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Effect of environmental parameters on Amphipods biodiversity in the Iranian continental shelf of the Oman Sea

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Abstract
Biodiversity of the Amphipods was determined in the Iranian continental shelf of the Oman Sea from Jask to Gwadar (approximately 350 km stretch). Sampling was carried out in 10, 50, 100 and 200 m depth along five transects of approximately equal distances from each other. Sampling was done with Van Veen grab (0.1 m^2) in three replicates; temperature, salinity, and Dissolve oxygen were recorded by CTD. Amphipod species were identified and abundance counted. Ecological indices were estimated and their correlation with environmental parameters was determined. The ecological indices were found to be highly correlated with dissolved oxygen, temperature while there was no significant relation to salinity.

Keywords: Ecological indices, Crustacean, Diversity, richness, evenness, dominance

1. Introduction
Amphipoda is an order of malacostracan crustaceans that includes more than 6000 species [1]. Besides being an abundant food item for epibenthic invertebrate, benthic amphipods as a large group of macrobenthic community play important roles in mineralization, promotion and mixing of sediments, flux of oxygen into sediments, and cycling of organic matter [2]. Thereafter the knowledge of the structure and composition of amphipod assemblages may be of major importance to assess changes in the marine environment as well as for management purposes. Although several studies on macrobenthic communities have been conducted in the Oman Sea, but few records on the amphipods in these waters are available [3, 4]. Our aim was to evaluate the effect of environmental parameters on amphipods biodiversity in the Iranian continental shelf of the Oman Sea.

2. Material and method
This study was carried out by the Iranian National Center for Oceanography, using research vessel Ferdows 2, during ten days in September 2009. Five equidistance transects were selected in a stretch of approximately 350 km of continental shelves of the Oman Sea along the Iranian coast from Jask (25°43' N, 57°31' E) to Gwadar (25°07' N, 61°32' E). Four depths (10, 50, 100 and 200 m) were selected in each transect (Figure 1). Sampling was, therefore, carried out at twenty stations in triplicate using a 0.1 m^2 Van Veen grab sampler [5]. In every station bottom water quality parameters as Temperature, Salinity and Dissolve Oxygen (DO) data were recorded via using CTD. The samples fixed and preserved using neutral formalin-Rose Bengal mixture. In the laboratory, amphipods were separated from other specimens, then sorted and identified under stereomicroscope using a reliable key [6, 7]. Then the specimens were sent to two centers, the National Oceanography Centre, Southampton, UK and (CNR)-Institute for Coastal Marine Environment, Roma, Italy for confirmation of identification. The number of individuals from each species was counted (ind/m^2) [8]. Amphipods community structure was described via PAST software by univariate analysis based on the diversity (as Shannon-Weaver's), richness (as Margalef's), Dominance (as Simpson's) and evenness (as Pielou's). Pearson's correlation coefficient was used to study the affinity of the biodiversity indices towards environmental parameters. Statistical analyses were performed using the SPSS version 21 software package and Excel 2007.

Fig 1: Study area; numbers represent the transects in the Iranian continental shelf of the Oman Sea

3. Result

3.1 Environmental parameters

In the study area the water temperature decreased significantly ($P<0.01$) as depth increased so the highest temperature was seen in 10 m depth. Dissolved oxygen generally decreased with depth, and this decrease was significant ($P<0.01$) from 10 m to 50 m depth but no difference was seen between 100 and 200 m depth. Water salinity significantly decreased ($P<0.01$) with increased depth from 10 m to 50 m, but remained constant from 50 m to 200 m. (Figure 2).

3.2 Abundance of Amphipods and Community structure indices

Amphipods species which were identified is shown in Table 1. In this study the highest number of amphipod species was observed in station 6, and no species was recorded at stations 12 and 20 (Table 1). The species diversity and richness increased from 10 m to 50 m then highest diversity and richness were observed in 50 m. Evenness increased by depth increased and higher evenness was recorded in 100 m. Dominance increased with depth and highest dominance was recorded in both 100 and 200 m (Figure 3).

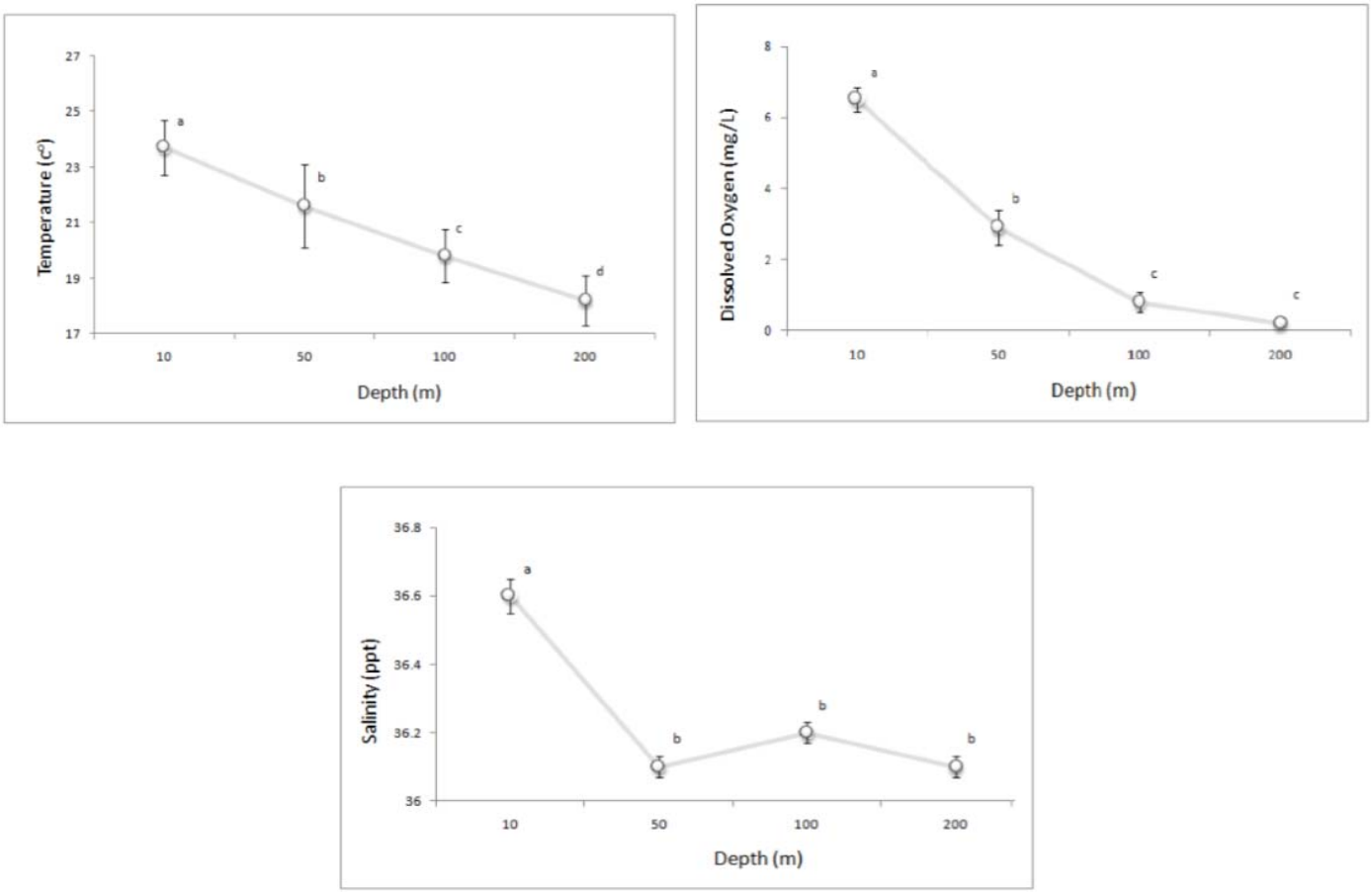

Fig 2: Temperature, DO and Salinity variation in depths in the Iranian continental shelf of the Oman Sea

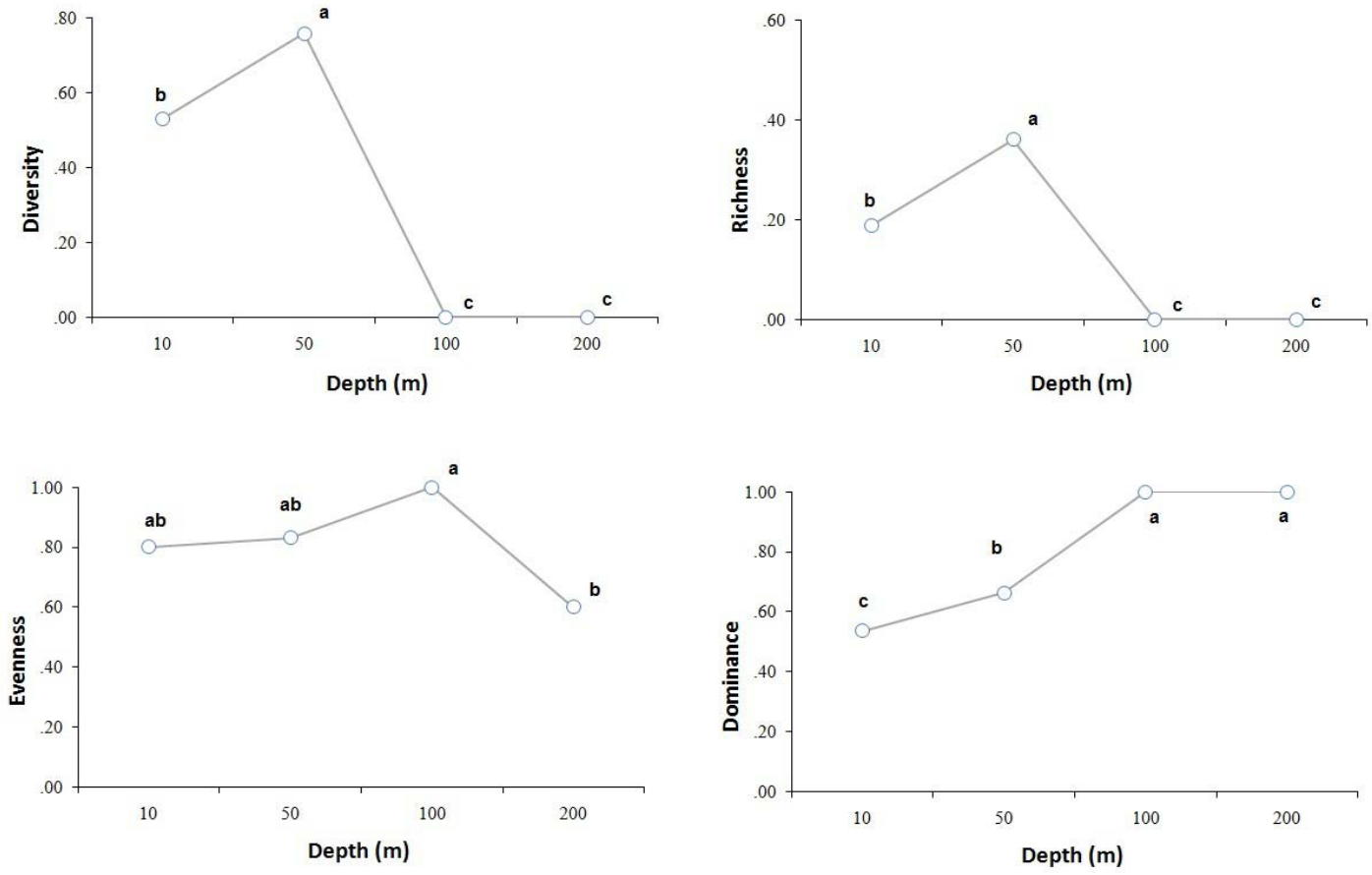

Fig 3: Variation in diversity indices of the amphipod community according to depth in the Iranian continental shelf of the Oman Sea

Table 1: Abundance (ind m-2) of amphipods at each station in the Iranian continental shelf of the Oman Sea

Stations (Depth)	Position		*Ampelisca* spp.	*Photis longicaudata*	*Apherusa sp*	*Metaphoxus simplex*	*Urothoe spp.*	*Lepidepecreum subclypeatum*
Transect1	**Lat.**	**Long.**			-	-	-	-
1(10m)	25˚43′47″	57˚31′36″	606.7±64.3	100±2	-	-	-	-
2(50m)	25˚43′36″	57˚31′36″	16.7±4.5	10±1.5	-	-	-	-
3(100m)	25˚43′27″	57˚31′36″	20±4	-	-	-	-	-
4(200m)	25˚43′15″	57˚31′36″	13.3±5.7	-	-	-	-	-
					-	-	-	-
Transect2					-	-	-	-
5(10m)	25˚35′13″	58˚18′08″	556.7±108	86.7±38.7	-	-	-	-
6(50m)	25˚35′08″	58˚18′08″	66.7±16	10±4.3	56.66±9.5	130±7.5	-	43.33±4.5
7(100m)	25˚34′95″	58˚18′08″	356.7±51.7	-	-	-	-	-
8(200m)	25˚34′58″	58˚18′08″	50±16.7	-	-	-	-	-
					-	-	-	-
Transect3					-	-	-	-
9(10m)	25˚29′31″	58˚91′14″	200±27	123.3±21.6	-	-	-	-
10(50m)	25˚29′20″	58˚91′14″	880±55.7	76.7±7.7	-	-	-	-
11(100m)	25˚29′09″	58˚91′14″	36.7±4.7	-	-	-	-	-
12(200m)	25˚29′01″	58˚91′14″	-	-	-	-	-	-
					-	-	-	-
Transect4					-	-	-	-
13(10m)	25˚21′51″	60˚24′42″	790±233	76.7±11.6	-	-	-	50±6.3
14(50m)	25˚21′46″	25˚07′59″	61˚32′36″	50±15.3	-	-	-	-
15(100m)	25˚21′38″	25˚07′43″	61˚32′36″	-	-	-	-	-
16(200m)	25˚21′23″	25˚07′23″	61˚32′36″	-	-	-	-	-
					-	-	-	-
Transect5					-	-	-	-
17(10m)	25˚07′59″	61˚32′36″	153.3±19.7	203.3±13.5	-	-	-	-
18(50m)	25˚07′43″	61˚32′36″	40±5	150±8.7	-	-	53.33±11.5	-
19(100m)	25˚07′23″	61˚32′36″	76.7±11.7	-	-	-	-	-
20(200m)	25˚07′04″	61˚32′36″	-	-	-	-	-	-

Table 2: Correlation of diversity indices with environmental parameters in the Iranian continental shelf of the Oman Sea

	Temperature (°C)	DO (mg/L)	Salinity (ppt)
Diversity	0.57**	0.48**	0.05
Richness	0.49**	0.36**	-0.03
Evenness	-0.74**	-0.69**	-0.22
Dominance	-0.65**	-0.56**	-0.11

**= P<0.01, *= p<0.05

3.3 Correlation of Community structure indices with environmental parameters

Species diversity and richness were positively correlated with temperature and DO (p<0.01), while it's observed there were no significant correlation between diversity and richness with salinity. Evenness and dominance were negatively related to temperature and DO (p<0.01) whereas there were no significant correlation between evenness and dominance with salinity (Table 2).

4. Discussion

In the amphipod community, *Ampelisca* spp. was the dominant group (76% of the total abundance) and were observed almost in all stations (Table 1), which corresponds with many studies in tropical and subtropical areas [9, 10, 11] and in deep waters of the Oman Sea [3]. In fact, the genus *Ampelisca* is known to be dominant at 2 to 100m depths worldwide [6, 7]. Other species were found to be restricted to certain stations (Table 1). This could be attributed to the wide expanse of the Iranian continental shelf along the Oman Sea. For future investigations it is recommended that each designated station be divided to substations for a more conclusive description of amphipod diversity. Lower diversity and richness in the shallower depth (10 m) of this study corresponds with the findings of some studies on west coast of India (Figure 3) [12]. Low richness and diversity in the deep bed in this study may be due to the reduced temperature, dissolve oxygen and increased depth (Figure 3) [12]. According to this study results, richness and diversity of the amphipods' community were correlated with temperature and DO (Table 2), which corresponds with some earlier works [13, 14].

5. Conclusion

In this study, biodiversity of amphipods was distinguished in evenly distributed amphipod community in the Iranian continental shelf of the Oman Sea. The highest diversity and richness was observed at 50 m depth and then sharply decreased as depth increased. Highest evenness was estimated in 100 m depth and highest dominance was observed in 100 and 200 m depth. The ecological indices were found to be highly correlated with dissolved oxygen, temperature while there was no significant relation to salinity.

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