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# DISTRIBUCION, ESTRUCTURA Y COMPOSICION DE LA MALACOFAUNA PRESENTE EN SUSTRATO DURO DE LA COSTA ARGENTINA DEL RIO DE LA PLATA

## *COMPOSITION, STRUCTURE AND DISTRIBUTION OF THE MALACOFAUNA LIVING ON A HARD SUBSTRATE AT THE ARGENTINIAN SHORE OF RIO DE LA PLATA*

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RESUMEN

El objetivo del presente trabajo es analizar la estructura y distribución de los moluscos en el litoral de "caliche" de la costa argentina del Río de la Plata. Se calcularon parámetros biocenóticos (abundancia, densidad, dominancia general media y frecuencia) y estructurales (diversidad de Shannon-Weaver, número de especies, equitabilidad y densidad media) en cuatro muestreos estacionales. Durante las bajas mareas se reconocieron diferentes microambientes en el sustrato heterogéneo, de acuerdo al grado de retención de humedad. Estos fueron: superficie lisa, rugosa y oquedad. Sobre un total de 241 ind·m$^2$ se colectaron 3 especies de bivalvos y 9 de gastrópodos. *Heleobia piscium*, *Potamolithus buschii*, *P. agapetus* y *Chilina fluminea*, resultaron dominantes en el ambiente, *Corbicula fluminea* común y el resto de las especies, raras. En relación con el litoral de "caliche", no existió una clara zonación de la distribución espacial de la malacofauna. Durante las bajas mareas, los moluscos prefieren los microambientes con mayor retención de humedad (superficie rugosa y oquedades). Considerando la variable estacional, en este hábitat no se observaron diferencias significativas en la composición malacológica.

PALABRAS CLAVES: Malacofauna, sustrato limo-arenocompacto, parámetros biocenóticos, Río de la Plata.

ABSTRACT

The aim of this paper is to analyse the composition, structure and distribution of molluscs living on "caliche" substrate at argentinian shore of Río de la Plata. Biocenotic parameters (abundance, density, mean general dominance and frequency) and structural ones (Shanon-Weaver diversity, number of species, evenness and mean density) were calculated on four seasonal samples. Different microhabitats in this heterogeneous substrate were considered according to a rising degree of humidity retention during low tides; they were: even surface, uneven surface and hollows. A total of 241 individuals per m$^2$ belonging to 3 species of bivalves, and 9 of gastropods were collected. *Heleobia piscium*, *Potamolithus buschii*, *P. agapetus* and *Chilina fluminea* are dominant in the habitat, while *Corbicula fluminea* is common and the rest of the species, rare. There is no clear zonation in relation to space distribution on this "caliche" shore. During low tides, the molluscs prefer microhabitats keeping more humidity (uneven surface and hollows). Considering seasonal variables, a significant modification in the malacological composition of the habitat is not observed.

KEYWORDS: Malacofauna, "caliche" substrate, biocenotic parameters, Río de la Plata.

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## INTRODUCTION

The estuary of Río de la Plata, due to its colossal size (35,000 km$^2$) and great flow of water (16,000-28,000 m$^3$/s), produces its own purification by dispersion and dilution of the wastes. However, it is highly influenced by human activity

(Colombo, *et al.* 1989; 1990). A harmful effect on the coast, spreading from its source down to the first 100 km of estuary coast, is caused by a growing concentration of inhabitants in the area (1/3 of the people of Argentina, i.e 10,600,000 inhabitants) and also agricultural and industrial activities (Darrigran, 1991; AGOSBA-OSN-SIHN, 1992).

This estuary is influenced by ocean waters, as shown by the spatio-temporal differences of salinity. Besides, an irregular and hardly predictable hydrological flow due to daily tide differences and disturbances by wind action make this estuary a complex system (Balay, 1961).

Apart from hydrophytes, there are two types of natural substrata, on the argentinian coast of Río de la Plata (Mouzo, 1982):

1. Soft substrata, formed by Holocene sediments, mud and clayish sand, generally covered by a thin recent alluvial layer.
2. Hard substrata, formed by a Pleistocene mud-sand compact outcropping or "caliche".

The environment's impact on the estuary of Río de la Plata, can be evaluated from the alterations detected in its littoral benthos.

There are two works done on the benthos of the Río de la Plata area, carried out in the littoral of Montevideo, Uruguay and Bagliardi Beach, Argentina. They make reference to the fauna associated to hard substratum (Scarabino *et al.*, 1975; Martin and Darrigran, 1994).

The aim of this work is to study the structure of molluscs fauna and its distribution in relation to different habitats present in the heterogeneous littoral of "caliche" at Anchorena Beach.

## MATERIAL AND METHODS

Four seasonal samplings were done during the Spring and Summer of 1987 and Autumn and Winter, 1988. Samples were collected every 5 m during low tides along 100 m transects perpendicular to the coast.

On hard substrata, samples were collected using a 0.40 m x 0.40 m frame divided into 16 squares (Fig. 3 B and C). In each subsample the malacofauna was collected and the type of microhabitat registered.

On soft substrata samples were taken by burying a metalic 0.07 $m^2$ cylinder at 0.10 m deep. They were sifted in the field through a 1 mm wire net sieve.

The spatial arrangement of specimens, with a 0.4 m x 0.4 m area, was determined through variance-mean ratio ($s^2/\bar{X}$). The $Xi^2$ test was applied to estimate the statistical signification between the ratio value and the unit (Elliot, 1983).

Malacofauna densities were compared by Kruskall-Wallis test (Siegel, 1974). $Xi^2$ test for independent samples was used for comparing the proportions among different species present in the microhabitats (Siegel, 1974).

The biocenotic parameters considered were: (A) abundance (number of individuals/sample); (d) density (number of individuals$\cdot m^{-2}$); (Dm) mean general dominance (total number of specimens of a species / total number of individuals of all species) and (F) frequency (number of samples where the species considered was present/total number of samples).

Considering the dominance and frequency (Rodriguez *et al.*, 1980), species were classified as:

a) Dominant: Dm 1%
b) Constant: F 50%
c) Common: 25% < F < 50%
d) Rare: F < 25%
e) Expansive: F > 15% and Dm > 25%
f) Diffuse: F > 15% and Dm < 25%

In reference to the mollusc community structure the parameters considered were: (H') Shannon-Weaver diversity; (S) specific richness; (Ev) evenness ($2.71^{H'-1}/S-1$) and (D) mean density.

Cluster analysis was performed, applying the Morisita coefficient (M) to two data matrix. Data matrix I: different microhabitats from 4 seasons by mean density species expressed as log x+1, and data matrix II: 6 microhabitats (SE: even surface, with and without water; SU: uneven surface, with and without water; H: hollows, with and without water) by mean density species expressed as log x+1 (Sneath and Sokal, 1973).

## DESCRIPTION OF ENVIRONMENT

Anchorena Beach (34° 29'S; 58° 28'W) is located in the fresh water zone of the estuary of Río de la Plata (Fig.1).

The climate of this region is warm, with four distinct seasons. The average yearly rainfall is 994 mm, with very wet periods during spring and autumn. The average yearly temperature is 17.2° C. Draughts periods are not observed, although January (Summer) is one of the driest periods.

Two types of substrata are found on the 100-150 m wide intertidal area (Fig. 2A and Fig. 3A). A sandy, homogeneous substratum, arranged in two narrow beaches (I and II in Fig. 2A), limits the hard type, the heterogeneous substratum called "caliche". On this hard substratum three zones can be recognized:

1- a zone next to the coast line (CC)
2- a zone next to the water (CW)
3- an intermediate zone (CI) between CC and CW.

CC and CI remain uncovered during ordinary low tides, while CW remains uncovered only during extraordinary low tides.

This analysis was done taking into account the tides at Puerto Buenos Aires during the sampling days (Fig. 2B). The "caliche" type of substratum is heterogeneous, showing flat and uneven surfaces, hollows and pools with stones. These microhabitats mantein different degrees of humidity during low tides.

## RESULTS

### MACROBENTHOS COMPOSITION:

In this study, 17 different taxa were collected. The following were not molluscs: two species of hirudinea, *Helobdella simplex* (Moore) and *H. adiastola* (Ringuelet); one species of crustacea *Aegla uruguayana* Schmitt, oligochaeta tubificidae and turbellaria tricladida. The distribution of the taxa collected on the beach is compiled in Fig. 4. It shows that only 12% of the collected taxa were present on the zone CC. The increase of such percentage is directly proportional to the coast line distance.

### MALACOLOGICAL COMPOSITION:

A total of 68 samples and 5,593 specimens (D= 241 individuals per $m^2$) were collected. The specimens belonged to 3 species of bivalves, 9 species of gastropods: 5 prosobranch and 4 pulmonates. *Gundlachia concentrica* (Orbigny), *Biomphalaria straminea* (Dunker), *Stenophysa marmorata* (Guilding), *Diplodon paranensis* (Lea) and *Anodontites* (*A.*) *tenebricosus* (Lea) were occasionally collected.

Number of individuals (X), mean density (N), mean general dominance (D), frequency (F) and faunal characteristics for each species along all sampling are shown in Table I.

*Heleobia piscium* (Orbigny) shows the highest density (139 individuals·$m^{-2}$). *Potamolithus buschii* (Frauenfeld), *P. agapetus* Pilsbry and *Chilina fluminea fluminea* (Maton) are dominant on the littoral. *P. agapetus* and *C. fluminea fluminea* were found in 44% and 51% of the samples respectively, while *P. buschii* was found in 50% of them *P. petitianus* Pilsbry and *P. lapidum* (Orbigny) are considered rare. *Corbicula fluminea* (Müller) is a common species only in soft substrata.

The spatial distribution of the mollucan populations is shown in Table II. Two types of distribution were observed: agregated and random. The latter could be produced by sampling mistakes.

The mean density values of malacofauna observed in each sample and zone did not show any significant differences.

When comparing the proportions of each species present on different zones (CC, CI and CW), the null hypothesis that, the individual proportion of each taxon is the same in all strata ($X^2_i$= 51.8, P= 0.0000), is rejected. This hypotesis is also rejected when each species is compared to microhabitat. The values of $X^2_i$ were: for species present on stones, $X^2_i$= 118.4, P= 0.0000 and for species present on even, uneven surfaces and hollows, $X^2_i$= 751.9, P= 0.0000.

### STRUCTURE OF MALACOFAUNA:

The structural parameters of mollusc in Anchorena Beach are shown in Table III. The species richness did not show differences in the seasonal samplings. During Autumn and Winter eveness and diversity become lower. All sampling diversity values are less than one.

### CLUSTER ANALYSIS:

In the dendrogram from mean density of the malacofauna present in even, uneven surfaces and hollows (Fig. 5A) two groups differentiate. Most microhabitats sampled in Autumn and all microhabitats sampled in Winter gathered in group I. Most Spring-Summer samples gathered in group II. According to the surface types, all the microha-

bitats of even surfaces and part of uneven surfaces are gathered in group I while the rest of uneven surfaces and hollows are gathered in group II.

Considering humidity retention there are two groups in the dendrogram according to the density of the malacofauna present in each microhabitat (Fig. 5B). In group I two subgroups can be observed, even surface microhabitats (with and without humidity) are gathered in one of them and uneven surface microhabitats (without humidity) in the other. Uneven surface microhabitats (with humidity) and hollows (with and without humidity) are gathered in group II.

There are two groups of species in the dendrogram from quantitative species analysis and its relationship with microhabitats (Fig. 5C). Group I include the dominant species: *P. buschii*, *H. piscium*, *P. agapetus* and *Ch. fluminea*, and group II gathers: *P. petitianus*, *P. lapidum* and *C. fluminea*.

## CONCLUSIONS AND DISCUSSION

Four groups of macroinvertebrates are associated to the malacofauna present in the "caliche" littoral of Anchorena Beach. They were: hirudinea (*H. simplex* and *H. adiastola*), oligochaeta tubiphicidae, crustacea (*A. uruguayana*) and turbellaria tricladida.

Four gastropods species were dominant in this littoral: *H. piscium*, *P. buschii*, *P. agapetus* and *Ch. fluminea fluminea* while *C. fluminea* is common and *P. petitianus* and *P. lapidum* are rare. *G. concentrica*, *B. straminea*, *S. marmorata*, *D. paranensis* and *A.* (*A.*) *tenebricosus*, were occasionally collected.

This type of environments is more suitable for gastropod populations than bivalves. This has been shown by the presence of nine gastropod species and only three bivalves species.

The genus *Heleobia* (=*Littoridina*) was the only gastropod present on the hard non "caliche" substratum in Montevideo city shore, Uruguay (Scarabino *et al.*, 1975).

The differences in the composition of the malacofauna between Anchorena Beach and Montevideo shore are due to differences in water salinity.

The mollucs and neighbouring macrofauna were better represented between 40 and 150 m from the coast (zones CI and CW). There is no clear zonation for the species in Anchorena Beach. On the contrary a clear zonation due to the influence of ocean water was noted for Montevideo shore (Scarabino *et al.*,1975).

Uneven surface and hollows, keeping more humidity during low tides, are the ones which present the highest mollusc number, specially during Spring and Summer. The even surface was more habitable during the wetest month than the same one during the driest and hotest month.

In relation to the seasonal variable no malacological composition modification was observed. Diversity index values remained lower than 1 and specifes richness varies between 6 and 7.

According to Prat and Ward (1994) and Hellawell (1986) the specific richness of the benthos indicates the disturbances. The low specific richness of the malacofauna found in Anchorena Beach means that this locality suffer disturbances induced by human interferences.

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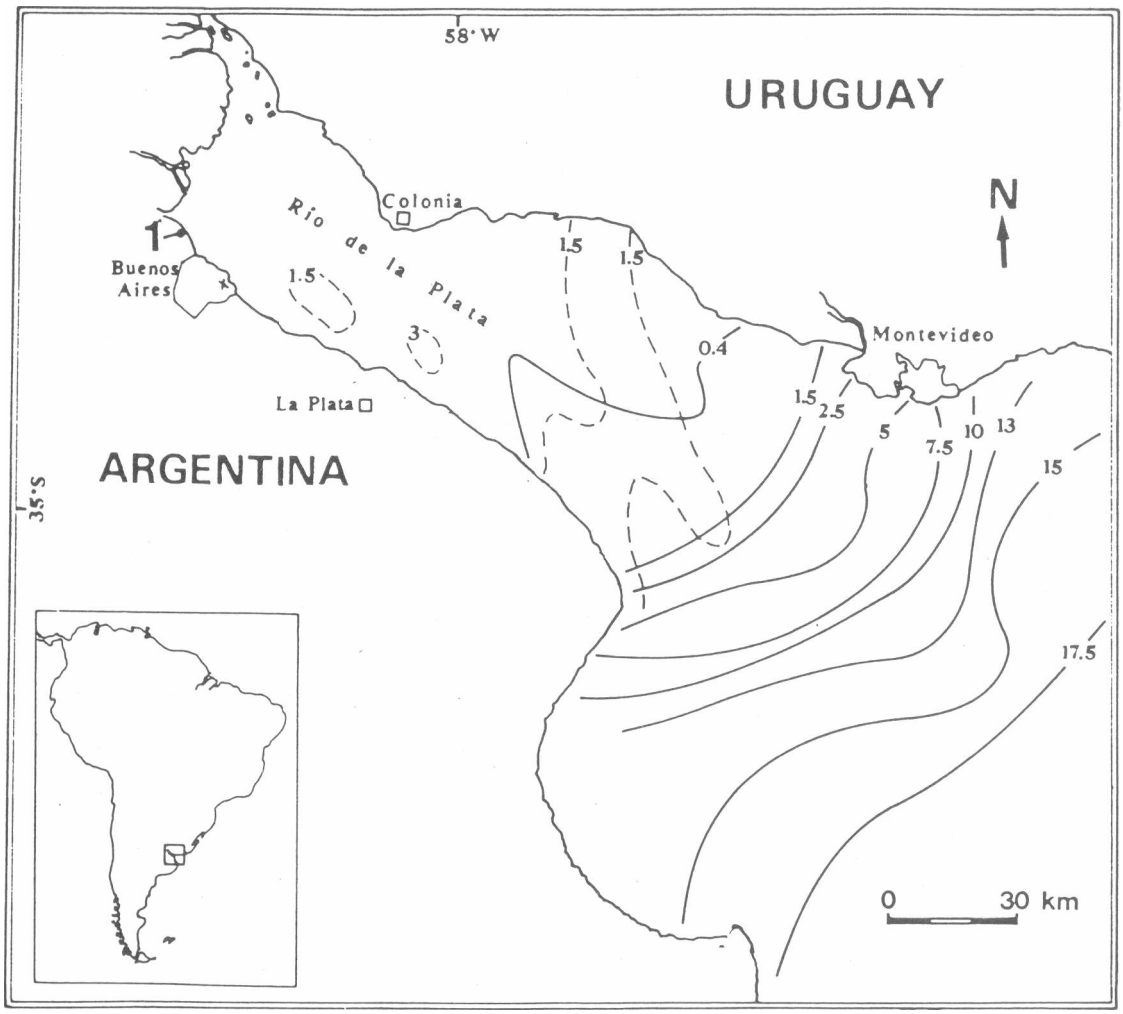


FIGURE 1. Map showing the studied locality and isohalines along the estuary of Río de la Plata. Continuous lines correspond to average salinities during the 1982-1987 period; broken lines correspond to an abnormal saline intrusion on March 10, 1984 (taken from Comisión Administradora del Río de la Plata, 1989). **1-** Balneario Anchorena. **x-** Puerto Buenos Aires.

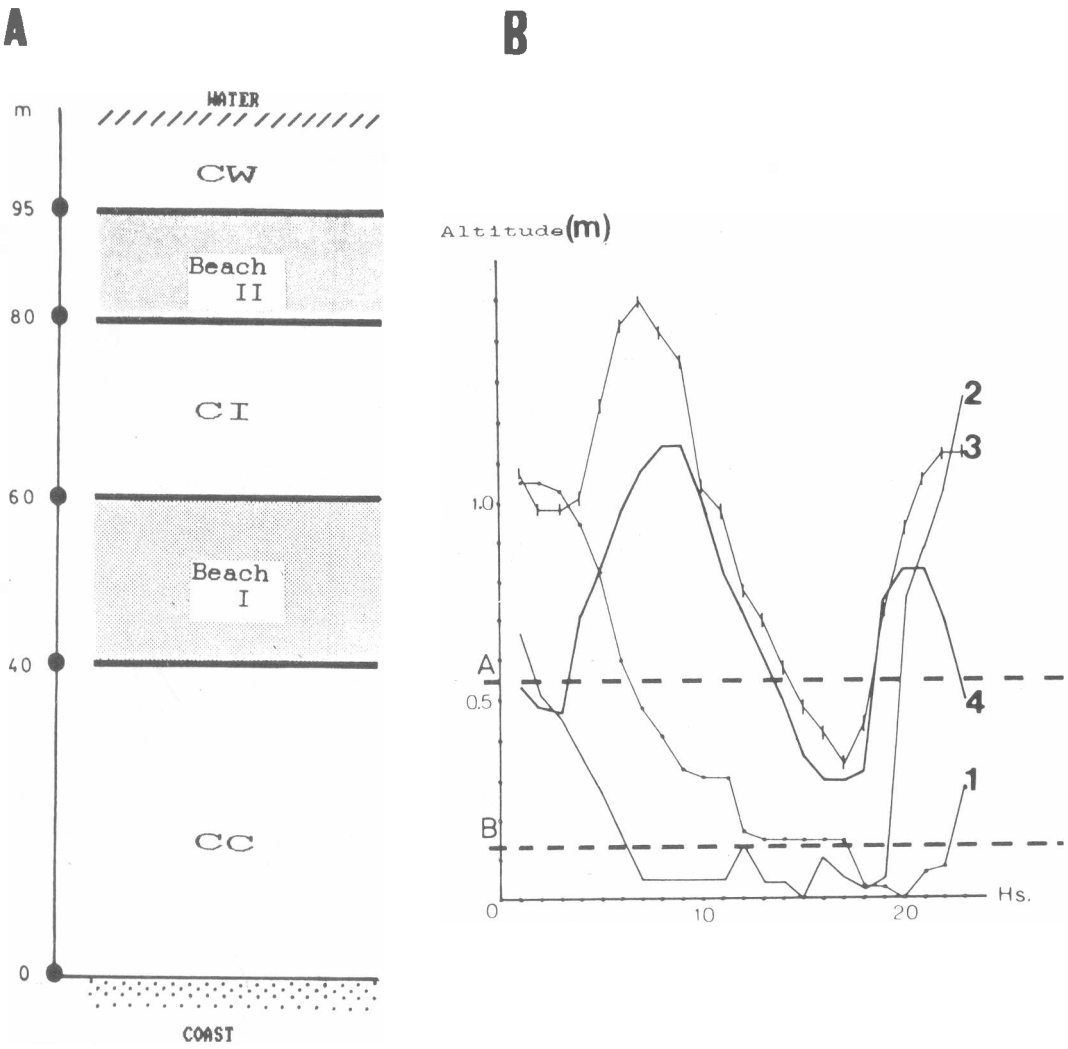


FIGURE 2. Spatial location of differentiated zones in Anchorena Beach and altitudes of the tides at Puerto Buenos Aires. A.- CC= "caliche" next to the coast; CI= intermediate "caliche" zone; CW= "caliche" next to the water. I and II, sandy beaches. B.- altitude values of tides at Puerto Buenos Aires during sampling days. A= tide altitude at which CC and CI are uncovered. B= tide altitude at which CW is uncovered. 1- Spring; 2- Summer; 3- Autumn; 4- Winter.

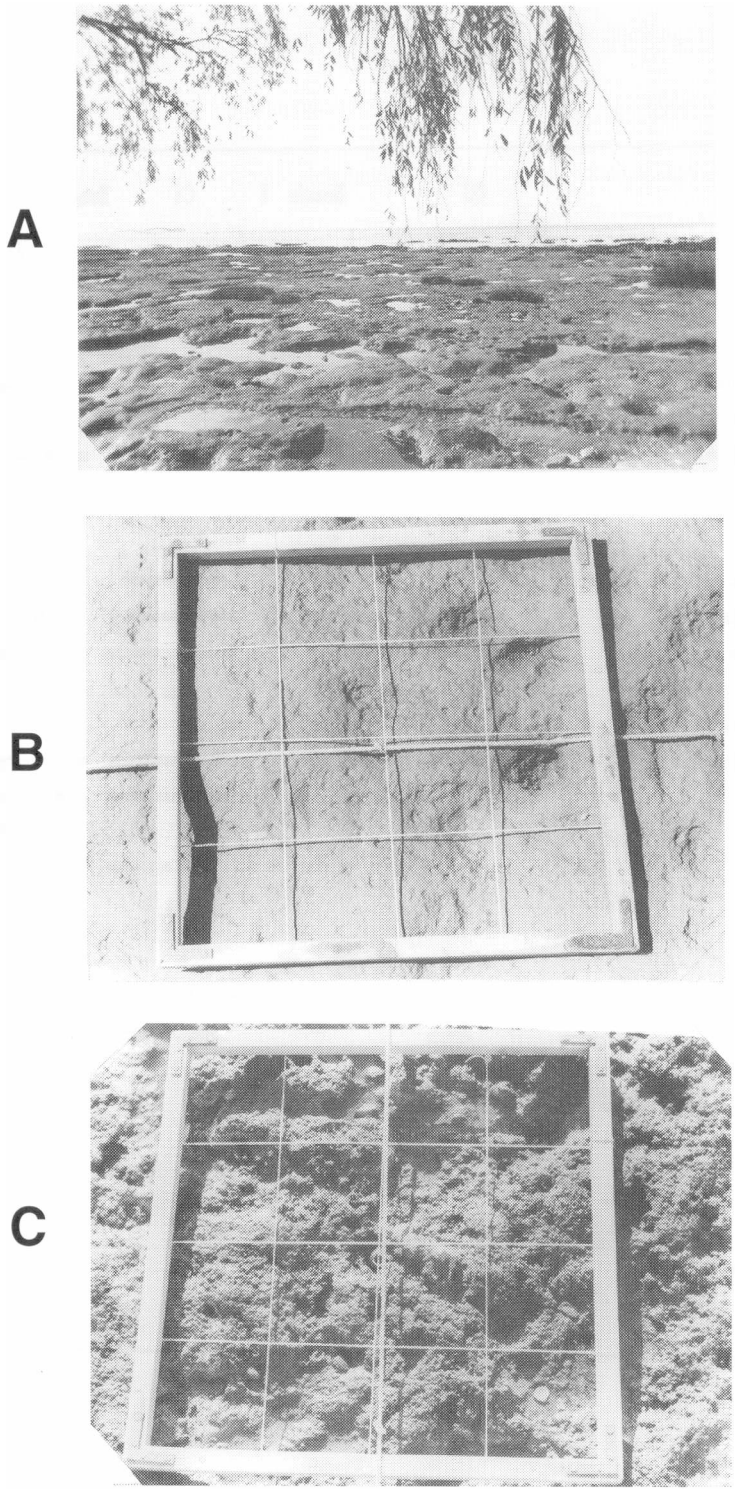


FIGURE 3. Studied area, sampler and microhabitat considered. A.- general view of "caliche" shore at Anchorena Beach. B.- even surface. C.- uneven surface.

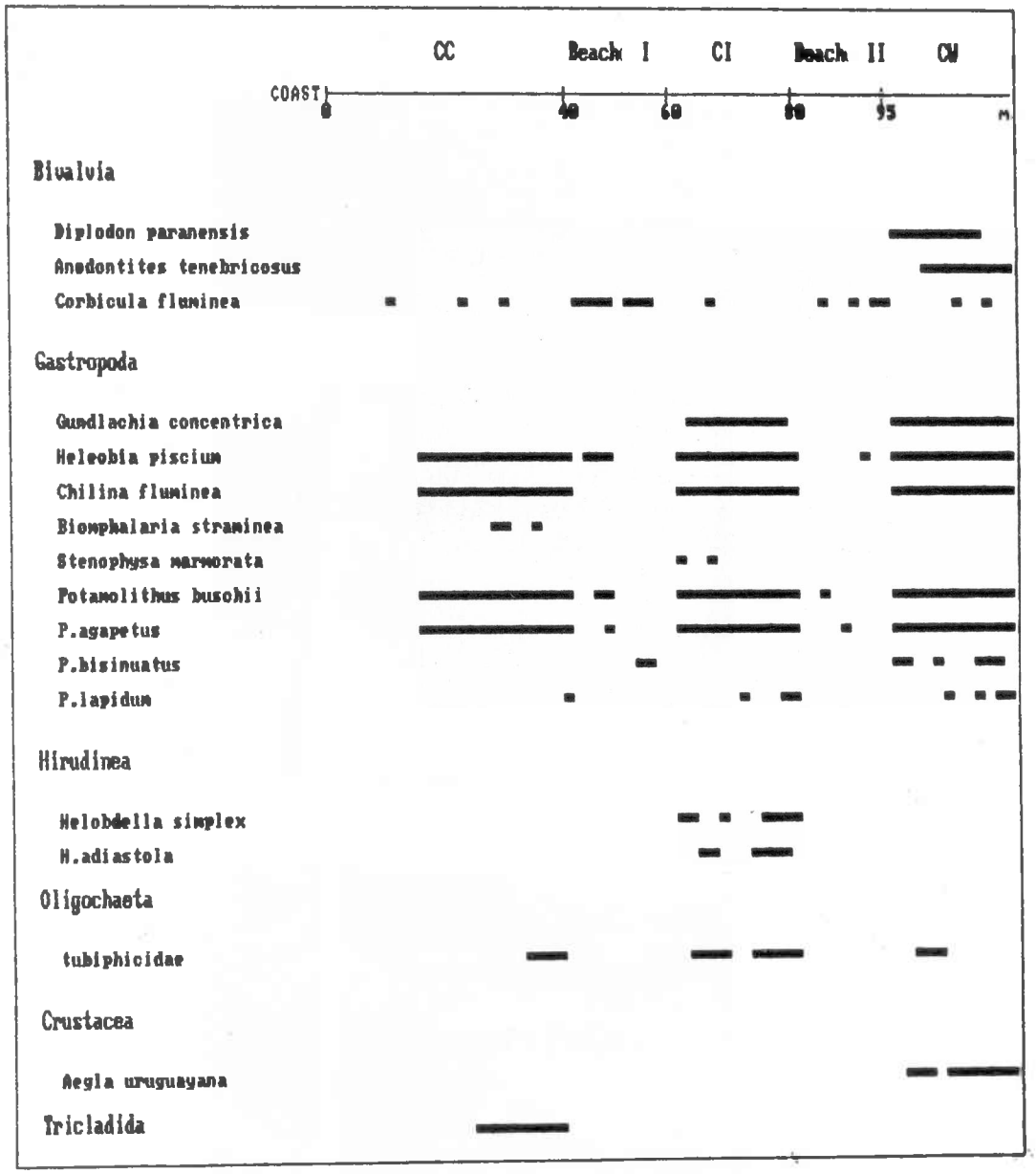


FIGURE 4. Faunal composition of littoral macrobenthos at Anchorena Beach. "Caliche" zones: CC, "caliche" next to the coast; CI, intermediate "caliche" zone; CW, "caliche" next to the water. I and II, sandy beaches.

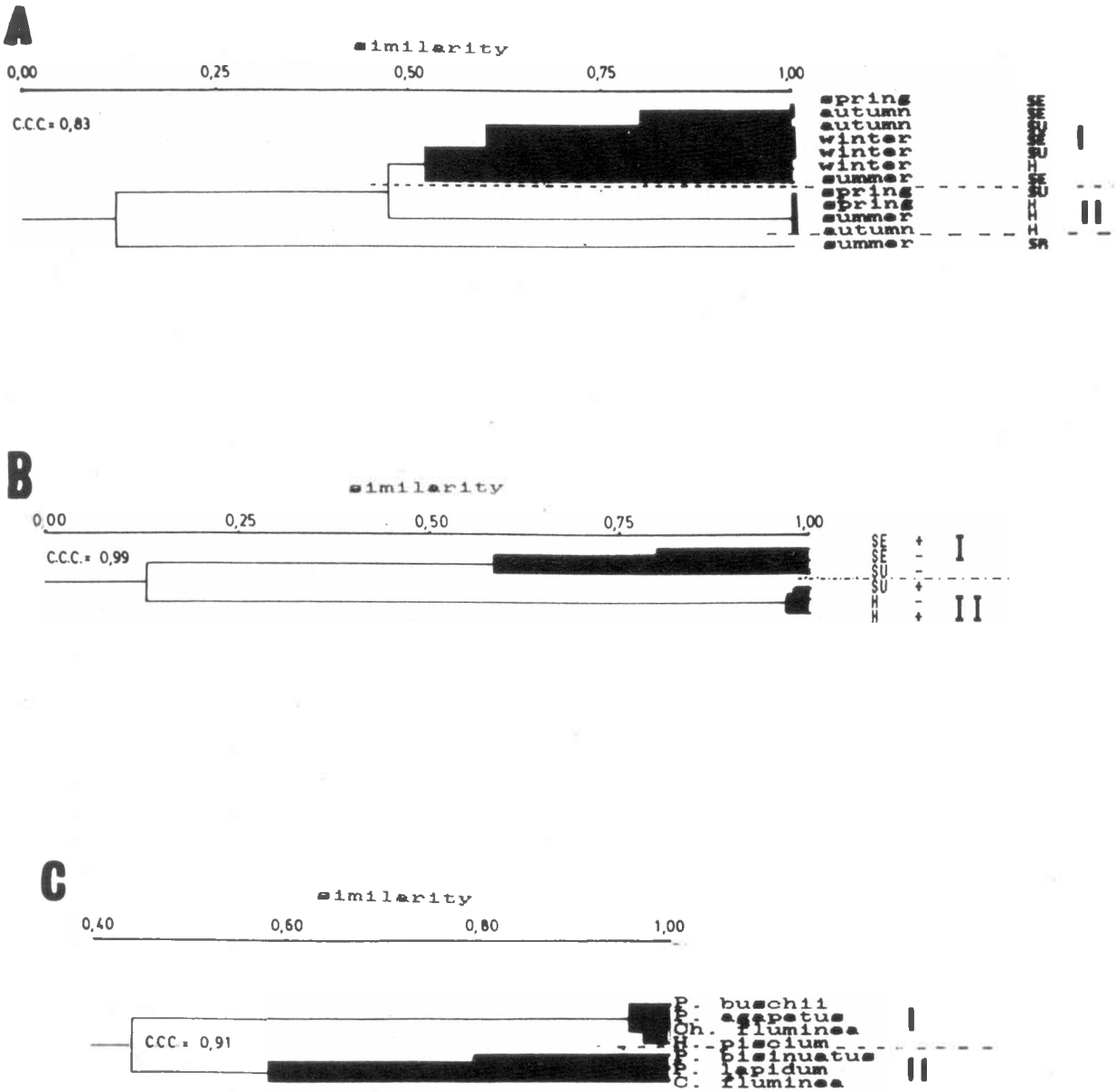


FIGURE 5. Cluster analysis. A.- Dendrogram of microhabitats from data matrix I (microhabitats from 4 season by mean density species). B-C.- Dendrograms from data matrix II (6 microhabitats: SE, SU and H with and without water by mean density species): B.- Q mode; C.- R mode.

TABLE I. Biocenotic parameters values of the malacofauna present on "caliche" shore of Anchorena Beach. X, number of individuals; N, number of samples where the species was present; D, mean density; Dm, mean general dominance; F, frequency.

| SPECIES | X | N | D | Dm | F | FAUNAL CHARACTERISTICS |
|---|---|---|---|---|---|---|
| *Potamolithus buschii* | 589 | 34 | 34 | 14.6 | 50 | Dominant-Constant-Diffuse |
| *P. agapetus* | 586 | 38 | 34 | 14.6 | 44 | Dominant-Common-Diffuse |
| *P. bisinuatus* | 7 | 6 | 0.5 | 0.2 | 21 | Rare-Diffuse |
| *P. lapidum* | 12 | 6 | 1 | 0.3 | 21 | Rare-Diffuse |
| *Chilina fluminea* | 512 | 35 | 28 | 12.7 | 51 | Dominant-Constant-Diffuse |
| *Heleobia piscium* | 2,282 | 45 | 139 | 56.7 | 66 | Dominant-Constant-Diffuse |
| *Corbicula fluminea* | 35 | 18 | 2 | 0.9 | 26 | Common-Diffuse |
| TOTAL | 4,023 | 241 | | | | |

TABLE II. Spatial arrangement of the malacofauna according to the sampled seasons.

| SEASON | SPECIES | $S^2/\bar{X}$ | $X^2_t$ | RANDOM | AGREGATE |
|---|---|---|---|---|---|
| Spring 1987 | *Potamolithus buschii* | 34.0 | 510 | | + |
| | *P. agapetus* | 62.8 | 942 | | + |
| | *P. bisinuatus* | - | - | | |
| | *P. lapidum* | 3.6 | 54 | | + |
| | *Chilina fluminea* | 21.8 | 325 | | + |
| | *Heleobia piscium* | 162.9 | 2443 | | + |
| | *Corbicula fluminea* | 2.0 | 30 | | + |
| Summer 1987 | *Potamolithus buschii* | 7.9 | 150 | | + |
| | *P. agapetus* | 61.2 | 1163 | | + |
| | *P. bisinuatus* | 0.8 | 16 | + | |
| | *P. lapidum* | 0.9 | 17 | + | |
| | *Chilina fluminea* | 60.2 | 1145 | | + |
| | *Heleobia piscium* | 33.5 | 635 | | + |
| | *Corbicula fluminea* | 2.3 | 43 | | + |
| Autumn 1988 | *Potamolithus buschii* | 45.8 | 687 | | + |
| | *P. agapetus* | 4.4 | 66 | | + |
| | *P. bisinuatus* | - | - | | |
| | *P. lapidum* | 3.0 | 45 | | + |
| | *Chilina fluminea* | 1.6 | 24 | + | |
| | *Heleobia piscium* | 65.7 | 986 | | + |
| | *Corbicula fluminea* | 1.5 | 22 | + | |
| Winter 1988 | *Potamolithus buschii* | 98.5 | 1477 | | + |
| | *P. agapetus* | 32.6 | 489 | | + |
| | *P. bisinuatus* | 1.3 | 19 | + | |
| | *P. lapidum* | - | - | | |
| | *Chilina fluminea* | 7.8 | 117 | | + |
| | *Heleobia piscium* | 219.1 | 3286 | | + |
| | *Corbicula fluminea* | 3.4 | 51 | | + |

Table III. Seasonal variation of the structural parameters of malacofauna present on the "caliche" shore of Anchorena Beach. D, mean density; H, Shannon-Weaver diversity; Ev, evenness; S, species richness; X, total number of individuals (in each sample).

| SEASON | P. bus. | P. aga. | P. bis. | P. lap. | Ch.fl. | H. pis. | C.flu. | D. | H' | Ev | S | $X_t$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spring 1987 | 53 | 75 | 0 | 2 | 36 | 225 | 1.5 | 392 | 0.51 | 0.65 | 6 | 1568 |
| Summer 1987 | 49 | 41 | 1 | 0.5 | 58 | 62 | 3 | 214 | 0.63 | 0.74 | 7 | 1049 |
| Autumn 1988 | 8 | 8 | 0 | 1 | 6 | 91 | 1 | 113 | 0.33 | 0.43 | 6 | 456 |
| Winter 1988 | 26 | 12 | 1 | 0 | 14 | 178 | 3 | 234 | 0.37 | 0.48 | 6 | 937 |
| TOTAL | 34 | 34 | 0.5 | 1 | 28 | 139 | 2 | 238 | 0.52 | 0.61 | 7 | 4023 |