THE DISTRIBUTION OF MEIOFAUNA COMMUNITY RELATED TO SALINITY GRADIENT IN THE HAM LUONG ESTUARY, MEKONG RIVER

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ABSTRACT: Seventeen taxa of meiofauna community in the Ham Luong estuary were investigated and comprised. Free-living nematodes were the most dominant and diverse group, presenting about 77% in the total of meiofauna density. Meiofauna density varied from 135.7 ± 33.5 inds/10 cm² to 1782.0 ± 199.5 inds/10 cm². The meiofauna density shows a decreasing trend from inland station to the brackish water station and it is increasing at mouth station. Significant differences in meiofauna density, diversity and Hill's indices were found between stations. The ANOSIM showed significant differences between stations in meiofauna composition (overall R = 0.972, p = 0.1%). The SIMPER analysis clarifies that the average similarity within stations was quite high, changing from EHL3 (76.2%) to EHL1 (86.1%).

Keywords: Estuary, meiofauna community, salinity, Ham Luong, Mekong Delta.

INTRODUCTION

An estuary is characterized by differently marked horizontal and vertical salinity gradients [1]. In different estuaries, the dilution pattern depends on the volume of freshwater, tidal amplitude range and the extent of water evaporation within the estuary [13].

The Mekong river system has special characteristics, through vast high land, mountain and forest, so its habitat shows a higher diversity of bio-resources along the southern coastal area from the vertebrates as fishes to invertebrates, such as mollusc, crustacean and annelids [26].

In Vietnam, meiofauna studies has been researched by Nguyen Vu Thanh & Nguyen Dinh Tu (2003) [18]; Nguyen Vu Thanh (2005) [15, 16]; Nguyen Vu Thanh & Doan Canh (2005) [17]; Nguyen Dinh Tu (2009) [14]. In the South Vietnam, there were some remarkable publications about meiofauna distribution published by Doan & Nguyen (2000) [8], Pavlyuk et al. (2008) [19] and Ngo et al. (2010, 2013) [20, 21].

This paper focuses on meiofauna distribution following salinity gradient in the Ham Luong estuary. The aims of this study are: to examine the meiofauna community along estuarine gradient; to investigate the relationship between salinity and meiofauna community.

MATERIALS AND METHODS

Sample collection and processes

Table 1. The coordinates of stations in Ham Luong estuary

Stations	Sampling coordinates	
	Latitude	Longitude
EHL.1	N 9°55'40.02"	E106°39'40.85"
EHL.2	N 9°59'0.31"	E106°33'55.53"
EHL.3	N 10°03'11.2"	E106°26'52.5"
EHL.4	N 10°06'47.97"	E106°23'36.96"

The samples were collected in March 2009 along estuary (figure 1). Four stations EHL1, EHL2, EHL3 and EHL4 were established (table 1). Three replicates sample at each station were collected and fixed with 60°C hot formalin 4% solution. Samples have been decanted and extracted by method in Heip et al. (1985) [10]. Meiofauna individuals were identified to higher taxa level after Higgins & Thiel. 1988 [11]. One-way ANOVA was used to test the significant difference between station when its condition is fulfilled the Levene test.

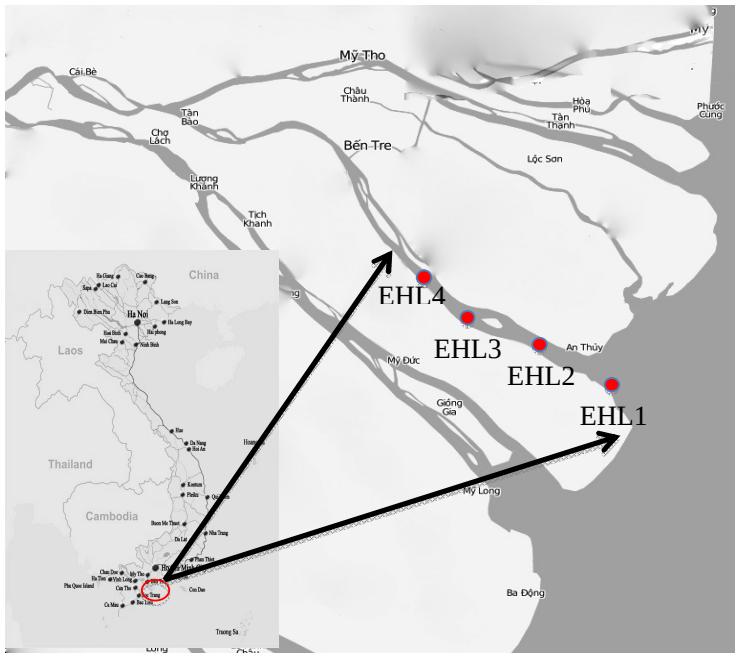

Figure 1. The map of sample stations in Ham Luong estuary

RESULTS AND DISCUSSION

Abiotic factors

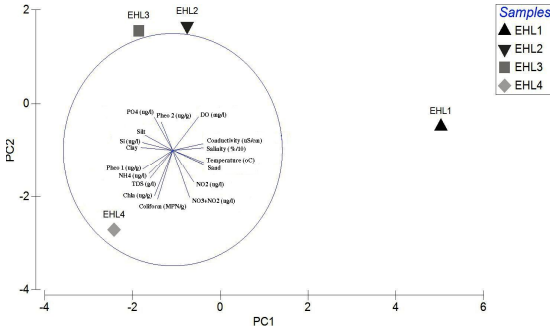

Figure 2. PCA for environment parameters

A PCA was used to analyse on the physic-chemical characteristics. The results indicated that the first two principal components PC1 (65.2%) variation and PC2 (23.6%) variation explained 88.8 % of the total variability (figure. 2). Three main groups can be distinguished: Group 1 is only EHL4 station based on higher pigment concentrations, phosphate, TDS and coliform measurements; group 2 are EHL2, EHL3 stations where characterized by pheo-2 and the finest sediments such as silt, clay; and group 3 is EHL1 station in which the largest sand fraction and situated closest to the mouth in the polyhaline part of the estuaries, followed by nutrients concentrations.

Meiofauna density, abundance and composition

The meiofauna density means varied from 135.7 ± 33.5 inds/10 cm² to 1782.0 ± 199.5 inds/10cm² (table 2). The results indicate that the meiofauna density shows a decreasing trend from inland station EHL4 to the brackish water station EHL2, increasing at mouth station EHL1 (figure. 3). The significant differences in meiofauna density are found between stations [H (7,24) = 21,13, $p < 0.05$].

The total of 17 taxa were identified (table 2), the dominant taxon was Nematoda (77.0%), followed by Copepoda (5.8%), Turbellaria (3.2%) and Sarcomastigophora (6.7%), representing 92.7% of the total meiofauna density (figure. 3).

The meiofauna community in Ham Luong estuary more diverse than that in subtropical estuary of Southern Coast Brazil (Kapusta et al., 2004) [12]. However, the taxa number is lower than in the Laguna estuary, Brazil [9].

Table 2. Meiofauna density and composition in Ham Luong estuary (inds/10 cm^2)

No.	Taxa	EHL1	EHL2	EHL3	EHL4
1	Nematoda	869 ± 52	90.0 ± 31	561 ± 78	1531.0 ± 261
2	Copepoda	2.3 ± 0.6	17.7 ± 7.1	23.3 ± 29.2	148 ± 162
3	Turbellaria	96 ± 51	0	1.7 ± 1.5	0
4	Polychaeta	9.3 ± 9.3	0.3 ± 0.6	0.3 ± 0.6	2.0 ± 1.0
5	Oligochaeta	39 ± 35	0	4.3 ± 2.1	25.0 ± 13.0
6	Tardigrada	2.3 ± 2.5	0	0	1.0 ± 1.7
7	Bivalvia	0	0.3 ± 0.6	1.0 ± 1.7	1.3 ± 2.3
8	Ostracoda	0.7 ± 0.6	5.0 ± 3.5	0	0
9	Amphipoda	5.0 ± 5.2	0	0	0.3 ± 0.6
10	Cumacea	0	0	1.0 ± 1.7	0
11	Gastrotricha	27 ± 15.0	0	0	0
12	Gastropoda	0	1.3 ± 1.5	0	0.3 ± 0.6
13	Sarcomastigophora	68 ± 25	14.0 ± 10	10.3 ± 8.1	63 ± 25
14	Rotifera	1.0 ± 1.0	4.3 ± 3.2	8.3 ± 8.5	7.7 ± 4.7
15	Halacaroidea	0.3 ± 0.6	2.7 ± 3.1	0	0.3 ± 0.6
16	Isopoda	0	0	0	1.3 ± 2.3
17	Ciliophora	0	0	9.7 ± 9.0	0
Density		**1120 ± 107**	**136 ± 34**	**621 ± 89**	**1782 ± 200**

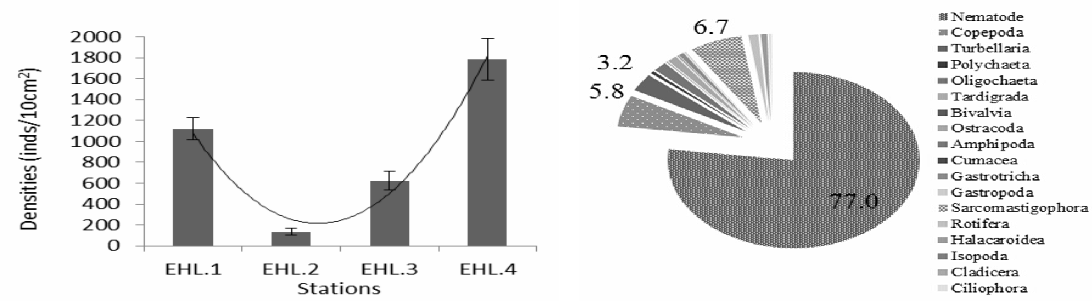

Figure 3. The density and composition of meiofauna in Ham Luong estuary

Meiofauna density is diverse and wide distributed in the world with the means of 10^6 inds/m² [7]. The meiofauna density in Ham Luong varied between 135.7 ± 33.5 inds/10cm² to 1782.0 ± 199.5 inds/10 cm² comparing with previous studies (1410-6060 inds/ 10 cm²) [27]; (217-2454 inds/10 cm^2) [2]; (14-1840 inds/10 cm^2) [3]; (200-17500 inds/10cm²) [22]; (67-1666 inds/10 cm²) [24]; (130-14500 inds/10 cm²) [23]; (83.7 ± 20.9-1383.5 ± 397.1 inds/10cm^2) in Mira [4] and (14.5 ± 5.2-2297.4 ± 426.9 inds/10 cm^2) in Mondego estuaries [4].

In Vietnam, the meiofauna density has been investigated in the Cua Luc (110.5 ± 28-295.5 ± 98.4 inds/10cm^2) [19] and the 8 Mekong estuaries (581.2 ± 400.1-3168.3 ± 352.7 inds/10 cm^2) [20].

The meiofauna diversity in Ham Luong was recorded with 17 taxa. Our results are shown higher than reported by Quang et al., 2010 [20], Pavlyuk et al., 2008 (10 taxa) [19], Damme et al. (1980) (10 taxa) [25], Witte & Zijlstra (1984) (4 taxa) [28] and Bouwman (1981) (5 taxa) [6].

The composition of meiofauna is similar in comparision with the results reported by Alves et al. (2009) in Mira and Mondego estuaries in Portugal [4]. The meiofauna composition is also similar to those found in the Oosterschelde estuary and five European estuaries, except some taxa were absent Archiannelida,

Hydrozoa, Kinorhyncha [22] and Cnidaria and Priapulida [23].

The high meiofauna density associated with the lower silt and clay concentration in sediment at mouth stations that is not similar to observations reported by Heip et al. (1985) [10], where the author stated that in sediment with a higher fraction of detritus and clay content there is a decrease of meiofauna diversity while abundances increases. Salinity is an important factor that strongly effects the distribution of meiofauna community along estuaries, but there are some other factors that also can interact and override the effect of salinity [5].

The second group of meiofauna in this study was Sarcomastigophora, it represented 6.7% of the total meiofauna density. This result is different compared with previous studies where Copepoda was recorded as second abundant group (Warwick & Gee, 1984 [27]; Smol et al., 1994 [22]; Soetaert et al., 1995 [23]; Kapusta et al., 2004 [12]; Pavlyuk et al., 2008 [19]; Alves et al., 2009 [4]; and Quang et al., 2010 [20]). The other groups were second abundant such as Polychaeta, Tardigrada and Turbellaria in studies by Alongi (1989) [3], Fonseca & Netto (2006) [9], Alongi (1987) [2], respectively.

Meiofaunal ecological indices

The meiofauna diversity along the salinity gradient in the Ham Luong estuary is quite low and varied between stations. The Margalef biodiversity index increases from inland to the mouth stations, it changes from 0.9 ± 0.1 (EHL4) to 1.3 ± 0.1 (EHL1). The Pielou's evenness J and H'(loge), Shannon-Wiener indices fluctuate with high values at the station EHL2 and low values at the station EHL3.The results show the average values changing from 0.2 ± 0.1 to 0.6 ± 0.1 and 0.4 ± 0.2 to 1.1 ± 0.2, respectively (figure 4). The significant differences for diversity indices are found between stations, [F(d)=3.93; F(J')=13.5; F(H')=15.4; $p < 0.05$]. The taxa richness is highest at the marine station EHL1 and lowest at EHL2. The results show the increase of taxa richness forward inlands stations. In addition, the indices N1, N2 and Ninf are highest at EHL2 to decrease at inland stations, while lowest at EHL1 (figure 4). The significant differences for Hill's indices between stations were found along salinity gradient, [F(N1)=16.7; F(N2)=13.6; $p < 0.05$].

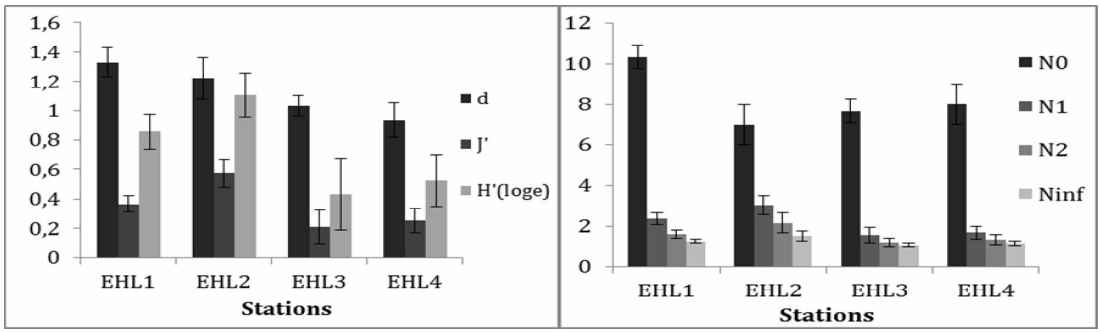

Figure 4. Meiofauna diversity indices

Multi dimention scaling (MDS) of meiofauna distribution

The multi dimension scaling (MDS) was used to investigate the spatial distribution of meiofauna communities along the salinity gradient (figure 5). The figure 5 shows the similarity in distribution pattern between stations, the stress value is excellent illustrating the goodness to fit well the regression. The ANOSIM showed difference between stations in meiofauna composition (overall R = 0.972, p=0.1%). The SIMPER analysis clarified that the average similarity within stations was quite high, changing from 76.2% to 86.1%.

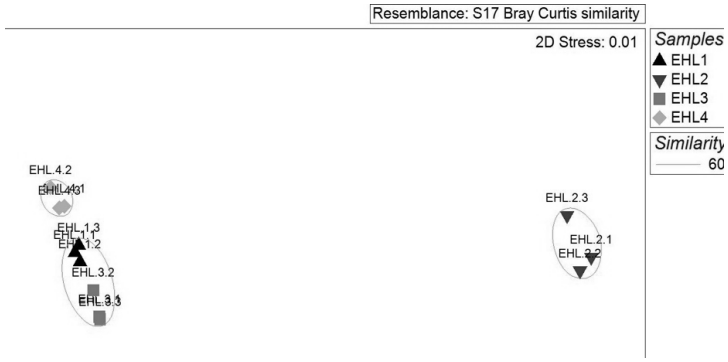

Figure 5. MDS for meiofauna community in spatial distribution

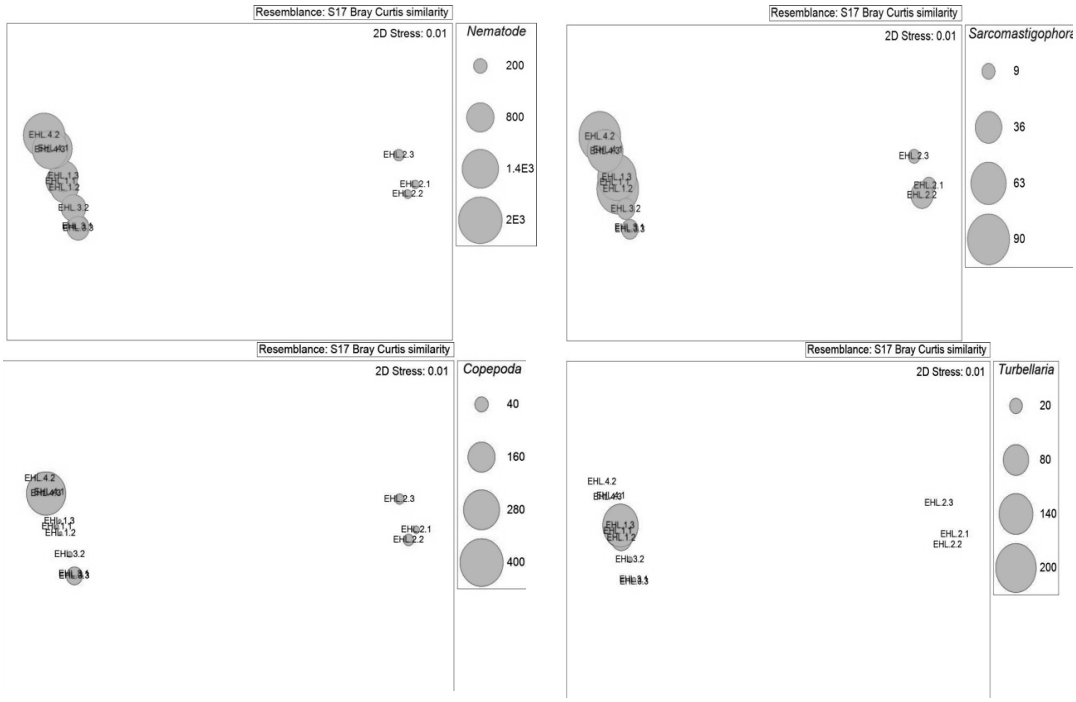

Figure 6. Dominant meiofauna taxa in spatial distribution patterns

About 60% similarity was found between replicates within station and between stations EHL1 and EHL3. The nematodes are predominant and presented more than 70% individuals in the total density. Therefore, the MDS pattern is mainly explained by the Nematoda density, followed by Sarcomastigophora, Copepoda and Turbellaria.

The MDS illustrated by the density means of each dominant taxon per station. Nematoda was abundant and wide distribution along estuarine gradients. The MDS results indicate that the nematode was high density at EHL1, EHL3, EHL4 and less abundant at EHL2. The pattern of spatial distribution of Copepoda was dominant at EHL4 and less density at others station, Sarcomastigophora was dominant at EHL1 and EHL4, while Turbellaria was dominant at EHL1 (figure 6).

CONCLUSIONS

There were total of 17 recorded meiofauna taxa. The dominant taxa were Nematoda, Sarcomastigophora, Copepoda and Turbellaria. The meiofauna density was high at inland stations and decreased from inland to the marine

stations. Meiofauna diversity indices were highest at the Polyhaline stations and decreased towards the Mesohaline and Oligohaline stations.

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PHÂN BỐ QUẦN XÃ ĐỘNG VẬT ĐÁY KHÔNG XƯƠNG SỐNG CỠ TRUNG BÌNH (MEIOFAUNA) THEO BIẾN THIÊN NỒNG ĐỘ MUỐI TRÊN CỬA SÔNG HÀM LUÔNG, SÔNG CỬU LONG

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TÓM TẮT

Bài báo ghi nhận 17 nhóm động vật không xương sống (ĐVKXS) cỡ trung bình phân bố trên cửa sông Hàm Luông, trong đó, quần xã tuyến trùng chiếm ưu thế, chiếm tỷ lệ 77% tổng số cá thể thu được. Mật độ ĐVKXS cỡ trung bình dao động từ 136 ± 34 đến 1782 ± 200 cá thể/10 cm². Giá trị này có xu hướng giảm theo sự tăng nồng độ muối. Chỉ số đa dạng sinh học cao tại các điểm gần cửa sông và giảm dần theo chiều từ cửa sông vào đất liền. Trong đó, chỉ số đa dạng Margalef dao động từ 0,9-1,3. Các chỉ số J-Pielou (dao động từ 0,2-0,6) và H'- Shannon Wiener (dao động từ 0,4-1,1) cao nhất tại điểm EHL2 và thấp nhất tại điểm EHL3.

Từ khóa: Meiofauna, hạ lưu, cửa sông, Hàm Luông, sông Cửu Long.

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