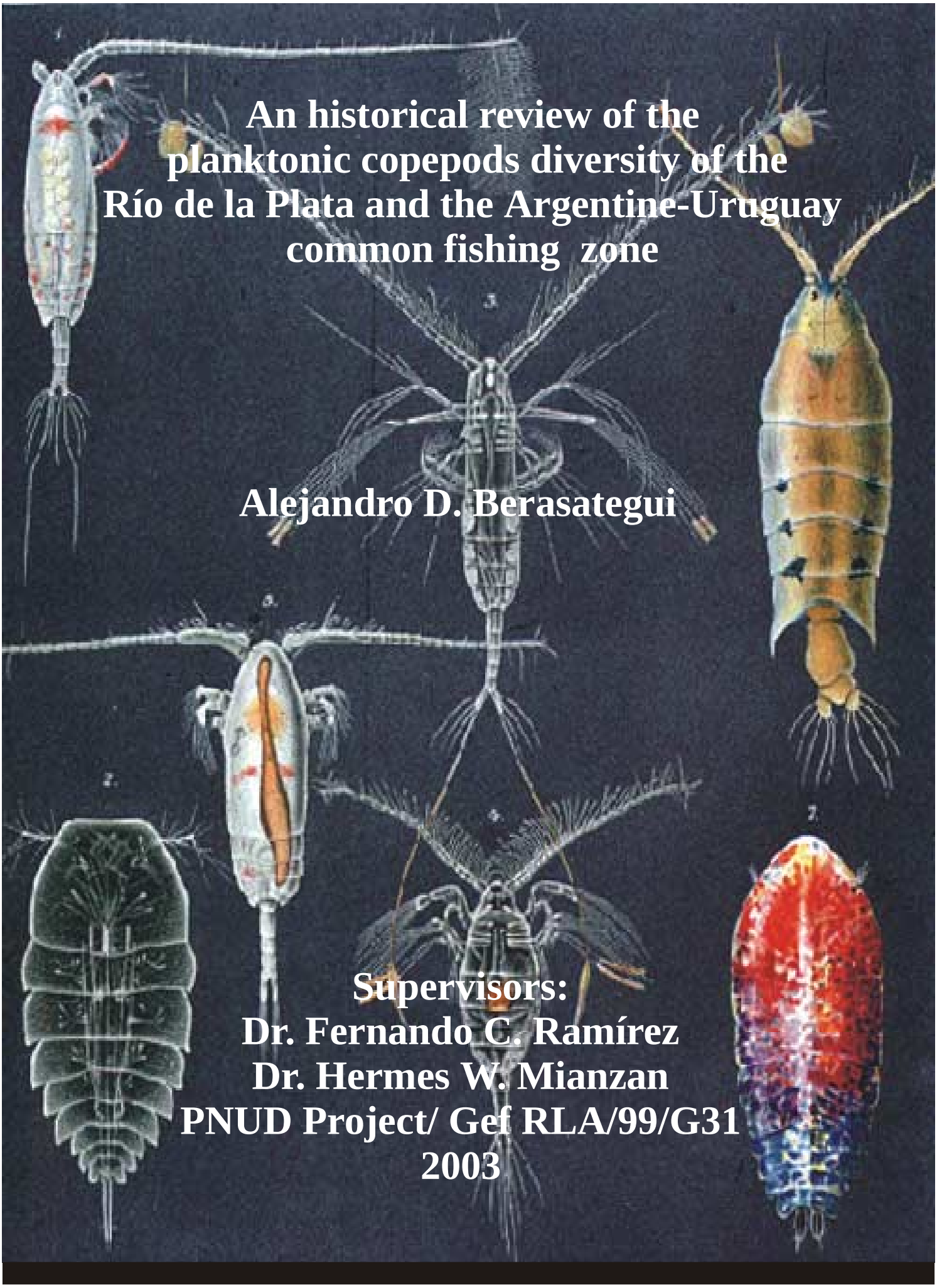

An historical review of the planktonic copepods diversity of the Río de la Plata and the Argentine-Uruguay common fishing zone

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Final Report

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Summary

The study area comprise a large and heterogenic portion of the South Western Atlantic, so it was divided in four main sectors based on oceanographic and bathymetric features. Biodiversity analysis was based on the point species richness of the Copepoda Class assuming that the patterns showed are representative of the rest planktonic groups. We perform this analysis based on two types of data-bases (one from the data corresponding to the second step of the FREPLATA cruise and the other based on historical and unpublished data). We find two major patterns repeated in the different analysis. First, the latitudinal one, where the northernmost portion of the study area (oceanic waters in front of Uruguay) shows the highest values of point species richness and the southernmost sector, influenced by the Malvinas current (in oceanic waters off Argentina) shows a decrease in this parameter. Second, the coastal-oceanic gradient, where the point species richness increases from the coast to the shelf-break.

The final database produced contains a total of 135 copepod species from 508 sampling stations (34 research cruises) made between 1963 and 2001 during different seasons of the year.

We include a list of the copepod species present in each sector and a table containing the presence of each species in the transects of the FREPLATA cruise.

I. **Introduction**

Pelagic marine biogeography forms a crucial part of the understanding the biology of the oceans. In the plankton realm, as in other environments, current spatial patterns in diversity are the result of evolutionary, biogeographic and more local abiotic, biotic and ecological factors operating at different spatial and temporal scales (Angel, 1998; Rex, Etter and Stuart, 1997). At the evolutionary scale, variability in biodiversity is related to geological events such as plate tectonics and orbital forcing (Angel, 1993; Molfino, 1994). These events have led to the opening or closure of seas, modification of global circulation patterns and oscillation of sea levels, which together have shaped pelagic biodiversity (Angel, 1998). These large-scale events should still be considered in the explanation of present day patterns of biogeography and species ecology (Williamson, 1998).

Boltovskoy (1970, 1981) define the major biogeographic divisions in the Southwestern Atlantic. The domains include five zones, Tropical (from the equator to 20°S), Subtropical (20° to 30-35°S), Transition (30-35 to 46-48°S), Subantartic and Antartic. Our study site is situated in the most dynamic domain, the Transitional zone, where water masses of different origins coexists, generating frontal systems of elevated spatio-temporal variability and high primary and secondary productivities (Hubold 1980 a, b; Carreto *et al.*, 1986).

In the context of the new emphasis on biodiversity studies and the development of marine ecological studies linked to the monitoring and understanding of the global change effects as well as to the rational management of fisheries, more taxonomical expertise and tools, like databases and identification guides, are crucially needed, specially in highly diverse and taxonomically difficult groups. A preliminary step towards this objective is the production of up-dated faunal checklists (De Broyer y Jazdzewski, 1993).

Despite substantial progress accomplished in the last decades, nowadays large portions of the Río de la Plata estuary and adjacent marine zones remain

understudied. Therefore, the main objectives of this work are to analyze the research developed on the zooplankton assemblages of this region (showing the present state of knowledge in the zooplankton community composition), and establish broad patterns of species diversity throughout the study area. It takes all the previous published information for this region and updated and enlarged it with new data.

II. Methodology

This report is based on data from different bibliographic sources (Table 1) and from unpublished databases. The bibliographic sources contains information taken by means of highly variable sampling methodologies that make unfeasible the building of a detailed species inventory with standardized abundance data (Table 1).

In this study, due to the prevalent information available in the bibliography of the planktonic assemblages of the study area is the number of species, we follow Gray (2000), and considered the point species richness SR_p (number of species in a single sampling unit from a given area) and the sample species richness SR_s (calculated as the total number of species based on a given number of sampling units) as a basic biodiversity index. There are strong relationships between sampling scale and the processes that influence diversity (Huston, 1994). At small scales all species are presumed to interact with each other and to be competing for similar limiting resources. SR_s is equivalent to the diversity of samples within-habitat, usually called alpha diversity (Fisher *et al.* 1943, Whittaker 1960 and 1967). For the entire study area the SR_L or large area species richness was calculated. This is defined as the species richness of a large area which includes a variety of habitats and assemblages.

Copepods may sometimes form up to 90-97% of the biomass of planktonic invertebrates in marine ecosystems, constituting therefore, an important link in

aquatic food webs and economy (Bradford-Grieve *et al*., 1999). Moreover, it constitutes the most numerous zooplanktonic group of the South Western Atlantic Ocean (Boltovskoy 1981 b, 1999) so, in this sense the copepod taxa were selected because it is expectable that possible trends in the zooplankton distributional patterns were influenced by the distributional patterns of the Copepoda Class and consequently constitute a perfect subject for a preliminary analysis on zooplankton species richness distribution of the estuarine system of the Río de la Plata and the continental shelf of the study area.

The study area comprise a large and heterogenic portion of the South Western Atlantic, so it was divided in four main sectors, as follows (Fig. 1):

1) An **estuarine zone** dominated by mixohaline waters, extended approximately from "Barra del Indio" in the central portion of the Río de la Plata to the external limit of the same river.

2) A **marine zone in front of the Argentine coast** (depth < 50m)

3) A **marine zone in front of the Uruguayan coast** (depth < 50m)

4) A **marine zone** with depth > 50m

This division was made largely following Acha and Lo Nostro (2002) and considering oceanographic (Salinity, temperatures and bathymetry) and bottom features (Urien, 1972; Guerrero et al., 1997; Mianzan et al., 2001), which probably influence the spatial distribution of planktonic assemblages.

III. Results

a. Freplata cruise results

During the second part of the Freplata cruise a total of 66 species of copepods were recorded, in addition 6 unidentified species were recorded (Table 2). This constitutes approximately the 47% of the total number of historically identified species for the study area (see Table 2 and 3).

Highest values of point specific richness occurs in the north transect off Uruguay, especially in the external group of stations. In this group of stations the simultaneous presence of both Subtropical and Subantarctic copepod assemblages contribute to the elevated number of species found (Fig. 2). The central transect showed a progressive decrease of the SR_p from shelf-break group of stations towards the estuarine stations of the Río de la Plata, ranging between 4 and 21 species per sample (Fig. 2), however an increase in the SR_p is observable in the ecotone between the river and the estuary near the Barra del Indio shoal due to the presence of riverine species concurrently present with estuarine species. The Southernmost transect shows the same trend, with the coastal waters off Faro Querandí presenting values between 4 and 7 copepod species, and the external stations presenting higher values of SR_p, displaying values between 9 and 12 (Fig. 2).

b. Historical account

This report is based on information from literature sources dealing with the zooplankton community of the study area (Table 1) and previous oceanographic cruises (including Freplata research cruise). The final database produced contains a total of 135 copepod species (SR_L) from 508 sampling stations (34 research cruises) made between 1963 and 2001 during different seasons of the year. This

group of stations covers a wide area approximately between 34 and 41°S and between 52 and 59°W, ranging from estuarine to oceanic waters through coastal ones (Fig. 3).

Following the zonation criteria presented above:

Estuarine waters present the lowest SR_s (21), this copepod species belongs to 18 genera and 14 families (Table3). At least seven of this species are freshwater species that occasionally were found in this area. The dominant species species in terms of abundance and positive number of stations in this region were *Acartia tonsa, Paracalanus parvus, Paracalanus crassirostris, Corycaeus amazonicus and Labidocera fluviatilis.*

In the **Argentinean Coastal waters** the SR_s reach 30. This 30 species belongs to 22 genera and 18 families. The dominant species were *Ctenocalanus vanus, Paracalanus parvus* and *Oithona nana.*

The **Uruguayan Coastal waters** presents a SRs of 66, this species takes part of 40 genera and 23 families. *Ctenocalanus vanus, Paracalanus parvus, Oithona nana, Corycaeus amazonicus* and *Oithona plumifera* were the principal species.

The **Continental Shelf-break waters** present the maximum SR_s (115), belonging to 53 genera and 26 families. In terms of abundance and positive number of stations, the most important group of species was integrated by a mixing of subtropical and subantartic copepods (*Calanus australis, Calanus simillimus, Clausocalanus brevipes, Acartia danae, Oithona similis, Ctenocalanus vanus, Drepanopus forcipatus*).

Less than 8% of the species were present in the four regions (*Acartia tonsa - Calanoides carinatus - Clausocalanus brevipes - Clytemnestra rostrata - Corycaeus amazonicus - Ctenocalanus vanus- Drepanopus forcipatus - Euterpina acutifrons - Labidocera fluviatilis - Oithona helgolandica - Oithona nana*). In

general terms a high percentage of species is shared between adjacent zones (Table 4), showing a weak limit between them. This is most likely due to the association between the zooplankton distribution and the water dynamics instead of a fixed geographical zonation.

When we analyze the historical data about copepod species richness of the study site (Fig. 3), we see that the marine coastal zones of Uruguay and Buenos Aires province showed the smallest values of SR_p ranging between 1 and 5, being an extreme case the estuarine zone of Samborombón Bay, part of the Río de la Plata estuary, that represents the lowest values of all the study area, whereas the rest of the estuary presents higher values, similar to that of the coastal zone of the ZCPAU (SR_p between 5 and 10). The ecotone between the river and the estuary near Barra del Indio shoal showed an increase in the SR_p, when we are moving from estuarine to riverine waters due to the combination of riverine and estuarine species. In the oceanic zone off the shelf break, especially in the northern part of the study area in front of Uruguay (Fig. 3), the Subtropical confluence leeds to a mixture of Subtropical and Subantarctic species of copepods, resulting in the highest values of SR_p of the study zone, reaching values higher than 35.

IV. Concluding remarks

1) In the study area exists a clear East-West gradient in the point species richness, between coastal/estuarine waters and the oceanic waters at the Subtropical Confluence zone (specially in the northern part where exist the center of maximum SR_p).
2) In contrast to terrestrial habitats, in the pelagic realm, there is an absence of semi-permanent fine to meso-scale structures limiting distributional ranges (i.e. equivalent to soil and rock type on land), nor is there any three-dimensional biological structuring that can generate microclimates (i.e.

equivalent to forest or coral reefs) (Angel, 1997). Therefore the point species richness in the pelagic universe was in close relation to the dynamic of the physical environment.

3) Contrary to the expected results (Remane and Schilieper, 1971; Levin *et al*., 2001) the point species richness of the estuarine stations is similar to that of the Continental Shelf stations, furthermore, this values are higher than that of the coastal waters of Uruguay and Buenos Aires province.

4) Information on Zooplankton community in the study area is not scarce, but intensification in the sampling of the estuarine zone of the Río de la Plata is needed for an improvement in the understanding of the biodiversity trends.

5) Finally a unification of the sampling methods and identification criteria is of central importance to acquire a better data quality.

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VI. Tables

Bibliographic source	Information types	Geographical sector
Goberna, 1986	Presence-Absence data	Coastal and shelf waters off Uruguay
Goberna, 1988	Presence-Absence data	Shelf break waters off ZCP
Ramirez, 1969	Presence-Absence and Density data	Río de la Plata estuary and ZCP
Ramirez, 1966	Semicuantitative data	Coastal waters around Mar del Plata city
Verona *et al*., 1972 a	Semicuantitative data	Coastal and shelf waters off Mar del Plata city
Verona *et al*., 1972 b	Semicuantitative data	Coastal and shelf waters off Mar del Plata city
Ramirez *et al*., 1973	Semicuantitative data	Coastal and shelf waters off Mar del Plata city
Roa *et al*., 1974	Semicuantitative data	Coastal and shelf waters off Mar del Plata city
Ramirez, 1971	Semicuantitative data	ZCP
Akselman, Carreto and Ramirez, 1986	Density data	Shelf waters off Mar del Plata city

Table 1. Bibliographic sources used in the present report.

	Unidentified species	Identified species
FREPLATA CRUISE	*Eucalanus spp. 1* *Eucalanus spp. 2* *Euchaeta spp. 1* *Candacia spp. 1* *Unidentified sp.1* *Unidentified sp.2*	*Acantocyclops robustus-Acartia danae-Acartia tonsa-Argirodaptomus denticulatus-Calanoides carinatus-Calanus simillimus-Calanus australis-Calocalanus pavo-Candacia cheirura-Candacia elongata-Centropages brachiatus-Centropages furcatus-Clausocalanus laticeps-Clausocalanus brevipes-Ctenocalanus vanus-Corycaeus flaccus-Corycaeus speciosus-Corycaeus giesbrechti-Corycaeus amazonicus-Clitemnestra rostrata-Copilia mirabilis-Drepanopus forcipatus-Eucalanus longiceps-Eucalanus elongatus-Eucalanus attenuatus-Euchaeta marina-Euterpina acutifrons-Farranula rostrata-Hemicyclops thalassius-Labidocera fluviatilis-Macrosetella gracilis-Mecynocera clausi-Metridia lucens-Mesocyclops longicetus-Microsetella norvaegica-Miracia efferatta-Nannocalanus minor-Neocalanus tonsus-Oithona nana-Oithona similis-Oithona plumifera-Oithona tenuis-Oithona robusta-Oithona atlantica-Oncaea conifera-Oncaea media-Oncaea venusta-Oncaea mediterranea-Oncaea scottodicarloi-Paracalanus quasimodus-Paracalanus parvus-Paracalanus nanus-Paracalanus crassirostris-Phaenna spinifera-Pseudodiaptomus richardi-Temora stylifera-Saphirina angusta-Scolecitrhix danae-Undinula vulgaris*

Table 2. List of identified and unidentified species found in the FREPLATA cruise.

	Families	Genera	species	Species
Estuarine waters	**14**	**18**	**21**	*Acanthocyclops michaelsini-Acanthocyclops robustus-Acartia tonsa*-Argyrodiaptomus denticulatus-Calanoides carinatus*Clausocalanus brevipes*-Clytemnestra rostrata*-Corycaeus amazonicus*-Ctenocalanus vanus*-Drepanopus forcipatus*-Euterpina acutifrons*-Hemicyclops thalassius-Labidocera fluviatilis*-Mesociclops araucaniensis-Metridia lucens-Notodiaptomus coniferoides-Oithona helgolandica*-Oithona nana*-Paracalanus crassirostris-Paracalanus parvus-Pseudodiaptomus richardi-* fresh water cop. w/identification
Argentinean Coastal waters	**18**	**22**	**30**	*Acartia tonsa-Calanoides carinatus-Calanus australis-Calanus propinqus-Calanus tonsus-Centropages furcatus-Centropages brachiatus-Corycaeus amazonicus-Clausocalanus brevipes-Clausocalanus laticeps-Clytemnestra rostrata-Ctenocalanus vanus-Drepanopus forcipatus-Eucalanus longices-Euterpina acutifrons-Hemicyclops thalassius-Labidocera fluviatilis-Metridia lucens-Microsetella norvegica-Monstrilla grandis-Oncaea venusta-Oithona atlantica-Oithona helgolandica-Oithona nana-Oithona plumifera-Paracalanus crassirostris-Paracalanus parvus-Paraltheutha minuta-Pontella patagoniensis-Temora stylifera*
Uruguayan Coastal waters	**23**	**40**	**66**	*Aetideus armatus-Acartia danae-Acartia tonsa-Brachycalanus bjornbergae-Calanoides carinatus-Calanoides acutus-Calanus australis-Calanus propinqus-Calanus tenuicornis-Calocalanus pavo-Candacia cheirura-Candacia longimana-Centropages brachiatus-Centropages furcatus-Centropages velificatus-Clausocalanus brevipes-Clytemnestra rostrata-Copilia mirabilis-Corycaeus amazonicus-Corycaeus flaccus-Corycaeus giesbrecti-Corycaeus speciosus-Corycella gracilis-Ctenocalanus vanus-Drepanopus forcipatus-Euaetideus giesbrechti-Eucalanus attenuatus-Eucalanus hyalinus-Eucalanus longiceps-Eucalanus pileatus-*

Uruguayan Coastal waters				*Euchaeta marina-Euchaeta spinosa-Euterpina acutifrons-Haloptilus spiniceps-Labidocera fluviatilis-Lubbockia squillimana-Macrosetella gracilis-Mecynocera clausi-Metridia lucens-Microsetella norvegica-Nannocalanus minor-Nannocalanus gracilis-Oculosetella gracilis-Oncaea conifera-Oncaea scottodicarloi-Oncaea venusta-Oithona atlantica-Oithona helgolandica-Oithona nana-Oithona plumifera-Oithona robusta-Oithona setigera-Oithona tenuis-Paracalanus parvus-Paracandacia simplex-Pleuromamma abdominalis-Pleuromamma gracilis-Pleuromamma xiphias-Pontella marplatensis-Pontella patagoniensis-Pontellopsis brevis-Rhincalanus cornutus-Sapphirina angusta-Sapphirina intestinata-Temora stylifera-Undinula vulgaris*
Continental Shelf-break waters	**26**	**53**	**115**	*Aetideus armatus-Aegisthus mucronatus-Acartia danae-Acartia negligens-Acartia tonsa-Calanoides carinatus-Calanus australis-Calanus minor-Calanus propinqus-Calanus simillimus-Calanus tenuicornis-Calanus tonsus-Calocalanus pavo-Candacia ethiopica-Candacia bispinosa-Candacia cheirura-Candacia elongata-Candacia longimana-Candacia simplex-Candacia pachydactila-Centropages bradyi-Centropages brachiatus-Centropages furcatus-Clausocalanus brevipes-Clausocalanus laticeps-Clytemnestra rostrata-Copilia quadrata-Copilia mirabilis-Copilia vitrea-Conaea rapax-Corycaeus amazonicus-Corycaeus flaccus-Corycaeus furcifer-Corycaeus giesbrechti-Corycaeus latus-Corycaeus speciosus-Corycaeus lautus-Corycella gracilis-Ctenocalanus vanus-Drepanopus forcipatus-Euaetideus giesbrechti-Eucalanus attenuatus-Eucalanus elongatus-Eucalanus hyalinus-Eucalanus longiceps-Eucalanus pileatus-Euchaeta marina-Euchaeta media-Euchaeta biloba-Euterpina acutifrons-Euchirella rostrata-Gaidius tenuispinus-Haloptilus acutifrons-Haloptilus austrinus-Haloptilus fertilis-Haloptilus longicornis-Haloptilus oxicephalus-Haloptilus spiniceps-Heterorhabdus austrinus-Heterorhabdus*

Continental Shelf-break waters				*papilliger-Labidocera fluviatilis-Lubbockia squillimana-Lubbockia aculeata-Lucicutia flavicornis-Lucicutia clausii-Macrosetella gracilis-Metridia lucens-Mecynocera clausi-Microsetella norvegica-Miracia efferatta-Nannocalanus minor-Nannocalanus robustior-Neocalanus gracilis-Neocalanus tonsus-Oithona atlantica-Oithona helgolandica-Oithona nana-Oithona plumífera-Oithona setigera-Oithona tenuis-Oncaea conifera-Oncaea media-Oncaea mediterranea-Oncaea robusta-Oncaea scottodicarloi-Oncaea venusta-Paracandacia bispinosa-Paraeuchaeta barbata-Paraeuchaeta sarsi-Paracalanus aculeatus-Paracalanus crassirostris-Paracalanus parvus-Phaenna spinifera-Pleuromamma abdominalis-Pleuromamma gracilis-Pleuromamma robusta-Pleuromamma xiphias-Pontella patagoniensis-Pontella plumata-Rhincalanus cornutus-Rhincalanus gigas-Rhincalanus nasutus-Sapphirina angusta-Scaphocalanus brevicornis-Scaphocalanus magnus-Sapphirina angusta-Sapphirina metallina-Sapphirina nigromaculata-Sapphirina opalina-Scolecithricella ovata-Scolecithrix danae-Scolecithrix glacialis-Scottocalanus securifrons-Temora stylifera-Undeuchaeta plumosa-Undinula vulgaris*

Table 3. Number of Families, Genera and Species found in the different zones of the study area and a list of the species present in each area. ***** Species present in the four regions.

	Estuarine waters	Argentine Coastal waters	Uruguayan Coastal waters
Estuarine waters	-	-	-
Argentine Coastal waters	15 (71)	-	-
Uruguayan Coastal waters	13 (62)	24 (88)	-
Continental shelf and shelf - break waters	14 (66)	28 (96)	54 (82)

Table 4. Number of species in common within different areas. In brackets percentage of species in common.

VII. Figures

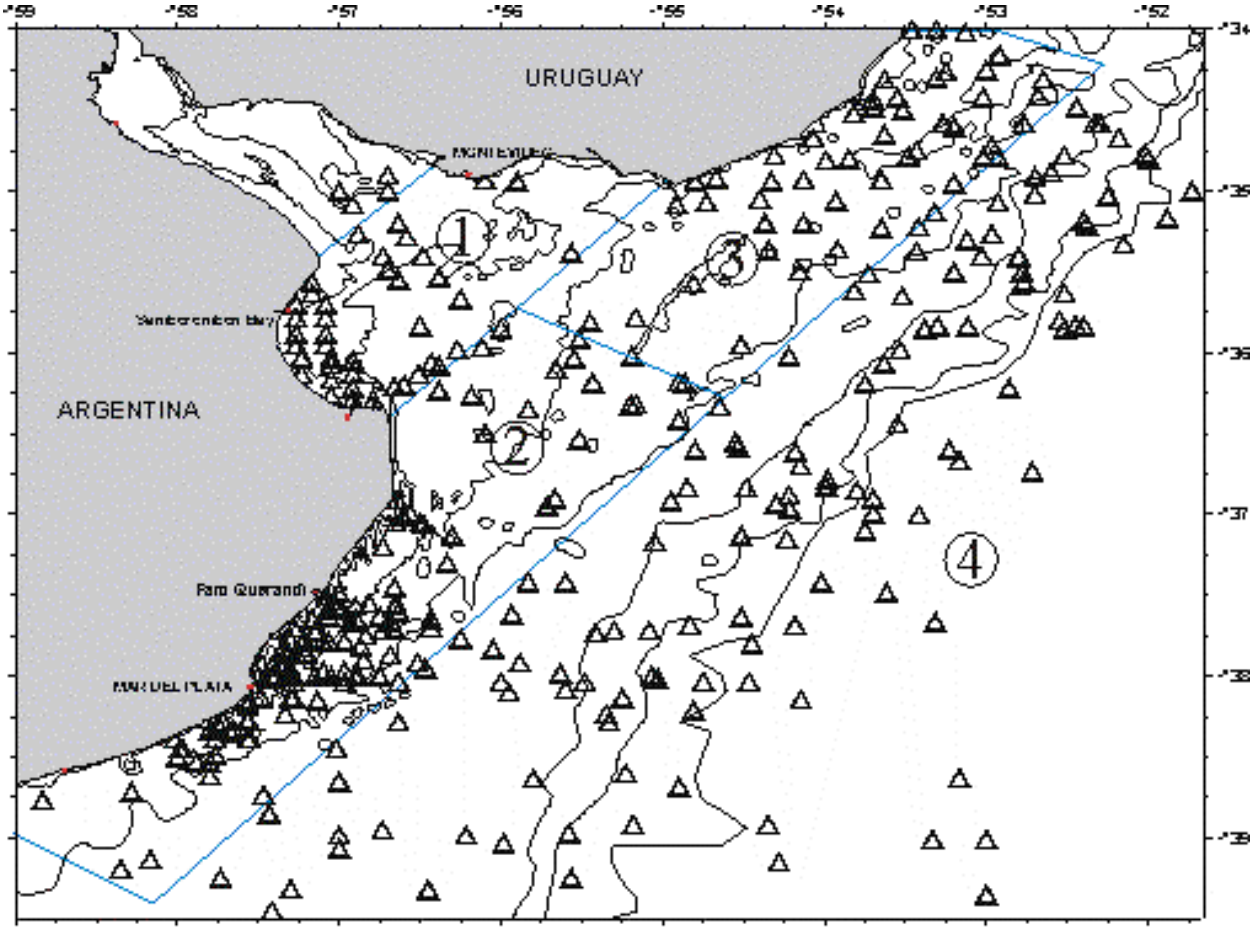

Fig. 1. Study area and position of sampling stations (triangles). Bathymetry giving in meters

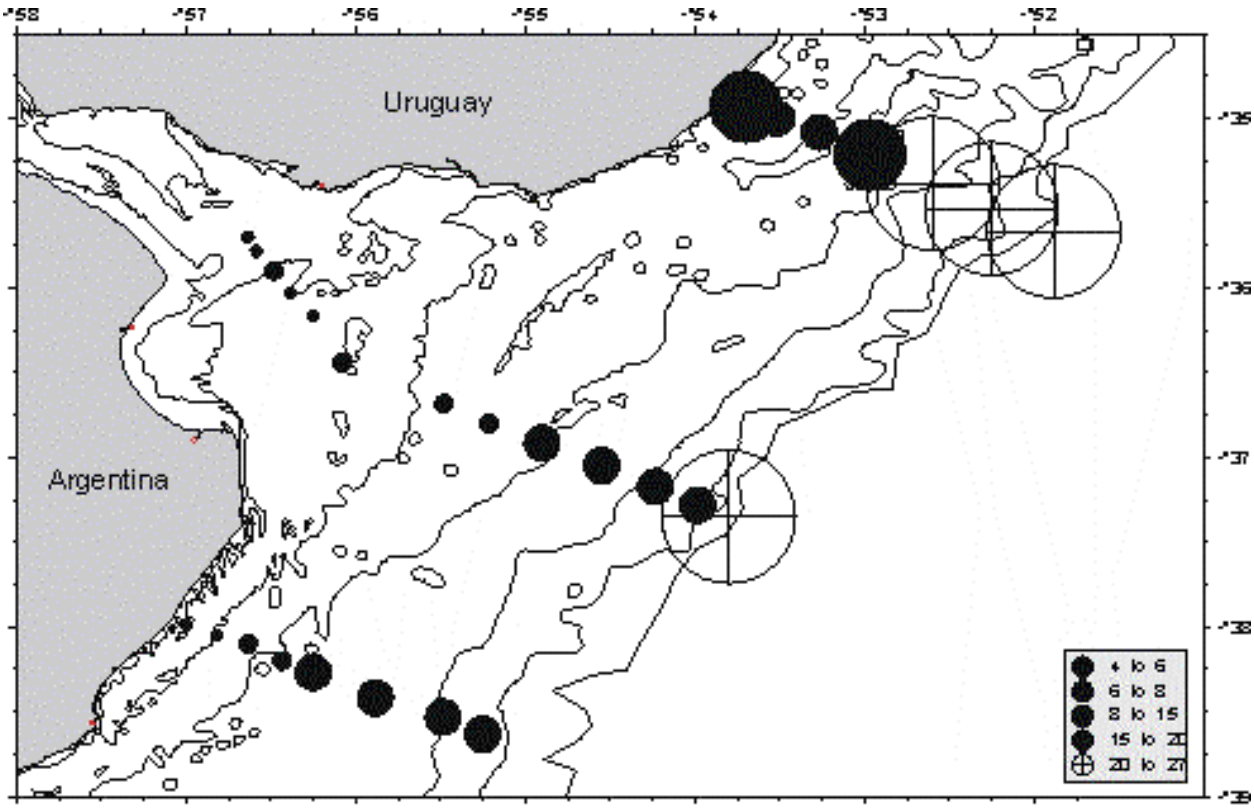

Fig. 2.Values of Point species Richness (SRp) from FREPLATA cruise. Symbol size is proportional to the Srp.

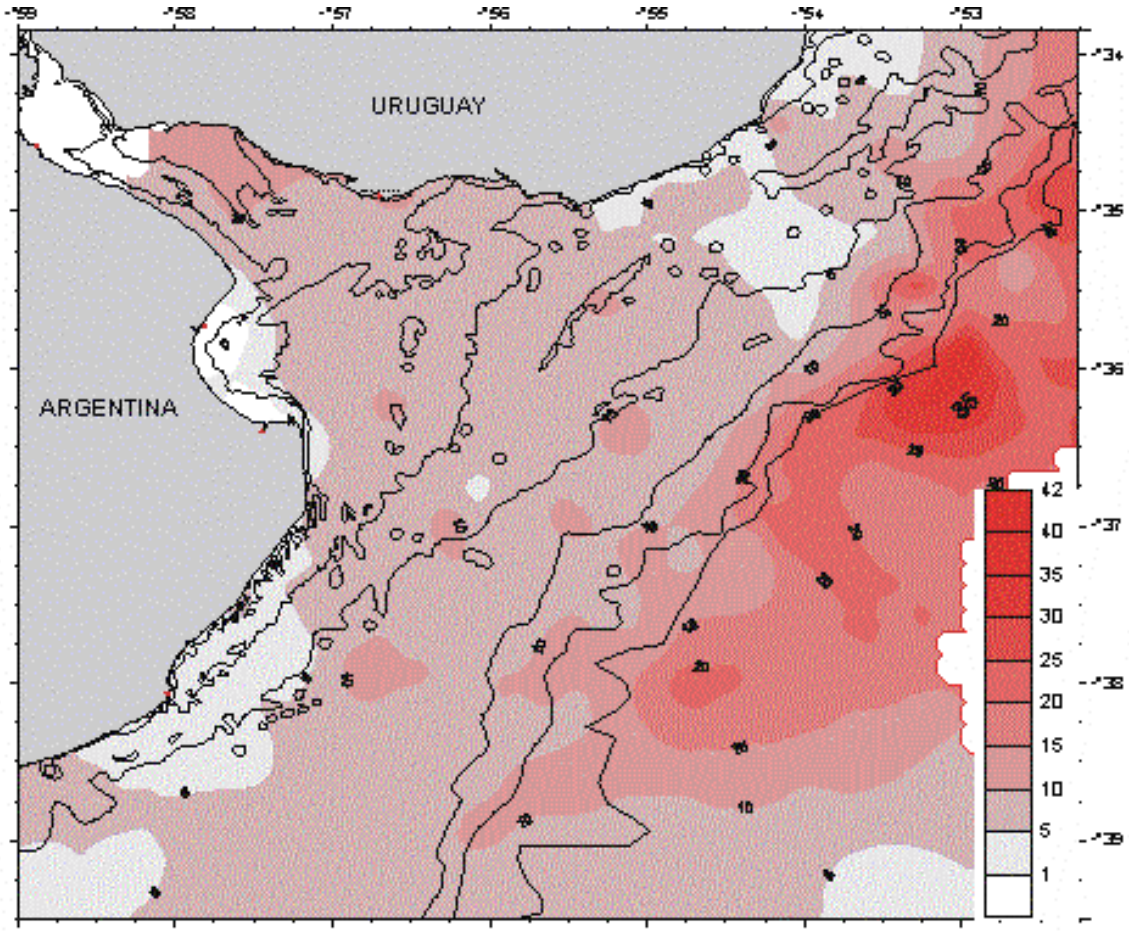

Fig. 3. Contour plot of Point species richness (SRp) recorded at the study area (values taken from bibliography, see Table 1). Isolines of 1, 5, 10, 15, 20, 25, 30 and 35 are presented.

VIII. Appendix

	E.G.	787	787	788	788	789	789	791	791	792	792	794	794	795	795	796	796	797	797
Taxa	E.M.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Acartia danae		-	-	-	-	-	-	-	-	-	-	X	X	-	X	-	-	X	X
Acartia tonsa		X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
Calanoides carinatus		-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Calanus simillimus		-	-	-	-	-	-	-	-	X	-	X	X	X	X	X	X	X	-
Calanus australis		-	-	X	-	-	-	X	-	-	-	X	X	X	X	-	-	-	-
Centropages brachiatus		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Clausocalanus brevipes		-	-	-	-	-	-	-	-	X	X	X	X	X	-	X	X	X	-
Ctenocalanus vanus		X	-	-	-	-	X	X	X	X	X	X	-	-	X	X	X	-	-
Corycaeus giesbrechti		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Corycaeus amazonicus		X	-	-	X	X	-	-	-	-	X	-	-	-	-	-	-	X	-
Clytemnestra rostrata		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Copilia mirabilis		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Drepanopus forcipatus		-	-	-	-	-	-	-	-	X	-	X	X	X	X	-	-	-	-
Subeucalanus longiceps		-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
Eucalanus elongatus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-
Eucalanus attenuatus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Euchaeta marina		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Euterpina acutifrons		-	-	-	-	X	-	-	X	-	X	-	-	-	-	-	-	-	-
Macrosetella gracilis		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Mecynocera clausi		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Microsetella norvegica		-	-	-	-	X	-	-	X	-	X	-	-	-	-	-	-	X	-
Neocalanus tonsus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-
Oithona nana		-	-	-	X	-	X	X	X	X	X	-	-	-	X	X	X	X	-
Oithona similis		-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	X	X	X

Oithona plumifera		-	-	-	-	-	-	-	X	-	-	X	-	X	-	-	-	X	X
Oithona tenuis		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Oithona atlantica		-	-	-	-	-	-	X	X	X	-	-	-	X	-	-	-	X	-
Oncaea conifera		-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
Oncaea venusta		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-
Paracalanus parvus		X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	X
Paracalanus crassirostris		-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Phaenna spinifera		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-

Appendix 1: Presence (X) of species collected at each sampling station (southernmost transect) of the second FREPLATA cruise. E.G.: number of general station. E.M.: number of plankton Net.

Taxa	E.G.	799	799	800	800	801	801	802	802	803	803	804	804	804	804	806	806	806	807	807	808	808	809	809	810	810	811	811
	E.M.	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Acantocyclops michaelsini		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Acartia tonsa		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Argirodaptomus denticulatus		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X
Calanoides carinatus		-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calanus simillimus		X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calanus australis		X	-	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Candacia elongata		-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centropages brachiatus		-	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centropages furcatus		-	-	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clausocalanus laticeps		-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clausocalanus brevipes		-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ctenocalanus vanus		X	X	-	X	-	X	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Corycaeus amazonicus		-	-	X	-	-	-	-	-	X	X	X	X	-	-	-	X	X	X	X	-	X	X	X	-	-	-	-
Drepanopus forcipatus		X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucalanus attenuatus		X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euterpina acutifrons		-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
Labidocera fluviatilis		-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	X	X	X	X	X	X	X	-	-
Metridia lucens		-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mesocyclops araucaniensis		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Oithona nana		X	X	X	X	X	X	X	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oithona similis		X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oithona plumifera		X	X	X	X	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oithona atlantica		-	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oncaea venusta		-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paracalanus parvus		-	X	-	-	-	X	X	X	X	X	X	X	-	-	-	X	X	X	X	X	X	X	X	-	-	-	-
Paracalanus crassirostris		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	X	X	X	X	-	-	-	-
Pseudodiaptomus richardi		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X	X
Temora stylifera		-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 2: Presence (X) of species collected at each sampling station (central transect) of the second FREPLATA cruise.

E.G.: number of general station. E.M.: number of plankton net.

	E.G.	820	820	821	821	822	822	824	824	825	825	826	826	827	827
Taxa	E.M.	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Acartia danae		X	X	X	X	-	X	-	-	-	-	-	-	-	-
Acartia tonsa		-	-	-	-	-	-	-	-	-	-	X	X	X	X
Calanoides carinatus		-	-	-	-	-	X	X	X	-	-	-	-	X	-
Calanus simillimus		-	-	-	X	-	-	-	-	-	-	-	-	-	-
Calanus australis		-	-	-	-	X	X	-	X	-	-	-	-	-	-
Calocalanus pavo		X	X	-	-	-	-	-	-	-	-	-	-	-	-
Candacia cheirura		-	-	-	-	-	X	-	-	-	-	-	-	-	-
Centropages brachiatus		-	-	-	-	-	-	X	X	X	-	-	-	-	-
Clausocalanus brevipes		-	-	-	-	X	-	-	-	-	-	-	-	-	-
Ctenocalanus vanus		-	-	X	X	X	X	X	X	-	X	X	X	X	-
Corycaeus flaccus		X	X	-	-	-	-	-	X	-	-	-	-	-	-
Corycaeus speciosus		-	-	-	X	-	-	-	-	-	-	-	-	-	-
Corycaeus giesbrechti		-	X	X	X	-	X	-	-	-	-	-	-	X	-
Corycaeus amazonicus		-	-	-	-	-	-	X	X	X	X	X	X	X	X
Clytemnestra rostrata		-	-	X	X	-	-	-	-	-	-	X	X	X	-
Drepanopus forcipatus		-	-	-	-	X	-	X	-	-	-	-	-	-	-
Subeucalanus longiceps		X	-	-	-	-	-	-	-	-	-	-	-	-	-
Eucalanus attenuatus		X	-	-	-	X	X	-	X	-	-	-	-	-	-
Euterpina acutifrons		-	-	X	-	X	X	-	X	-	X	X	X	X	X
Farranula rostrata		X	X	X	X	-	-	-	-	-	-	-	-	-	-
Hemiciclops thalassius		-	-	-	-	-	-	-	-	-	-	X	-	X	X
Labidocera fluviatilis		-	-	X	-	X	-	X	X	X	X	X	X	X	X
Macrosetella gracilis		X	X	X	X	-	-	-	X	-	X	-	-	-	-
Mecynocera clausi		X	X	X	X	-	X	-	-	-	-	-	-	-	-
Miracia efferata		X	X	X	-	-	-	-	-	-	-	-	-	-	-
Nannocalanus minor		X	X	X	X	X	-	-	-	-	-	-	-	-	-
Oithona nana		-	-	-	-	-	-	X	X	X	-	X	X	X	X
Oithona similis		-	X	X	X	X	X	X	X	-	-	-	-	-	-
Oithona plumifera		-	-	X	X	-	-	X	X	X	X	-	-	-	-
Oithona tenuis		X	-	-	-	-	-	-	-	-	-	-	-	-	-
Oithona robusta		-	-	-	-	-	-	-	-	-	-	-	-	X	-
Oithona atlantica		-	X	X	X	X	X	-	-	-	-	X	-	-	X

	E.G.	820	820	821	821	822	822	824	824	825	825	826	826	827	827
Taxa	E.M.	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Oncaea conifera		-	-	-	-	-	-	-	-	-	X	X	X	-	-
Oncaea media		X	X	-	-	-	X	-	-	-	-	-	-	-	-
Oncaea venusta		X	-	-	-	-	-	-	-	-	-	-	-	-	-
Oncaea mediterranea		X	-	X	-	X	-	-	-	-	-	-	-	-	-
Oncaea scottodicarloi		-	X	-	X	-	X	-	X	-	-	-	-	-	-
Paracalanus parvus		-	-	X	-	-	X	X	X	X	X	X	X	X	X
Temora stylifera		X	X	-	-	-	-	-	-	-	-	-	-	-	-
Sapphirina angusta		X	X	-	-	-	-	-	-	-	-	-	-	-	-
Scolecitrhix danae		X	-	-	-	-	-	-	-	-	-	-	-	-	-
Undinula vulgaris		-	X	-	-	-	-	-	-	-	-	-	-	-	-

Appendix 3: Presence (X) of species collected at each sampling station (northernmost transect) of the second FREPLATA cruise. E.G.: number of general station. E.M.: number of plankton net.