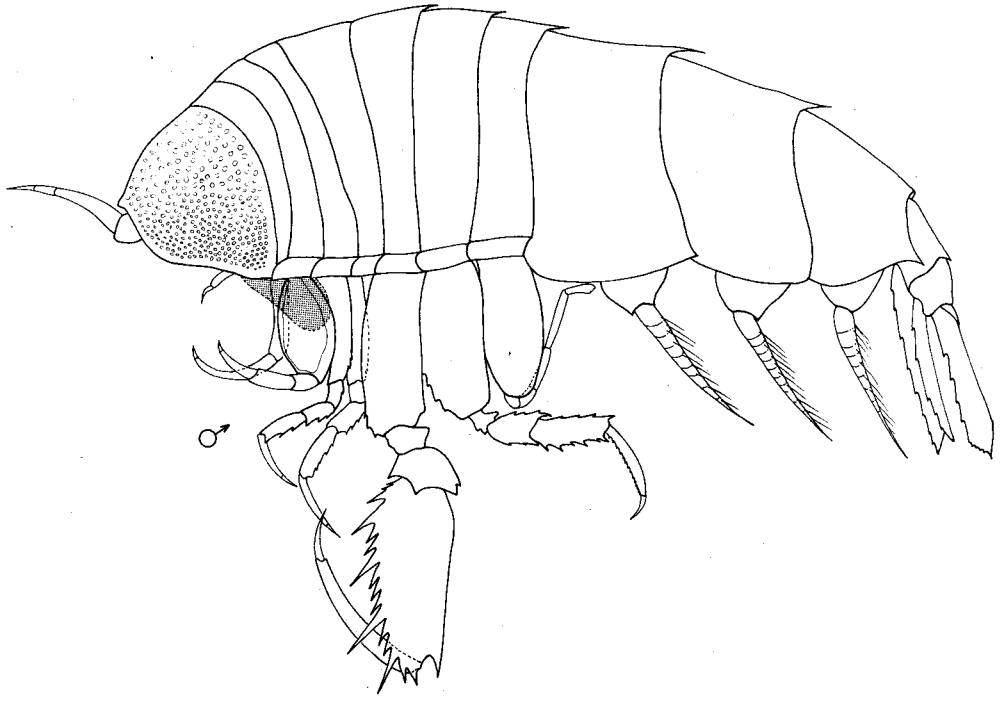

Fig. 10.— *Primno macropa,* specimen of 10 mm length.

several long teeth separated by groups of short teeth. U2 and 3 with teeth on outer margin.

Distribution. It is distributed in Atlantic and Pacific Oceans in both hemispheres, reaching south to Antarctic waters. Altogether 1283 specimens were found in this work, from 32 stations (44% of the total sampling), next to *T. gaudichaudii*, the dominant species.

DISCUSSION

Species distribution

Surface waters exhibited latitudinal temperature gradient (fig. 5) in most of the shelf areas towards the slope, isotherms being parallel to it; same was found true for other depths studied. This indicates that oceanic species must overcome a thermal increase while entering into the neritic region. In relation to this, *Hyperiella antarctica* was found in adjacent areas of the slope through all the latitudes covered by the present cruises; this fact exhibits a close relationship with Malvinas Current (fig. 5). Its distribution seems to be correlated with surface isotherms below 10°C, without excluding its presence in more oceanic stations, with 5° to 6°C temperatures. Consequently, the species can be considered as criophil. It has been pointed out (Schott, 1926 taken from Ekman, 1953) that the annual mean isotherm of surface shelf waters is detected, near latitudes of San Jorge Gulf, which marks the transition between cold and temperate waters. This explains the presence of criophil species in the neritic plankton of Patagonic latitudes (Ramírez, 1970, 1971, 1977; Orensanz and Ramírez, 1974). In this regard, *Primno macropa* which up to 48°S was found in oceanic waters, occurs surrounding the neritic sector in southern waters of the shelf (fig. 11). *Themisto gaudichaudii*, the only hyperiid present in all the sectors of the shelf, also predominated over the other species in many of the slope stations. Information on the species *Hyperoche medusarum, Cyllopus magellanicus* and *Phronima sedentaria* is not considered as a testimony of its distribution given that they were only found in a few samples (fig. 3).

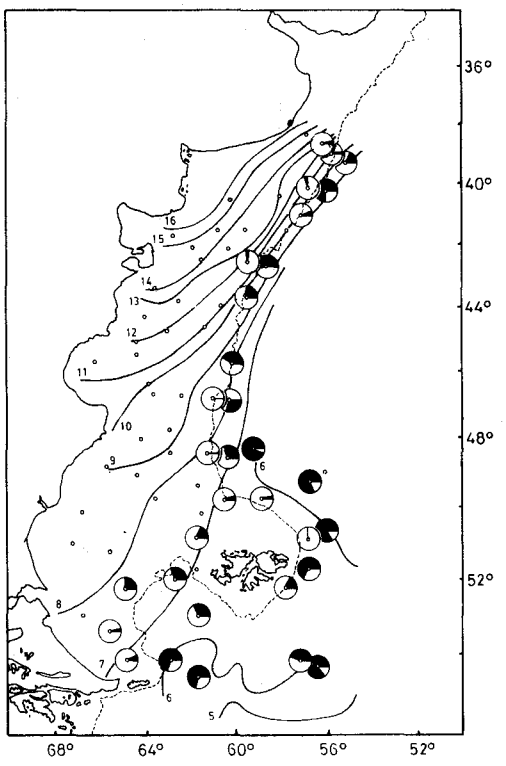

Fig. 11.— Percentage abundance of *Primno macropa.* Surface isotherms (as in fig. 5).

CONCLUSIONS

1) Six species of hyperiids were found in Argentine shelf waters: *Cyllopus magellanicus, Hyperiella antarctica, Hyperoche medusarum, Themisto gaudichaudii, Phronima sedentaria* and *Primno macropa.*

2) *T. gaudichaudii* was widely distributed in shelf and slope waters; *P. macropa* and *H. antarctica* were found almost exclusively in oceanic waters; poor representation of *H. medusarum* and *C. magellanicus* was detected in intermediate latitudes.

3) Methodological limitations are considered in relation to the results of abundance and distribution of the group: avoidance speed, swarming diurnal migrations, associations with gelatinous organisms.

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