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SPATIAL PATTERN OF ZOOPLANKTON BIOMASS IN THE GULF OF MONTIJO, PANAMA

ARTÍCULO DE COMUNICACIÓN CORTA

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ABSTRACT

The following study analyses the spatial pattern of zooplankton biomass in a seven inshore offshore stations between Puerto Mutis and Cébaco island on October of 1997. At each station triplicates of 150 l samples were collected using a 4-stroke self priming volute pump and filtered through an 80 um plankton net. The salinity increased of 9.7 ppt at Puerto Mutis to 30.3 ppt at Gobernadora Island whereas temperature remained constant at 29.5 ºC mean. Piñas and Puerto Mutis showed lower Secchi depths whereas higher values were found near Gobernadora. Copepods and nauplios comprised 90% of the catches. Zooplankton biomass was significantly higher at Piñas station (83.3 $\pm$ 5.8 mg/ mt3) whereas lower values were registered south Leones (5.10 $\pm$ 2.8 mg/mt3).

KEYWORDS

Gulf of Montijo, estuaries, zooplankton biomass, zooplankton.

RESUMEN

Se estudiaron los patrones de distribución espacial de la biomasa del zooplancton en siete estaciones de muestreo del golfo de Montijo. El estudio se efectuó en octubre de 1997 e incluyó la recolecta de triplicados de muestras de 150 litros utilizando para ello una bomba de succión de cuatro tiempos y filtrando el material a través de una red de plankton de 80 um de diámetro de poro. La salinidad se incrementó de 9.7 ppm en puerto Mutis a 30.3 ppm en las cercanías de Gobernadora mientras que la temperatura se mantuvo constante cerca de los 29.5 ºC. Las aguas de Piñas y Puerto Mutis mostraron baja transparencia mientras que los valores más altos se registraron cerca de Gobernadora. Los copépodos y los nauplios constituyeron el 90% de las capturas mientras que los mayores y menores valores de biomasa se registraron en Piñas (83.3 $\pm$ 5.8 mg/mt^3) y el sur de Leones (5.10 $\pm$ 2.8 mg/mt^3).

PALABRAS CLAVES
Golfo de Montijo, estuarios, zooplancton, biomasa del zooplancton.

INTRODUCTION

It has been shown that environmental variability plays a major role in determining spatial and temporal patterns of zooplankton distribution and species composition in marine tropical ecosystems (Moore & Sander 1976, 1982; Chisholm & Roff 1990). The gulf of Montijo is a coastal plankton based ecosystem in which the zooplankton act as trophic intermediates between the very productive phytoplankton and higher trophic levels, including many of the economically important fish, shellfish and shrimps. A multitude of physical, chemical and biological processes affect marine organisms and these processes operate over a range of spatial and temporal scales (Mc Alice 1970; Steele 1974; Lorenzen 1971) that must be considered in explaining variability in the structure, function and distribution of phytoplankton communities. In general, zooplankton abundance has been associated with changes in phytoplankton standing stocks and with the combined effects of regional climatology and local hydrographic variables. The gulf of Montijo, on the pacific slope of Panama, is under influence of the Intertropical Convergence Zone (ITCZ). Frequent rainfalls start in May and continue until October when ITCZ moves northward over Panama. In late November, the dry season has begun in earnest and little or no rain falls until the following May. This seasonal rainfall produce temporal and regional differences in river discharge which induce fluctuations in salinity, nutrient concentrations, turbidity (i.e. penetration of light) and therefore, biological productivity. These differences could be responsible for the observed variations in the spatial dynamics of zooplankton. In this study, we attempt to demonstrate the occurrence of spatial patterns of aggregation in the zooplankton of the gulf of Montijo.

MATERIALS AND METHODS

The gulf of Montijo is located to the south of Veraguas on the Pacific of Panama (Fig.1). The gulf is an estuarine system fringed with either low or tall mangroves and backed by forest, grassy hills, low swampy areas, agricultural land and palm outcrops. Routine sampling of zooplankton abundance was performed through seven sampling stations at one inshore-offshore transect, between Puerto Mutis and Cébaco island.

Observations were made during daylight hours (0900-1200) of 10 May, 1997. At each station triplicates of 150 l samples were collected using a 4-stroke self priming volute pump and filtered through an 80 um plankton net. Zooplankton abundance was estimated by count under a dissecting microscope and using a Petri disc. Average zooplankton biomass was calculated according to the method described by Longhurst (1985). Reading of temperature, salinity and light penetration were recorded using a YSI-30 conductivity-salinometer and a Secchi disk.

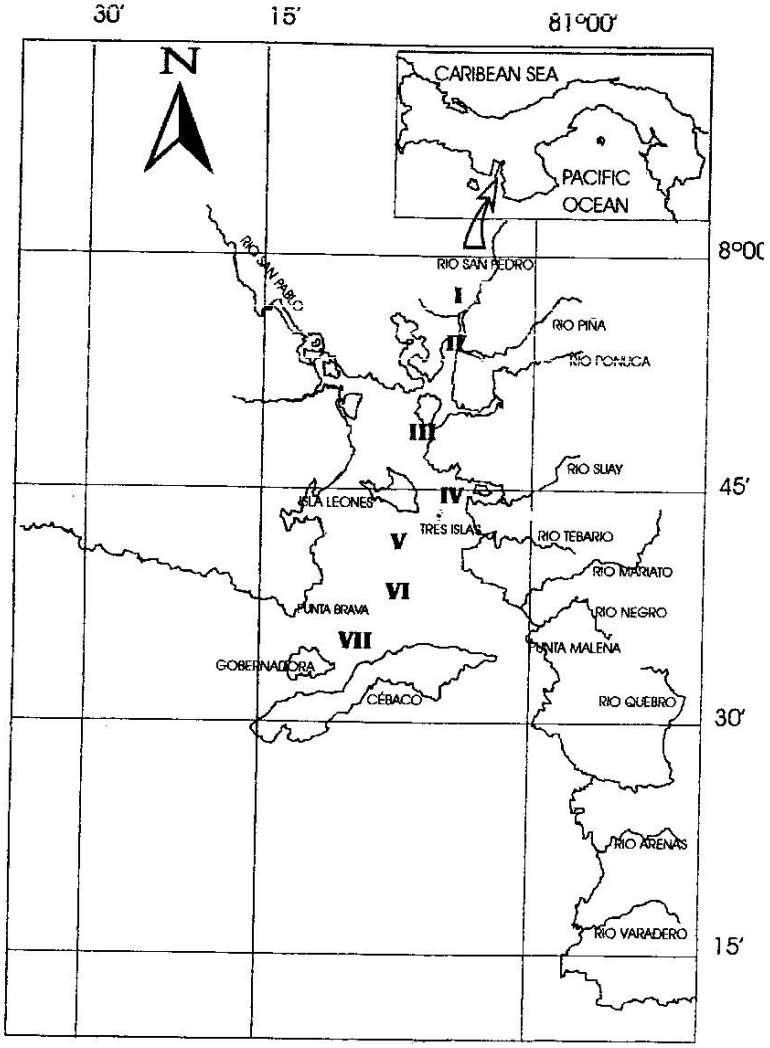

Fig.1. Map showing location of study area and sampling station (I-VII).

RESULTS

Hydrological patterns

Light penetration at offshore was higher than at inshore stations. Lower Secchi depths were measured at Puerto Mutis and Piñas stations. Temperature was constant around 29.5 $\pm$ 0.3 ºC while the vertical profile of salinity was more variable. Offshore stations near Gobernadora showed higher values than the inshore stations. The mean for the estuary was 24.9 $\pm$ 7.9 ppt. (Table 1).

Table 1. Secchi depth (D) and extintion coefficient (E) and salinity mean (ppt) in different sampling stations of the gulf of Montijo in October of 1997. I: Puerto Mutis, II: Piñas, III: Perdomo, IV: Tres Islas, V: LC1, VI: LC2, VII: LC3.

Sampling stations	D (mts)	E	Salinity (ppt)
I	0.31	5.48	9.7
II	0.68	2.50	18.6
III	2.00	0.85	28.0
IV	2.90	0.58	28.3
V	3.80	0.44	30.0
VI	2.90	0.58	29.9
VII	3.88	0.43	30.3

Biomass of zooplankton

Significantly higher mean values (Kruskal-Wallis, $P < 0.01$) of zooplankton biomass were found at Piñas station (83.3 $\pm$ 5.8 mg- mt^3). Mean zooplankton abundance at stations V and VI between Leones island and Cébaco were significantly lower than the other (Kruskal-Wallis, $P < 0.01$). The mean total abundance for the gulf of Montijo was 34.01$\pm$ 25.35 mg mt^3. (Table 2).

Table 2. Spatial pattern of surface zooplankton biomass (mg/mt^3) in different sampling stations of the gulf of Montijo in October of 1997. I: Puerto Mutis, II: Piñas, III: Perdomo, IV: Tres Islas, V: LC1, VI: LC2, VII: LC3.

Station	Biomass	Mean
I	28.6 54.0 41.3	41.3 ± 12.7
II	86.0 76.6 87.3	83.3 ± 5.8
III	58.0 38.6 34.6	43.7 ± 12.5
IV	14.6 20.6 30.6	21.9 ± 8.1
V	7.3 6.0 2.0	5.10 ± 2.8
VI	24.6 8.0 16.3	16.3 ± 8.3
VII	33.6 20.6 25.3	26.5 ± 6.6
Mean		34.0 ± 25.3

Copepods and nauplii dominated numerically the catches in all sampling stations. The two groups accounted for approximately 90% of the total zooplankton counts. At Mutis (I) and Piñas (II) stations both taxa comprised together 50% of total zooplankton (30 900 individuals mt3). (Table 3).

Table 3. Patterns of distribution of dominant zooplankton taxa (indiv/m^3) in the gulf of Montijo in October of 1997. I: Puerto Mutis, II: Piñas, III: Perdomo, IV: Tres Islas, V: LC1, VI: LC2, VII: LC3.

TAXA	I	II	III	IV	V	VI	VII	MEAN
Copepods	10 066.	8 140	5 266	4 573	2 373	1 433	6 473	5 475
Nauplius	7 800	4 893	3 326	1 740	1 486	726	586	3 384
Chaetognaths	126	46	673	313	440	326	133	294
Appendicularia	100	26	333	226	193	0	140	145
Polychaetes	0	380	120	300	53	0	80	133
Rotifera	0	33	0	26	553	0	260	124
Polychaetes larva	0	240	126	206	46	133	86	120
Zoea	20	80	0	13	106	26	0	35
Mysis	33	33	0	13	6	0	66	21
Fish eggs	0	0	0	2	40	26	0	11
TOTAL	18 145	13 871	9 844	7412	5 296	2670	9824	

DISCUSSION

In the gulf of Montijo, the influx of fresh water from rainfall is a recurring seasonal phenomenon related with the hydrological patterns. In Panama, annual precipitation ranged between 1 000 to 7000 mm. The annual cycle of precipitation is determined by the northeasterly

winds, known as “alisios” or “trade winds.” These winds promoted a well-defined dry and rainy seasons on the Pacific slope. Northeasterly winds become more intensive during the dry season, which last from early December to mid-March. Frequent rainfalls start in May and continue until October, when Intertropical Convergence Zone moves northward over Panama. In late November, the dry season has begun and little or no rain falls on the Pacific slope until the following May. Rainfall runoff is an important source of allocthonous nutrients that subsidize phytoplankton and zooplankton productivity especially into the estuary where the hydraulic residence time is longer (García & López 1989). In the gulf of Montijo the higher zooplankton biomass generally occurred at stations I, II and III upstream into the estuary. Other noticeable feature of zooplankton community structure in the gulf of Montijo is the high relative abundance of copepods and nauplii (90% of the total zooplankton counts) in the waters into the estuary. Samples at stations I, II and III contain near 65% of the total counts of copepods and nauplii. This finding is consistent with previous studies in near-shore zooplankton communities that report high relative abundance of copepods (Sander & Moore 1978; Chisholm & Roff 1990).

The results of this investigation demonstrate the occurrence of aggregation in the zooplankton of the gulf of Montijo with the higher values into the estuary near of Piñas river and relative preponderance of copepods and nauplii. Further studies are necessary to increase our understanding about the dynamic of plankton in this ecosystem.

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