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INTERTIDAL FAUNAL ASSEMBLAGES AT LIGHT HOUSE–KEAMARI SEAWALL: MANORA CHANNEL LAGOON (KARACHI, PAKISTAN)

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ABSTRACT

The intertidal faunal assemblages of the Light house -Keamari Sea wall of Manora channel was studied during the period May 2006 to August 2008. Animal species belonging to following phyla were found: Porifera (1 species), Cnidaria (1 species), Annelida (3 species), Arthopoda (16 species), Mollusca (41 species), Echinodermata (2 species) and Chordata (1 species). Molluscs were the main components of the lagoon studied. Ten most abundant species were *Euchelus asper, Nerita dombyi, Thais rudolphi, Thais tissoti, Morula tuberculata, Chiton oceanica, Onchidium daemelli, Megabalanus tintinabulum, Canthrus spirilis* and *Cellana radiata* respectively. More animals were collected in summer months compared to other seasons.

Key words: Intertidal, artificial habitats, abundance, Seawalls, Manora channel, Karachi, Pakistan.

INTRODUCTION

Coastal Urbanization has modified and continues to modify marine shorelines around the world to meet the commercial and residential demands (Bulleri and Chapman, 2010).The hard coastal structures of Pakistan's coastline (Seawalls, jetties and breakwaters) have turned natural habitat into hard intertidal habitat.

The loss of intertidal habitats have implications for a variety of species that utilize them for shelter, spawning, nesting, breeding and food (Lee *et al.*, 2006). These include the decline or loss of species, ranging from commercially important fish species to migratory
waders (Faulkner, 2004). Seawalls offer little variety or complexity of habitat types, thus reducing species diversity (Chapman 2003; Moreira *et al.*, 2007).

Marine waters surrounding Keamari Seawall (Manora channel) are utllized for number of socioeconomic activities such as shipping, port and ship maintenance,loading and unloading of oil and fish harbor activities As a result, it faces numerous anthropogenic pressures and disturbances. Potential impacts include contamination or pollution through spills or resuspension of contaminated material though dredging.

The intertidal faunal assemblages that occupy Seawalls have not been studied in Pakistan There exists only one study about the Gametogenic patterns of *Ostrea nomads* from Keamari Seawall, Karachi Harbour (Siddiqui and Ahmed, 2002).A number of workers had studied these on intertidal Seawalls around the world (Blockley, 2007; Blockley and Chapman, 2008; Bulleri *et al*, 2005; Bulleri and Chapman, 2004, 2010; Chapman, 2003, 2004, 2006, 2007; Chapman and Bulleri, 2003; Davies *et al*., 2002; Lam *et al*, 2009; Lee *et al*, 2009 and others).

Studies on beaches of Pakistan are mostly related on the distribution, abundance and taxonomy of organisms (Ahmed, 1977; Tirmizi and Siddiqui, 1981; Tirmizi *et al*., 1982; Tirmizi and Kazmi, 1986; Haq *et al.*, 1978; Ajazuddin and Moazzum,2007)

Studies related to quantative ecology of marine animals from Pakistan are very limited. (Barkati and Burney, 1991; Zehra *et al*., 1995; Ahmed and Hameed,1999a; Barkati and Rahman, 2005; Niazi *et al* , 2007; Rahman and Barkati, 2010)

The present study was undertaken to provide information about intertidal faunal assemblage that occupy on artificial habitats like Keamari Seawall of Pakistan. This would form the basis for future comparative studies of these specific environments.

MATERIALS AND METHODS

Samples of faunal assemblage (macroinvertebrates and vertebrate (fishes) from inter-tidal zone of Keamari Sea wall near Light House were obtained at monthly intervals for a period of 28 months from May 2006 to August 2008. The study site is 100m long and 2m vertically wide Sea wall near Light House (Fig.1).The Sea wall selected was one of the most approachable Sea wall along Manora channel, Karachi coast.

The Sea wall was divided arbitrarily into 3 zones on the basis of tidal height as high, mid and low tidal zones. At good low tide sampling was done by walking along the 100m long Sea wall at same speed for picking animals. The animals were collected from uneven boulders, concrete bricks, gaps between boulders, crevices, sheltered areas

among boulders and bricks. The animals were also collected at low tide from 2 m wide vertical and uneven exposed surface of Sea wall. The collection was done from bricks and uneven boulders of the Sea wall during the low tide when exposed at mid and high water marks.

The macro-invertebrates were collected by large size forceps and vertebrates (fishes) by small hand net. Some animals such as, sea anemones, polycheates, C*hiton oceanica*, *Cellana radiate*, etc., were collected by scrapping and using hammer and cheisel. The size and number of unscrapable animals were taken into account for further processing.

The samples were brought to the laboratory in icebox. In the laboratory, all samples were washed with tap water to remove adhering sand, fine gravel, silt, mud and extra material. The washed samples were counted and measured. Temperature of water was recorded by using simple Centigrade thermometer whereas salinity was taken at the study site by using an automatic hand Referactometer. The pH or Hydrogen ion concentration was determined by digital pH meter in the laboratory soon after each collection, The following publications were used to identify the marine animals: Subrahmanyam *et al* (1949, 1952), Chhapgar (1956 a, b), Day (1878 & 1889), Khan and Dastagir (1971 & 1972); Dance (1974); Kundu (1962) and Tirmizi and Kazmi (1986).

RESULTS

Ecology of Study Site

The study area, Keamari Sea wall (24° 47´ 57.04" N´; 66° 59´0.17" E), is artificially built breakwater wall, about 1500 m long (Fig.1). The Light house area of Seawall face strong wave action.

An area of 100 meter long and 2meter wide Keamari Sea wall was selected for this study. The high tidal zone of the site is almost a plain area of concrete floor while the mid and low tidal zones are sloppy plain areas with lot of boulders, large concrete bricks (2x2 foot) and cervices respectively. The vertical slope of Seawall also possesses uneven loose boulders and concrete bricks at mid water and low water marks. At low water mark boulders and bricks of various sizes, exposed and sheltered areas, crevices, rough and smooth surfaces were present In the midtidal zone various kinds of rock boring animals (crustaceans, molluscs).were present There is no sign of pollution due to strong wave action, dilution factor and being far away from oil terminal installation.

Environmental Variables

Values of environmental variables of the study area (pH, water temperature and salinity) are illustrated in (Fig. 2). The values of temperature ranged from a minimum of 19 C º in January 2008 to maximum of 31Cº in June 2006 and 2007 with an yearly average of 18.8Cº.

The values of salinity ranged from a minimum of 30 ‰ in August 2006 to maximum of 38 ‰ in March 2008 with an average of 34.46 ‰.

The values of pH ranged from a minimum of 7.20 in December 2007 to maximum of 8.88 in August 2006 with an average of 7.84.

Number of Animal species

The fauna of Light House –keamari Sea wall is rich and diverse. The molluscs are most abundant components of the area. Sixty five animal species were recorded belonging to 41 species of Molluscs, 16 species of Arthropods, 3 species of Annelids, 1 species of Chordate (Pisces), 1 species of Cnidarian, 1 species of Poriferan and 2 species of Echinoderms. The animal species ranged from a minimum of 9 (in November, 2007 and February 2008) to a maximum of 29 (May 2006; Table 1).

Some animal species are more abundant than others (Table1). Included among the 10 most abundant animal species are *Euchelus asper, Nerita dombyi, Thais rudolphi, Thais tissoti, Morula tuberculata, Chiton oceanica, Onchidium daemelli, Megabalanus tintinabulum, Canthrus spirilis* and *Cellana radiata* respectively. Nine of these belong to Molluscs and one to Arthopod. Of these some species were available in large number as well as more regularly than others. For instance, *Chiton oceanica* in 28 samples, *Euchelus* asper and *Thais rudolphi* in 27, *Onchidium daemelli* in 23, *Nerita dombyi* in 22, *Thais tissoti* and *Morula tuberculata* in 21, *Canthrus spirilis* in 20 and *Megabalanus tintinabulum* in 17 samples.

Abundance of animals

A total of 5476 animals representing 7 phyla were collected during the study period (Table 1) They belonged to Mollusks (92.15%), Arthropods (6.30%), Annelids (0.80%, Chordates (Pisces, 0.31%), Cnidarians (0.24%), Poriferan (0.15%) and Echinoderms (0.05%; Fig. 3).

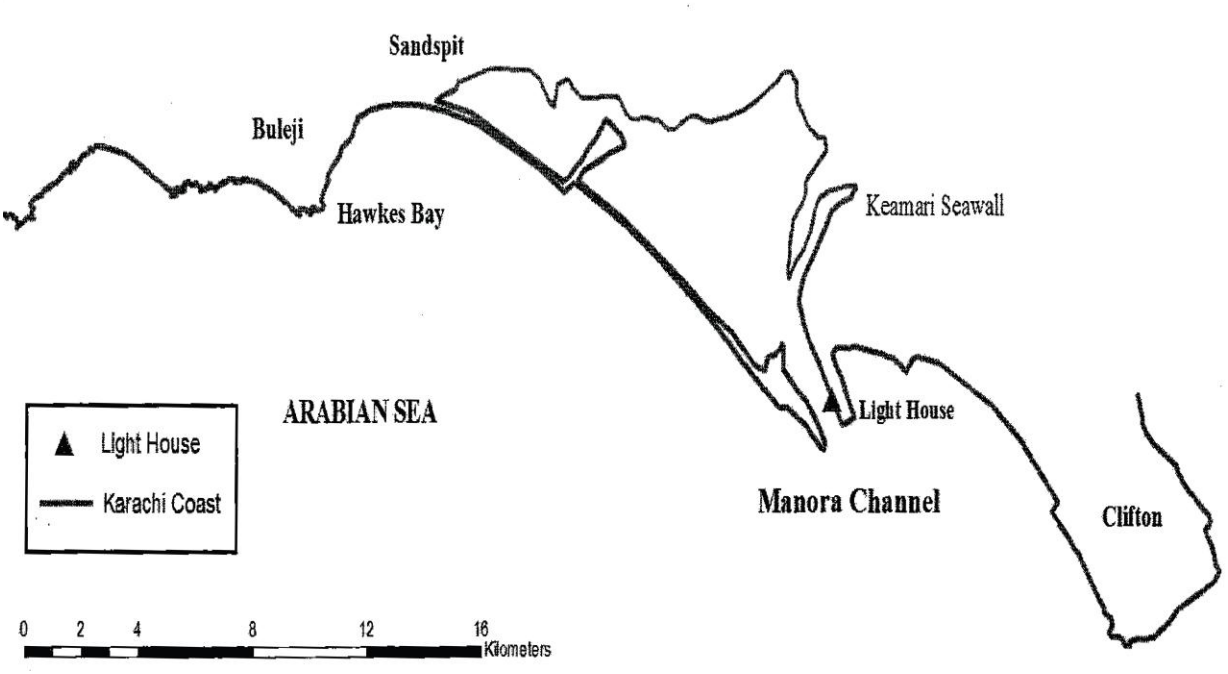

Fig.1. Map showing location of Light House-Keamari Seawll along Manora channel.

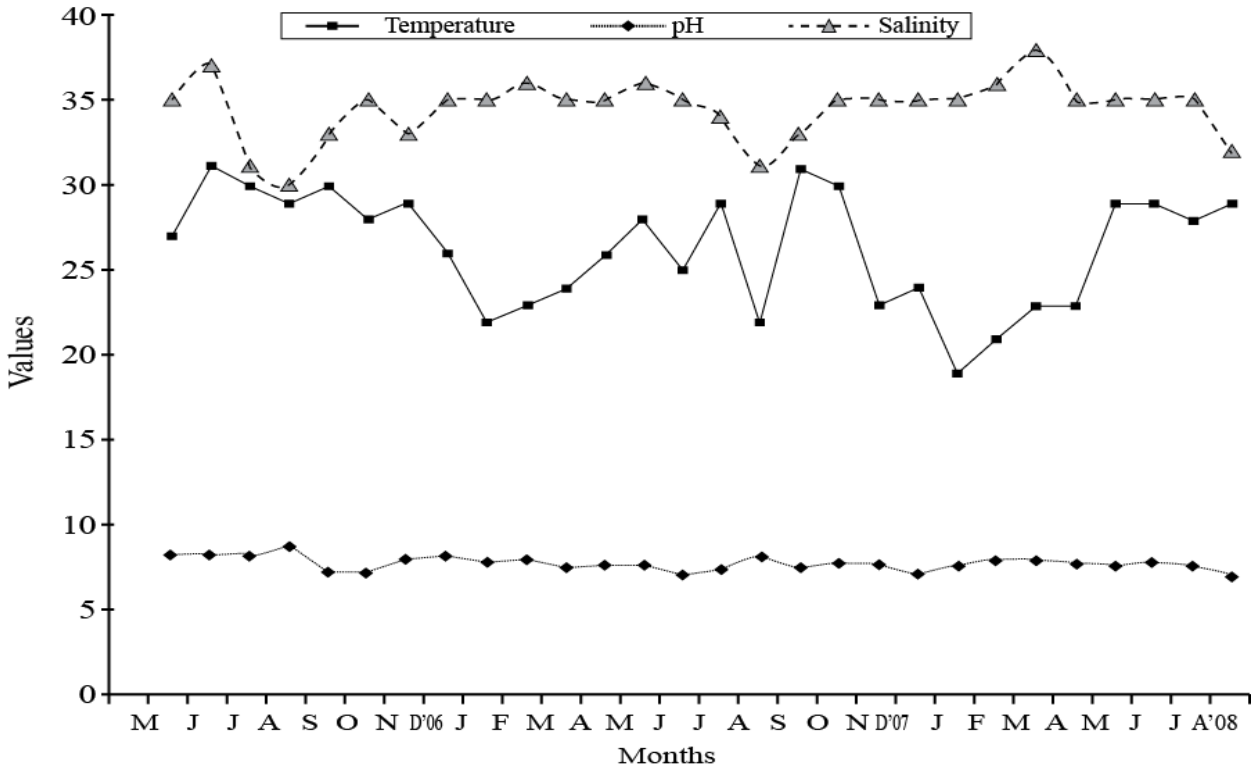

Fig. 2. Monthly fluctuations in the environmental vatiables during the study period May 2006 to August 2008 at location of Light House-Keamari Seawall.

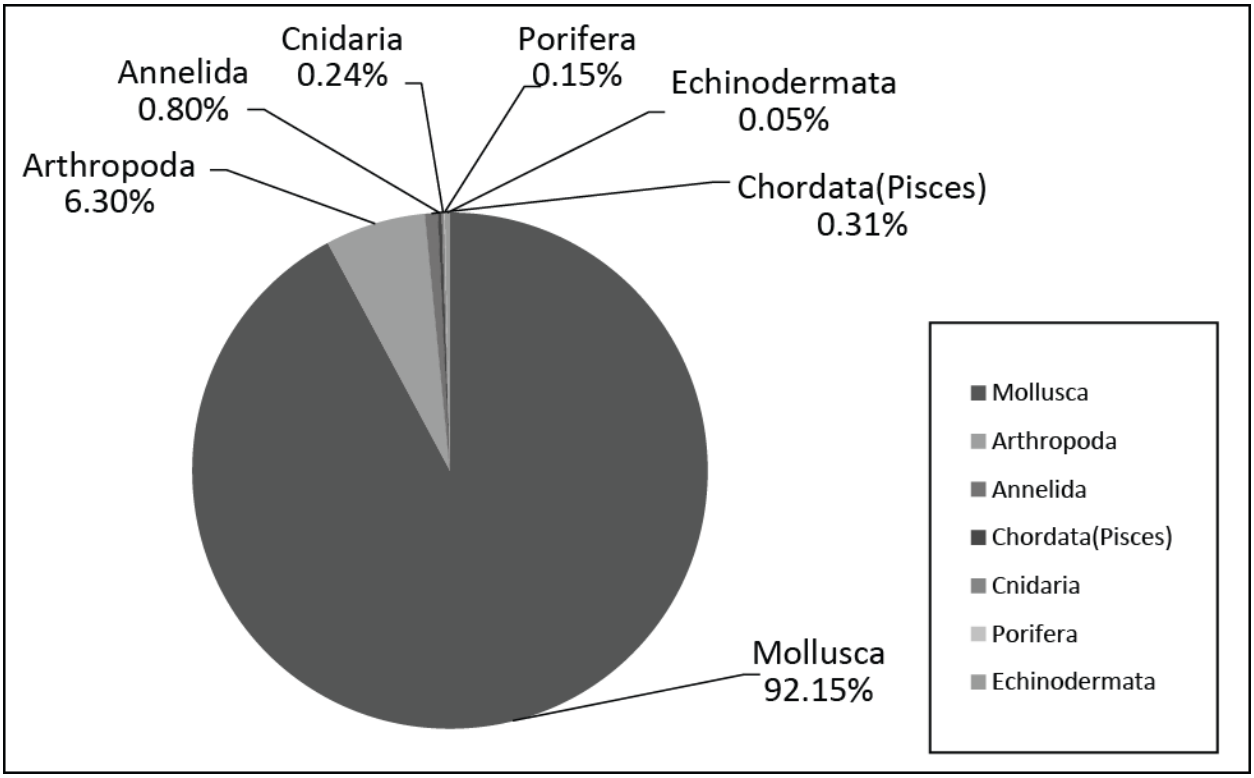

Fig.3. Pecentage composition of different phyla at Light House-Keamari Seawall along Manora channel.

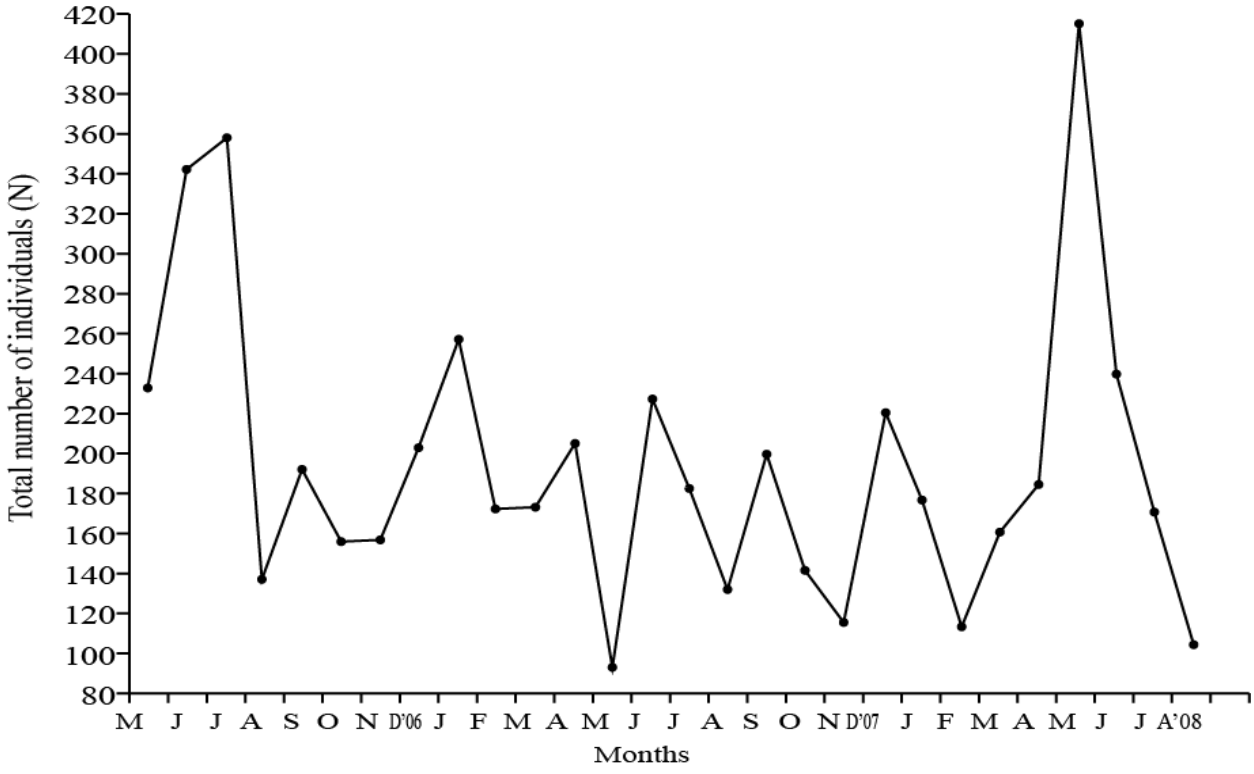

Fig.4. Monthly variation in the total number of animals (N) collected during the period May 2006 to August 2008 at the location of Light House-Keamari Sea wall.

Table 1. Total number of anim als during the study period May 2006 to August 2008 at the location of Light House-Keamari.

Species	Sampling months																												Total
	M	J	J	A	S	O	N	D' 06	J	F	M	A	M	J	J	A	S	O	N	D' 07	J	F	M	A	M	J	J	A' 08	
Porifera																													
Sponges	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	8
Cnidaria																													
Actinia equina	-	1	-	-	-	1	-	1	9	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Annelida																													
Chaetopterus sp.	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38
Nematodes	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Polycheate worms	-	-	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	5
Arthropoda																													
Alephus innopinatus	2	-	-	-	-	-	-	-	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Acetes indicus	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Atregatus roseus	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5	10
Balanus amphitrite	-	-	-	6	-	-	-	-	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24
Charbydis lucifera	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	5
Grapsus strigosus	1	-	-	-	1	-	1	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	8
Isopods	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Megabalanus tintinabulum	-	-	12	1	20	-	-	-	27	21	6	18	1	3	-	-	4	4	0	11	5	-	14	10	-	65	41	-	263
Ocyopoda cerathalmus	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Pacheless tomentosus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Peaneus merguiensis.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Petrolisthes boschii	-	-	-	1	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Pseudozius caystrus	-	-	-	-	-	-	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Leptodius exaratus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Scylla serrata	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	3
Thalmita pyrmna	4	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Mollusca																													
Arca foliata	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Arca inequivalvis	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Babylonia spirata	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
Brachydontes karachiensis	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Bullia lineolata	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Bullia mauritiana	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cantherus undosus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Canthrus spirilis	1	4	-	-	38	2	19	20	-	6	3	4	1	-	-	-	23	6	-	26	7	30	18	2	22	-	-	-	232
Cellana radiata	1	18	41	22	3	24	4	-	8	-	4	4	-	7	3	4	4	5	3	-	-	-	1	6	30	2	-	4	198
Cerithium cingulatus	4	-	-	19	1	-	-	-	7	-	5	3	4	2	1	-	1	-	4	-	3	-	4	-	-	1	2	-	61
Chiton oceanica	32	20	6	6	9	21	9	1	6	1	7	9	17	26	23	5	6	25	-	10	2	4	7	8	12	4	4	2	282
Conus biliosus	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Crossostrea rivularis	-	-	3	-	-	10	-	8	2	3	-	2	-	-	-	4	6	-	3	-	-	-	-	3	2	-	5	5	56
Cymatium sp.	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

Table 1 (cont'd)

Species	M	J	J	A	S	O	N	D' 06	J	F	M	A	M	J	J	A	S	O	N	D ' 07	J	F	M	A	M	J	J	A' 08	Total
	Sampling months																												
Dosinia prostata.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Euchelus asper	-	36	20	12	45	33	84	113	103	44	39	19	6	7	1	14	57	25	54	60	83	34	28	23	75	10	26	31	1082
Gaffarium sp.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Lithophaga nigra	-	-	-	-	-	-	-	2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Littorina intermedia.	-	80	84	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	178
Mercenaria sp..	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Mitra obeliscus	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Morula tuberculata	-	23	-	-	-	-	-	-	30	6	16	29	19	15	44	25	5	15	4	10	11	4	29	34	28	27	13	24	411
Nactica tigrina	4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Nerita costata	-	6	4	6	-	-	2	-	2	-	-	-	-	-	-	-	1	-	8	-	2	-	-	-	-	-	-	-	31
Nerita dombyi	3	9	17	19	3	5	-	-	-	3	41	45	28	32	24	16	23	14	-	36	-	4	4	50	113	84	12	15	600
Nerita albicilla	-	9	-	-	-	2	-	-	7	-	1	1	-	51	34	23	3	4	-	-	-	-	-	2	1	8	3	4	153
Nerita crepudalaria	-	21	13	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36
Nerita lineata	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Olivia nebulosus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Onchidium daemelli	1	4	-	-	38	2	9	20	-	6	3	4	1	-	-	1	23	6	20	26	7	30	18	7	22	20	3	8	279
Ostrea folium	-	-	8	-	21	-	-	-	11	12	1	3	4	51	30	10	12	4	-	8	-	-	1	4	1	-	-	1	182
Paphia indica	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Perna viridis	-	-	16	-	-	10	-	12	11	4	-	10	-	-	-	7	-	-	10	10	13	2	9	12	15	-	40	-	181
Pyrene entrepe	-	-	-	-	-	-	-	-	2	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
Telescopium telescpium	-	-	-	-	-	-	-	-	-	44	30	19	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	97
Thais carinifera	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Thais hypocastanum	-	-	-	6	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	12
Thais intercostalis	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
Thais rudolphi	33	37	47	24	11	44	11	-	12	1	7	13	8	31	22	10	7	28	10	8	2	3	6	20	30	15	21	5	466
Thais tissoti	55	70	72	-	1	-	15	18	14	1	5	-	4	2	1	14	25	6	-	16	40	-	22	-	58	-	-	-	439
Umbonium vestiarum	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Echinodermata																													
Ophiactis savignyi	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Astropectin indicus	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Chordata																													
Mugil cephalus	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
	234	342	357	138	193	157	158	204	257	173	175	206	93	228	183	133	200	142	116	221	177	114	161	185	413	240	171	105	5476

Table 2. Monthly variation in the total number of the animal phyla groups at Light house-Keamari during the period May 2006 August 2008.

Phyla	M	J	J	A	S	O	N	D' 06	J	F	M	A	M	J	J	A	S	O	N	D' 07	J	F	M	A	M	J	J	A' 08	Total
Porifera	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	
Cnidaria	-	1	-	-	-	1	-	1	9	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Annelida	38	-	2	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	4
Arthropoda	14	-	15	8	23	1	4	8	29	25	10	37	2	4	-	-	4	4	-	11	5	-	14	12	2	66	42	5	34
Mollusca	165	340	340	130	170	155	154	195	219	139	164	169	92	224	183	133	196	138	116	210	170	111	147	173	411	173	129	100	504
Echinodermata	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Chordata	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total	234	341	357	138	193	157	158	204	257	173	175	206	94	228	183	133	200	142	116	221	177	114	161	185	413	240	171	105	547

Molluscs ranked first in abundance whereas Arthropods and Annelids ranked second and third, respectively. The other phyla followed next in abundance are Chordate ,Cnidarians, Poriferans and Echinoderms (Fig. 3). Monthly abundance of individuals of several animal phyla is shown in Table 2.

The relative abundance (%) of molluscan species are as follows: *Euchelus asper*, (21.49), *Nerita dombyi* (11.8), *Thais rudolphi* (9.24), *Thais tissoti* (8.70), *Morula tuberculata* (8.15) , *Chiton oceanica* (5.50), *Onchidium deamelli* (5.53), *Cerithium spiralis* (4.60), *Cellana radiate* (3.92) and *Ostrea folium* (3.61;.Table 1).

Arthropods formed second highest group in percentage (%) among all animals, consisting of *Megabalanus tintinabulum* (76.23), *Balanus amphitrite* (6.96), *Atregatus roseus* (2.61), *Grapsus strigosus* (2.32) and *Alephus innopinatus* (2.03). Barnacles especially *Megabalanus tintinabulum* constituted the major components of Arthopoda (Table 1). They were most abundant in June 2008. Among annelids Parchment Tube worm, *Chaetopterus* sp. was the most abundant species and sea star, *Astropectin indicus* out numbered the other echinoderms (Table 1).

Seasonal variation in the total number of individuals

A clear seasonal trend in the variation of number of individuals was absent (Fig. 4) In May -July and December 2006, January and April 2007 , the number of individuals were higher than in other months while lowest number were collected in August , October, November 2006 and February 2007 during first year of study (Table 2).

In the second year of study (May 2007- April 2008), the number of individuals remained higher in June, July, September, December 2007, January and April 2008 than in other months of the year whereas the lowest number of animals were collected in May, August, November 2007 and February 2008 (Table 2)

Total number of individuals fluctuated seasonally from a minimum in August 2006 (exception noted in May 2007) to a maximum in July 2006 and June 2007 during first and second year of study respectively The values were maximum in summer months during both year of study i-e, (July 2006 and June 2007).

DISCUSSION

Keamari Seawall support 65 animal species comprises.mainly of molluscan and arthropods.Lam *et al.,* (2009) reported 17 animal species from Seawalls of Victoria Harbour (Hong Kong).; workers along the coasts of Singapore, Lee *et al.,* (2009) recorded 66 species belonging mainly to Mollusca, Arthropoda, and Annelida.Bulleri *et al.,* (2005) reported 42 species mainly consisting of Mollusca, Arthropoda and other groups. Mollusca and Arthropoda were the main contributors from Seawalls of northwest coast of Italy (Bulleri and Chapman, 2004).

Working on faunal assemblages on natural rocky shores on the coast of Pakistan, a number of workers reported Mollusks, Arthropods and Annelids as main contributors from West Bay of Gawadar and East Bay of Gawadar (Ahmed *et al.,*1982;Hameed 1996; Barkati and Burney ,1991,1995. Mollusca and Arthropoda also reported as major component of macroinvertebrate at other places of world also (Dwivedi *et al.,*1973; Evink, 1975).

In the present study, 41 mollusk species were reported. According to published research work, molluscan species ranging from 11 to 27 species were reported from different places of the world (Lam *et al.,* 2009; Lee *et al.,* 2009).

Gastropod molluscs were found dominant, comprising of 86% of among total molluscs in the present study. Literature from artificial structure, Seawall around the world also reported that gastropod molluscs are dominant molluscs.Literature from natural rocky shores around the world also showed the dominance of gastropod molluscs among other moluscs: East, West and South coast, Sri Lanka (Atapattu, 1972); Somalia (Chelazzi and Vannini, 1980; California, USA (Littler, 1980); Mexico (Gonzalez *et al*, 1991); China (Fuxue *et al.*, 1994); Spain (Troncosa and Urgorri, 1991);Egypt (El- Komi, 1996).

A number of authors have drawn the same inference for molluscan population on natural rocky shores (Ahmed, 1977; Ahmed *et al.*,1982; Ahmed and Hameed ,1999a,b;Hameed and Ahmed, 2000; Rahman and Berkati, 2012). The gastropod molluscs are dominant at four rocky shores along Karachi namely Manora, Buleji, Nathiagali and Cape Monze.

The abundance of macroinvertebrates and macrophytes on the rocky shores vary in abundance with the seasons (Saifullah, 1973; Dwivedi *et al*., 1973; Horn *et al*., 1983; Qari and Qasim, 1986, 1994; Fatima and Barkati, 1999; Nasreen *et al.*, 2000 etc.). The intertidal fauna was also found fluctuated in different seasons. It was high in summer months (June and July) and low in Autumn (August) in both years of study (exception was noted in May 2007). The results of the present investigation are in accordance with many earlier studies. According to Nasreen *et al* (2000) the monsoon season seems to be healthy season for total number of animals on Manora rocky shore. An increase in number of individuals occurred from May to August (beginning of SW monsoon).

Similarly working on the standing crop of sea weeds of Buleji. Saifullah (1973) reported that production was low during northeast monsoon. Qari and Qasim (1986, 1994) reported maximum growth of algae in post monsoon period. Horn *et al.,* (1983) documented that the overall abundance of macrophyte population was greatest during summer and fall and least during winter on central California rocky intertidal near Piedras Blancas. The total macroinvertebrate abundance was lowest in winter and highest in spring. Dwivedi *et al*., (1973) observed variations in benthic fauna of two sites of Goa, India from month to month. Density of macrobenthos declined in August and increase in October.

The Light House- Keamari seawall displayed both exposed and semi protected conditions having rapid circulation of oxygen richness. The temperature at the study site showed a controlling factor for the distribution of animals. The salinity did not make much difference in controlling the distribution of animals. The low pH seemed to be a controlling factor as the distribution of animal became very low in the month of October of both study years.

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