

Some Macrobenthic Invertebrates in the Qatari Waters, Arabian Gulf

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تركيبة مجتمع اللافقاريات الكبيرة في المياه القطرية في الخليج العربي

جاسم عبدالله الخياط

قسم علوم البحار - كلية الآداب والعلوم - جامعة قطر

في هذه الدراسة تم تحليل عينات من ١١ محطة مختارة في المياه القطرية بالخليج العربي للتعرف على اللافقاريات البحرية، وذلك خلال شهر ديسمبر ١٩٩٨. تم تعريف ٥٢ نوعا من اللافقاريات القاعية، والتي اشتملت على ١٩ نوعا من القشريات، و١٧ نوعا من الديدان عديدة الأشواك، و١٣ نوعا من شوكلات الجلد، و٣ أنواع من طائفة الهدريات. تراوح معامل التنوع الأحيائي ما بين (١,٨٨ - ٣,١٢٩)، وقد ظهر أعلى معامل للتنوع في المحطة (305). اختلف تكوين التربة القاعية لمحطات الدراسة ما بين التربة الرملية والرملية الطينية، في حين قدر المحتوي العضوي لتربة القاع ما بين (١,٢٧ - ٤,٣٣%)، بينما كانت نسبة كربونات الكالسيوم عالية في جميع المحطات.

Keywords: *Macro-invertebrates, community Structure, Qatar, Arabian Gulf.*

ABSTRACT

Macro-invertebrates from eleven stations along the Qatar Exclusive Economic Zone (EEZ), Arabian Gulf, were studied during December 1998. A total of 52 species were encountered from all stations. Crustaceans were the most diverse group with 19 species. Polychaetes were represented by 17 species, followed by echinoderms (13 species) and hydrozoans (3 species). The faunal diversity index using Shannon-Wiener method ranged from 1.88 to 3.129. Overall species diversity based on numbers of individuals was maximum at station 305 ($H' = 3.129$). The bottom characteristics ranged between sand and sandy muddy. The organic matter was between 1.27 - 4.33%, while the calcium carbonate ranged between 43.19 to 94.91 % for all stations.

Introduction

Marine invertebrates in the Arabian Gulf are highly diverse and abundant forming an important source of food for higher consumers. Physical and biological conditions in the Gulf profoundly influence the occurrence and distribution of marine invertebrate. Available biological and ecological data on marine biota of the Arabian Gulf are scarce, with some coastal areas receiving more attention than others. Some critical marine habitats like coral reefs, intertidal salt marshes, mangroves and seagrass beds, have been defined [1-4].

A review of the available literature reveals that macro-invertebrates of the intertidal, subtidal and deep waters of Qatar have recently received considerable attention. Jones [5,6] reported some notes on intertidal and shallow subtidal fauna and flora species in Ras Laffan to the north of Qatar. Al-Khayat [7] recorded the common marine intertidal Mollusca at the east and west coast of Qatar. Al-Khayat [8] produced a comprehensive list of mollusc species (246 spp.) collected from the Qatari EEZ. The general features of the intertidal and subtidal benthic habitats of the northeast and west of Qatari waters are well documented [9-12]. The aim of this study is to assess the community structure of some macrobenthic invertebrates in Qatari water.

The present work is the second in a series of the study of macroinvertebrate in the area. The previous study concentrated on molluscs in Qatari waters [8].

Materials and Methods

During December 1997 benthic macrofauna were sampled from 11 stations, on board the R/V "Mukhtaber Al-Bihar" of the University of Qatar, along the EEZ of Qatar (Figure 1). From each station, grab samples were picked up and preserved in 5% buffered formalin. The organisms contained in the sediment were then separated using 0.5mm mesh size sieve and the retained organisms were sorted out and preserved for identification. During each cruise, the hydrographic parameters i.e. temperature, salinity, pH and dissolved oxygen were recorded using calibrated Water Quality Logging System (Model 3800 from YSI Incorporation), while chlorophyll-a was measured using the acetone extraction technique [13].

Mechanical properties of the sediment were analyzed by the method of Buchanan [14]. The organic content of the sediment was estimated as the loss of weight after ignition (450-500°C) and was then expressed as a percentage of the dry weight prior to ashing. Carbonate component was determined according to Carver [15]. The dominance of taxa was expressed using the Biological Index Value (BIV) of McCloskey [16]. Community diversity was measured according to Shannon-Wiener function [17]. The faunal similarity among stations was measured using the "Faunal Similarity Index" (FSI).

Results

Environmental features

A summary of the values of some hydro-chemical parameters for sampled stations along the Qatari EEZ is given in Table 1. The surface water temperature recorded during the study period ranges between 27.08°C and 27.98°C, while surface salinity ranged between 40.20 psu and 41.72 psu. The concentration of dissolved oxygen ranged between 5.01-5.42 ml l⁻¹. The values of chlorophyll-a were 0.06 and 0.09µg/l. pH displayed very limited variations between different stations (8.12-8.24).

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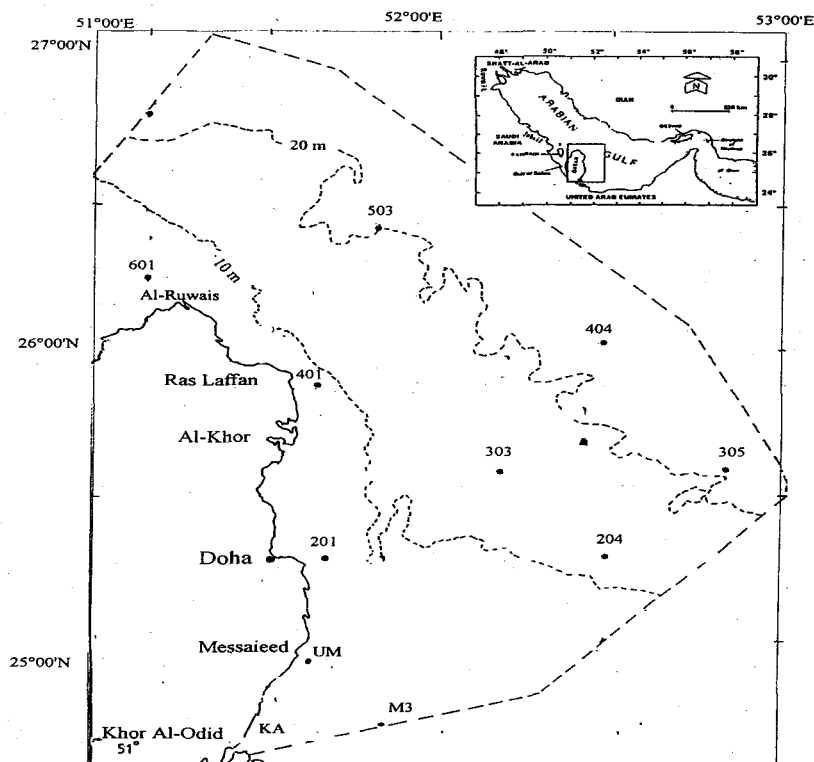


Figure 1: Selected stations in Qatari waters

Table 1: General hydrophysical and hydrochemical parameters at different stations studied along the Qatari EEZ.

Station No	Depth	Temp. °C	Salinity psu	Dissolved O ₂ (ml l ⁻¹)	pH	Chl <i>a</i> (µg/l)
201	14.00	27.30	41.3	5.42	8.22	0.09
204	19.00	27.64	41.2	5.33	8.18	0.09
303	27.00	27.8	40.4	5.25	8.15	0.09
305	36.50	27.60	41.5	5.18	8.14	0.08
401	10.50	27.10	40.3	5.01	8.19	0.08
404	55.00	27.08	40.3	5.05	8.24	0.07
503	40.00	27.37	40.4	5.29	8.20	0.06
601	10.50	27.98	40.8	5.27	8.12	0.07
M3	23.00	27.50	41.1	5.12	8.22	0.09
UM	11.50	27.82	40.2	Not recorded	8.19	0.07
KA	12.00	27.45	41.7	Not recorded	8.21	0.08

The results of grain size analysis, organic matter (%) and calcium carbonate (%) are presented in Table 2. Sediment of stations 204, 401, 601 and KA were made up of 100% sand, while those of stations 303, 404 and 503 were of >69% sand. On the other hand, sediments with higher percentage of silt were recorded at the near shore stations 201 (66.86%), M3 (54.80%) and UM (76.16%). The

organic content was low at most stations, ranging between 1.88-2.42%. The highest value of organic content was only observed at station 201 (4.33%), sampled off Doha. The calcium carbonate in sediments of all stations is generally high, ranging from 43.19% to 94.91%. Significantly higher value of calcium carbonate was recorded in sediments of the station 201. Calcium carbonate in most other stations was > 50%, except in station 404 (43.19%) and station UM (48.60%).

Table 2: Sediment characteristics at the different stations along the Qatari EEZ

Station No	Sand %	Silt %	Clay %	Texture	Organic matter %	Calcium carbonate %
201	17	67	16	Sandy muddy	4.33	56.35
204	100	-	-	Sandy	2.42	94.91
303	74	22	4	Sandy muddy	2.40	54.48
305	46	48	6	Sandy muddy	1.88	73.75
401	100	-	-	Sandy	2.20	70.26
404	70	22	8	Sandy muddy	2.00	43.19
503	76	19	5	Sandy muddy	1.92	59.35
601	100	-	-	Sandy	1.27	76.95
M3	36	55	9	Sandy muddy	2.00	56.77
UM	16	76	8	Sandy muddy	2.00	48.60
KA	100	-	-	Sandy	1.71	88.44

Macrobenthic fauna

Fifty-two macrobenthic taxa were encountered from the eleven stations sampled during this study (Table 3). Crustaceans were the most diverse group with 19 species (36.54% of the total fauna), followed by polychaetes with 17 species (32.69%), Echinodermata with 13 species (25%) and Hydrozoae with 3 species (5.77%) (Figure 2).

The highest number of taxa (28) was found at station 303, followed by 25, 24 and 21 taxa at stations 305, 401 and 404, respectively. Seventeen taxa were recorded at stations 503 and 601, while 13, 11 and 11 taxa were observed at stations 204, M3 and KA, respectively. The lowest number of taxa (10) was of station 201.

Similarly, the highest number of crustacean species was collected from station 303 (13 sp.). Lower numbers of crustacean species were from stations M3, UM, KA AND 201 (4 taxa). The highest number of polychaetes species was from station UM (13 taxa). Lower numbers were found at other stations (2-9 taxa). The highest number of Echinodermata species was collected from station 401 (9 taxa), while lower numbers were found at other stations (1-6 taxa). The hydrozoan taxa were absent or low in numbers in some stations, except at station 303 where 3 taxa were recorded.

Species diversity

The overall species diversity based on numbers of individuals was greater at station 305 ($H'=3.129$), followed by stations 401 and 404 with diversity values of 2.922 and 2.820, respectively. The lowest species diversity was noticed at station 201 ($H'=1.889$). The difference in evenness was much similar to species diversity for all stations. The overall evenness (E) was greater at station 601 ($E=0.981$) while the lower value ($E=0.774$) at station 503 (Table 4).

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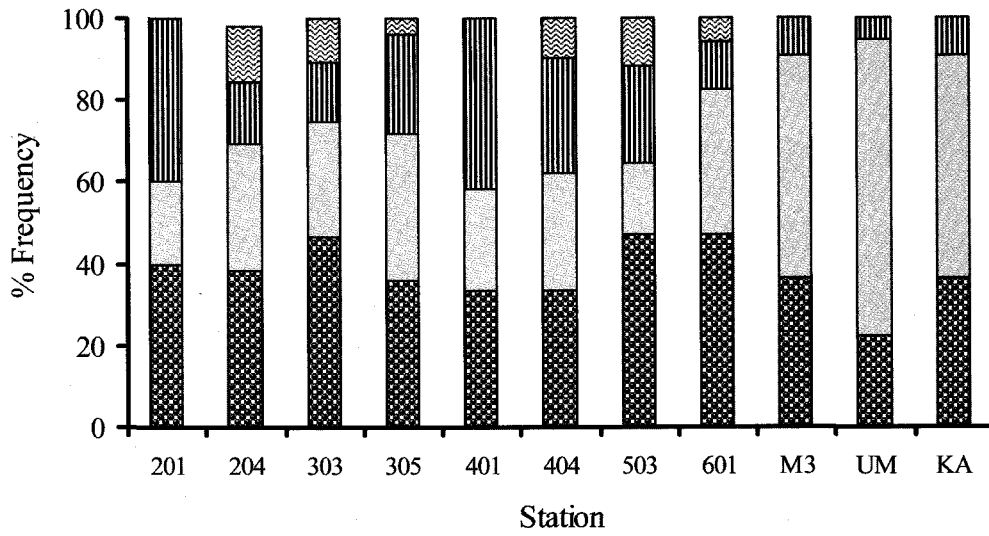


Figure 2: Percentage frequency of different groups in the investigated station

Table 3: Distribution of Macroinvertebrates in different stations, December 1998

Station	201	204	303	305	401	404	503	601	M3	UM	KA
Water depth (m)	10	19	27	36	11	55	40	10.5	23	12	12
Species											
Crustacea											
<i>Pilumnus longicornis</i>			*	*							
<i>Pilumnus</i> sp.				*							
<i>Pilumnus verpertilio</i>								*			
<i>Trapezia</i> sp.			*								
Unidentified crab sp.	*	*	*	*	*	*	*	*	*	*	*
<i>Portunus</i> sp.			*								
Spider crab			*	*							
<i>Leucosia signata</i>			*		*	*					
<i>Dardanus</i> sp.				*	*		*				
<i>Menaethius</i> sp.					*	*	*				
<i>Synalpheus quinquegens</i>							*				
<i>Alpheus</i> sp.			*	*	*	*	*	*			
Caridean prawns							*	*			
<i>Periclimenes obscurus</i>			*								
<i>Crangon</i> sp.			*					*			
<i>Penaeus</i> sp.		*	*	*	*	*		*	*	*	*
<i>Penaeus semisulcatus</i>	*	*	*								
Amphipoda sp.	*	*	*	*	*	*	*	*	*	*	*
<i>Balanus amphitrite</i>	*	*	*	*	*	*	*	*	*	*	*

Cont. Table 3.

Station	201	204	303	305	401	404	503	601	M3	UM	KA
Water depth (m)	10	19	27	36	11	55	40	10.5	23	12	12
Species											
Polychaeta											
<i>Eunice antennata</i>			*					*			
<i>Eunice</i> sp.		*	*	*	*	*		*		*	
<i>Onuphis emerita</i>		*	*	*	*	*	*				
<i>Neries</i> sp.	*	*	*	*	*	*	*	*	*	*	*
<i>Janua kayi</i>			*	*					*	*	*
<i>Amphitrites</i> sp.										*	
<i>Nephtys</i> sp.			*	*					*	*	*
<i>Eulalia</i> sp.										*	
<i>Polydotes</i> sp.								*		*	
<i>Glycera</i> sp.								*	*	*	*
<i>Prinospio pinnata</i>								*	*		
<i>Hydroides</i> sp.			*	*	*	*	*			*	
<i>Lumbrineris</i> sp.					*	*				*	
<i>Megalomma</i> sp.									*	*	*
<i>Vermiliopsis pygidialis</i>				*							
Unidentified polychaete sp.1	*			*	*	*				*	
Unidentified polychaete sp.2		*	*	*						*	*
Echinodermata											
<i>Phallusia nigra</i>			*		*		*				
<i>Colonial ascidian</i>			*		*	*		*			
<i>Astropecten polycanthus</i>				*	*	*	*				
<i>Ophithrix savignyi</i>	*								*	*	*
<i>Ophionereis dubia</i>	*	*			*	*	*				
<i>Ophithela danae</i>	*										
<i>Sabellastarte</i> sp.					*	*					
<i>Pentaceraster mamillatus</i>				*	*						
<i>Linkia multiflora</i>	*	*		*	*						
<i>Echinometra mathaei</i>			*	*	*	*	*				
<i>Clypeaster humilis</i>				*	*	*					
<i>Laganum depressus</i>				*	*			*			
Unidentified sp.			*								
Class: Hydrozoa											
<i>Obelia dichotoma</i>		*	*	*		*	*				
<i>Obelia</i> sp.			*				*				
<i>Clytia linearis</i>		*	*			*		*			
Total Species no.	10	13	28	25	24	21	17	17	11	18	11

Table 4: Number of species in each station, species diversity (H') and evenness (E) at different stations along the Qatari EEZ.

Station No	Number of species	Diversity index (H')	Evenness (E)
201	10	1.889	0.820
204	13	2.476	0.965
303	28	2.675	0.803
305	25	3.129	0.972
401	24	2.922	0.920
404	21	2.820	0.926
503	17	2.193	0.774
601	17	2.602	0.918
M3	11	2.352	0.981
UM	18	2.427	0.840
KA	11	2.243	0.935

Dominance

Of the 52 taxa recorded from eleven stations in Qatari waters, ten are considered the community dominants (Table 5). These taxa accounted for 54.19% of total number of animals. The crustacea, *Balanus amphitrite* was the most dominant and was collected from all stations. Unidentified crab species and Amphipoda species were also dominant at all stations but with less number of individuals. *Penaeus* sp was encountered at 9 stations, while *Leucosia signata* dominated only at 3 stations. The polychaete, *Nereis* sp was the most dominant of this group and was found at all stations. *Janua kayi* and *Nephtys* sp were dominated at five stations. Echinodermata was dominated by two taxa, *Ophithrix savignyi* and *Ophionereis dubia*. The former occurred abundantly at 3 stations, while the later dominated at 5 stations.

Table 5: The most dominant taxa according to biological index value (BIV) of McCloskey [16] along the Qatari EEZ. during December 1998.

Species	% of total species	Ranking points	% frequency*	Ranking points	BIV	Rank
<i>Balanus amphitrite</i>	15.92	20	5.64	20	40	1
<i>Nereis</i> sp	10.06	19	5.64	20	39	2
<i>Janua kayi</i>	6.70	18	2.56	15	33	5
<i>Penaeus</i> sp	3.35	17	4.62	16	33	5
<i>Nephtys</i> sp	3.35	17	2.56	15	32	7
Unidentified crab sp	3.07	15	5.64	20	35	3
Amphipoda sp	3.07	15	5.64	20	35	3
<i>Ophithrix savignyi</i>	3.07	15	2.05	12	27	8
<i>Leucosia signata</i>	2.79	12	1.54	11	23	10
<i>Ophionereis dubia</i>	2.79	11	2.56	15	26	9

* represent frequency of occurrence in 11 grab samples.

The faunal homogeneity

The distribution of the species between different stations was compared qualitatively based on Jaccard's formula. The similarity matrix for all animals fauna are presented in the presence-absence dendograms which fitted between stations (Figure 3).

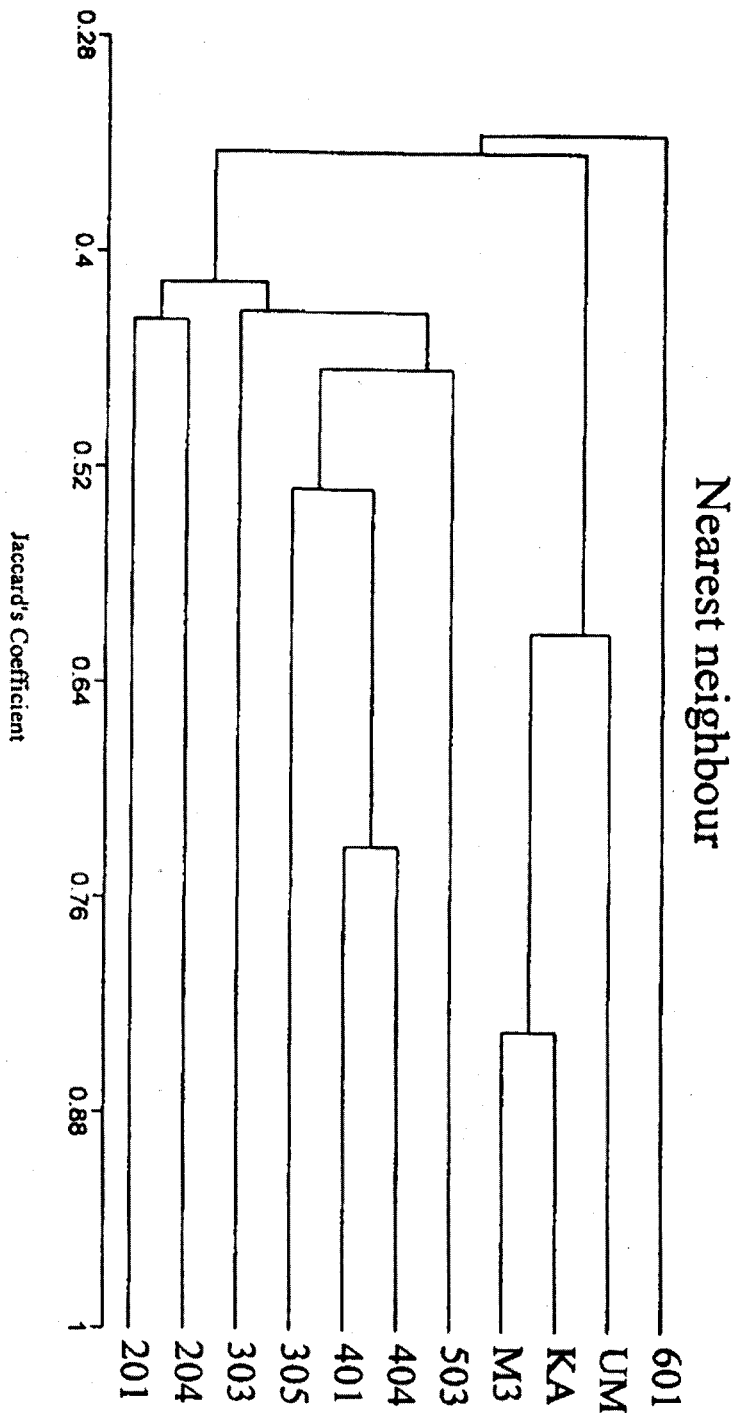


Figure 3: Jaccard's coefficient showing similarities between sampling stations.

It is apparent from this figure that the highest similarity indices (0.833) occurs between taxa inhabiting stations M3 and KA, and UM linked with these stations at similarity level of 0.611. Equal similarity also exists between taxa inhabiting stations 401 and 404 (0.731) while stations 303 and 503 were linked with them at 0.531 and 0.431, respectively. Station 601, however, recorded the least similar level (0.333). There is less similarity level (0.344) between most stations indicating that their faunal composition is different from each other.

Discussion

Information about the macro-benthos of the offshore deep water of the Arabian Gulf is meager. Most studies concentrated on distribution and species composition of the intertidal and shallow subtidal habitats. In the Arabian Gulf, subtidal sandy ecosystems extend down to at least 30m, whereas mud occurs in depths of 6m and more and is also the principal benthic ecosystem at depths greater than 30m [1,18]. Species richness is reported to be high (>600 species) in both subtidal sand and subtidal mud, surpassing that of all other ecosystems [18], even coral reefs (543 species) [1]. Polychaetes followed by gastropods were the dominant faunal groups. However, other studies have revealed different patterns of species richness and dominance [19]. McCain [20,21] reported a significant positive correlation ($p < 0.05$) between salinity and the number of major taxonomic groups within subtidal sand.

It is evident that the values of organic matter content along study area are relatively low range (1.27-2.42%). The macro-benthic invertebrate shows nearly low numbers of individuals for each taxa during present study. This can be related to several factors including the hydrographical features of seawater, rate of primary production, sediment composition, and seasonal changes. Mahoney and Livingston [22] stated that the mechanisms behind the seasonal fluctuations of the benthic organisms revealed that more than one variable in the environment may be responsible for the observed changes in the abundance of fauna. In the present study the macro-benthic community seemed to be controlled by the nature of substratum in most stations. It was very obvious at station 201 where (10) species were encountered most probably due to high percentage of sandy mud (Table 2). The sediment with high percentage of mud resulted in low oxygen content. Polychaetes were observed to prefer fine to medium type of sandy bottom with moderate amount of admixture of silt and clay.

Jones [5,6] reported chlorophyll-a values ranging from 0.2 to 0.86 mg/l in the ambient marine environment of the inner part of the Arabian Gulf which is not particularly high, whereas values around 0.5 mg/l and greater have been recorded from the Arabian Sea waters [23]. Some sources stated that the Arabian Gulf is one of the most productive bodies of water in the world, though there has been confusion between benthic and pelagic production in this shallow body of water. This statement may apply only to the total, or benthic production [24]. Variations of chlorophyll-a in the study area were not significant (Table 1) and seemed not to have impact on macro-benthic fauna distribution or species composition.

Many species of crustacean occur through the Arabian Gulf, few of them are commercial and the rest are important food web components. The dominant crustacean in different stations of the study area in Qatari waters are *Balanus amphitrite*, unidentified crab, amphipods sp *Penaeus* sp and *Leucosia signata*. The dominant polychaetes are *Nereis* sp, *Janus kayi* and *Nephtys* sp. Echinoderms of the Arabian sea were studied by Price [25,26]. There are about 350 recorded species from the region. The Red Sea has about 170 species of which 5.3% are endemic, while in the Gulf 12.1% are endemic. Among Echinodermata, *Ophithrix savignyi* and *Ophionereis dubia* were dominant in Qatari waters.

There were some differences in community structure between the offshore stations located on the east, southeast and northeast of Qatar peninsula. A total of 52 taxa of crustaceans, polychaetes, echinoderms, and hydrozoa were identified from all stations. The previous study on common mollusca community of the same stations was composed of 246 taxa including 115 gastropods, 124 bivalves, 4 scaphopods, and 3 polyplacophores [8,9]. This indicated that Qatari waters are quite similar in molluscan and other invertebrate fauna to other localities in the Arabian Gulf [1,5,6].

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