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Intermittent study of benthic fauna in the Eastern Harbour of Alexandria, Egypt.

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ABSTRACT
The hard bottom benthic fauna at a fixed site in the Eastern Harbour of Alexandria, Egypt was studied during intermittent seasons from 2014 to 2018. The results recorded 26 species, belong mainly to polychaetes (11 species) and crustaceans (9 species), in addition to 2 species of mollusks and one species for each of Cnidaria, Porifera, Bryozoa and Sipuncula. The species richness varied between 9 species after the winter storm of 2014 to 21 species in spring 2015, while the numerical abundance of the total fauna fluctuated between 1007 ind./m^2 in spring 2017 and 3442.3 ind./m^2 before the winter storm of 2014. The Shannon diversity index was low (0.98 - 1.51), associated with low evenness (0.39 -0.69). Polychaetes constituted 45.2% of the total faunal count, followed by crustaceans (35.2%), and mollusks (19.4%). Five species only appeared to be responsible for 91.7% of the total count, namely the polychaetes *Pseudonereis anomala* Gravier (1899) and *Spirobranchus triqueter* Linnaeus (1758), the amphipod *Elasmopus pectenicrus* Spence Bate (1862), the isopod *Cirolana bovina* Barnard (1940), and the bivalve *Brachidontes pharaonis* P. Fischer (1870). Other species sustained relatively high counts, forming high percent of the total population at certain time, such as the polychaetes *Syllis schulzi* Hartmann-Schröder (1960), *Loimia medusa* Savigny (1822), the isopod *Dynamene bidentata* Adams (1800), and the gastropod *Fissurella* sp. The counts and relative abundance of the major groups as well as the dominant species experienced pronounced temporal variation throughout the period of study.

INTRODUCTION

The Eastern Harbour of Alexandria is a semi-closed small shallow basin, lying at the central part of Alexandria coast and exposed to different stresses due to commercial, touristic, transport activities and anthropogenic stress of fishing activities, direct and indirect discharged wastes. The harbour's bottom is covered by three types of sediments (Hamoud *et al.* 2016), while the western area is characterized by rocky features and broken blocks. In addition, the harbor's water is rapidly exchanged with the open sea due to the short flushing time (1.3 - 2.9 days, El Bessa, 2011).

Several studies have been done on the settling rate of fouling communities on artificial panels in the Eastern Harbour (e.g. Ramadan *et al.* 2006a, 2006b), others were done one certain groups of benthic animals along the Alexandria coast

(Soliman, 1997; Abdel-Salam and Ramadan, 2008a, 2008b; Azzurro *et al.* 2010; Abdel-Salam, 2014; Abdel-Salam *et al*. 2017; Hamdy *et al.* 2017), in addition to several studies on benthic polychaetes on the Egyptian Mediterranean coast (see Dorgham *et al*. 2014).

The present study was directed toward the species composition and numerical abundance of benthic communities on a natural rocky bottom in the Eastern Harbour of Alexandria at intermittent time intervals from 2014 to 2018.

MATERIALS AND METHODS

Samples of benthic fauna were collected twice in winter 2014 and in some spring seasons during the period 2014 -2018 from a rocky area covered by green and red algae. The sampling site was lying in front of the building of Oceanography Department, Faculty of Science, Alexandria University (Fig. 1). The spring was chosen for collection since it is the most suitable season for algal growths which host the benthic fauna. Three replicates of each sample were collected within a metallic frame with a dimension of 25x40 cm by removing all biota existing on the rocky surface.

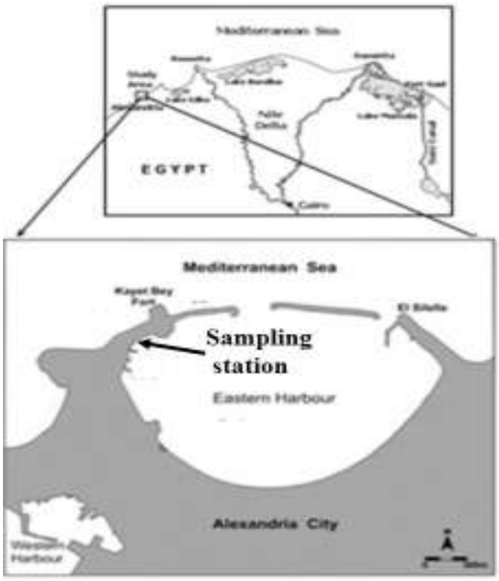

Fig. 1: The Eastern Harbour of Alexandria and the sampling station.

The samples were placed in plastic bags and the different animal groups were sorted in the laboratory and preserved in 10% neutralized formalin. All the taxa were identified and counted, and the total faunal count was estimated as individuals per square meter.

The Shannon diversity index was calculated according to Shannon Weaver (1963) and evenness according to Pielou (1969). Bray Curtis similarity between the diffenet communities was found following Bray Curtis (1957).

RESULTS

Environmental characteristics:

Unfortunately, the physical chemical parameters of the study area were not measured during the collection of the benthic fauna. However, the environmental data shown in table 1 are taken from published studies on the Eastern Harbor in different years. These studies indicated pronounced variations on the long term scale, particularly in dissolved oxygen, nutrients and phytoplankton biomass.

Table 1: The range of some environmental parameters during different times in the Eastern Harbour of Alexandria.

	EEAA, 2000	EEAA, 2001	EEAA, 2002	EEAA, 2003	Khairy *et al*., 2014 (2009)
Temp.	18- 29	18- 29	16- 30	14- 30	
DO (mg/l)	3.8 - 9.9	3 - 7.6	3.6 - 7.2	3.6 - 7.4	4.9 - 8.52
pH					7.55 – 8.15
NO3 (µM/l)	1.51 - 21.15	0.88 - 12.06	1.15 - 10.82	1.76 - 13.26	0.44 -5.9
NH4 (µM/l)	0.61 - 6.14	1.25 - 6.65	0.83 - 3.96	0.92 - 3.94	0.03 23.49
PO4 (µM/l)	0.11 - 0.44	0.05 - 0.93	0.22 - 1.51	0.02 - 0.97	0.02 - 2.2
SiO4 (µM/l)	1.95 - 5.44	1.48 - 10.68	0.44 - 6.48	1.11 - 31.57	0.5 - 27.26
Salinity	35.1 - 37.8	32.3 - 38.4	35 - 39.2	34.9 -39.5	35.24-38.85
Chl. a (µg/l)	0.14 – 8.73	0.19 – 58.11	0.9 – 17.01	0.39 – 12.18	1.16 - 2.99

The fouling community at the sampling station comprised 26 species of different taxonomic groups (Table 1), fluctuating between 8 species in spring 2017 and 21 species in spring 2018 (Fig. 2). The numerical abundance of the benthic fauna attained a maximum of 3442 ind/m^2 in winter 2014 and a minimum of 1007 ind/m^2 in spring 2017. The Shannon diversity index was always low during the whole period of study, varying from 0.98 in April 2018 to 1.51 after the storm of the winter 2014, and evenness index varied between 0.39 in April 2018 and 0.69 after the winter storm of 2014. The relative abundance of the benthic assemblages (percentage to total faunal count) indicated that polychaetes dominated the community by 45.2%, followed by crustaceans (35.2%) and mollusks (19.4%). Five species only constituted the great bulk of the total count (91.7%), namely the polychaetes *P. anomala* (28.4%) and *S. triqueter* (11.6%), the amphipod *E. pectenicrus* (21%), the isopod *C. bovina* (12.3%), and the mussel *B. pharaonis* (18.5%). Other species attained temporary high counts with relatively high percent at certain time, such as the polychaetes *S. schulzi* (up to 150 ind./m^2, 4.4%) before the winter storm of 2014, *L. medusa* (140 - 172.5 ind./m^2, 5.1 - 11.1%) during spring 2018, the isopod *D. bidentata* (100 ind./m^2, 3.3%) after the winter storm of 2014, the gastropod *Fissurella* sp. (up to 76 ind./m^2, 6%) during spring 2018. All other taxa were represented by pronouncedly low counts or occasionally found (Table 2).

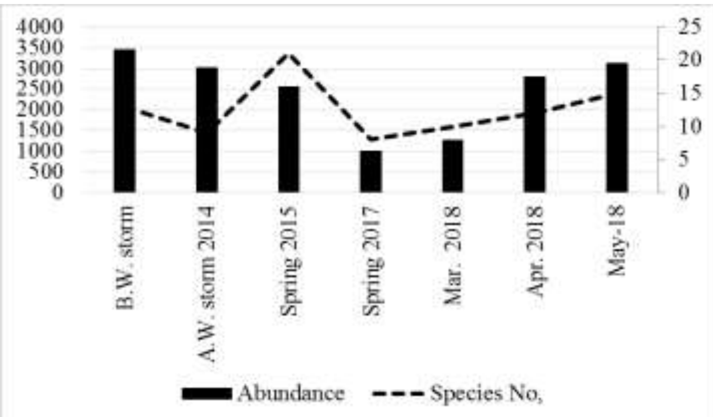

Fig. 2: The number of species and the total count (ind/m^2) of the benthic fauna in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

Table 2: Numerical abundance (ind/m^2) of the benthic fauna in the Eastern Harbour from winter 2014 to spring 2018. (BWS=before winter storm, AWF= after winter storm).

	BWS	AWS	Spring	Spring	March	April	May
	2014	2014	2015	2017	2018	2018	2018
Subphylum: Crustacea							
Elasmopus pectenicrus Spence Bate, 1862	923.3	700.0	613.3	498.0	85.0	245.0	545.0
Jassa marmorata Holmes, 1905	0.0	0.0	4.0	13.3	0.0	0.0	0.0
Hyale sp.	13.3	0.0	18.0	0.0	0.0	0.0	0.0
Sphaeroma serratum Fabricius, 1787	0.0	0.0	5.3	0.0	0.0	0.0	0.0
Cirolana bovina Barnard, 1940	446.7	330.0	273.7	335.3	76.7	170.0	480.0
Dynamene bidentata	40.0	100.0	6.7	0.0	3.3	21.7	5.0
Tanais dulongi Audouin, 1826	0.0	0.0	0.0	0.0	1.7	6.7	12.5
Eriphia verrucosa Forskål, 1775	0.0	0.0	0.3	0.7	0.0	0.0	5.0
Balanus sp.	13.3	16.7	15.7	0.0	0.0	3.3	25.0
Phylum:Mollusca							
Brachidontes pharaonis P. Fischer, 1870	1630.0	570.0	957.0	0.0	8.3	6.7	7.5
Fissurella sp.	0.0	0.0	0.3	0.0	76.0	50.0	32.5
Phylum: Polychaeta							
Pseudonereis anomala Gravier, 1899	20.0	26.7	30.3	105.0	817.5	2098.3	1782.5
Syllis hyalina Grube, 1863	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Syllis schulzi Hartmann-Schröder, 1960	150.0	30.0	54.0	31.3	51.7	40.0	22.5
Syllis variegata Grube, 1860	0.0	0.0	2.0	23.3	0.0	0.0	0.0
Lumbrinereis coccinea Renier, 1804	0.0	0.0	0.0	0.0	0.0	0.0	7.5
Schistomeringos rudolphi Delle Chiaje, 1828	0.0	0.0	0.0	0.0	0.0	1.7	0.0
Spirobranchus triqueter Linnaeus, 1758	193.3	1226.7	569.3	0.0	0.0	0.0	0.0
Capitella capitata Fabricius, 1780	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Caulleriella bioculata Keferstein, 1862	0.0	0.0	3.3	0.0	0.0	0.0	5.0
Polyophthalmus pictus Dujardin, 1839	3.3	0.0	0.3	0.0	0.0	0.0	2.5
Loimia medusa Savigny, 1822	6.7	6.7	1.7	0.0	140.0	141.7	172.5
Phylum: Porifera							
Unknown sponge sp.	+	0.0	+	+	0.0	0.0	0.0
Phylum: Cnidaria							
Hydrozoan polyps	2.3	0.0	0.7	0.0	0.0	0.0	0.0
Phylum: Sipuncula							
Sipunculid worms	0.0	0.0	0.0	0.0	1.7	6.7	20.0
Phylum: Bryozoa							
Bugula sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3442	3006.7	2558	1007	1262	2792	3125
Sp. No.	13	9	21	8	10	12	15
Div. index	1.42	1.51	1.22	1.21	1.24	0.98	1.31
Evenness	0.55	0.69	0.40	0.58	0.54	0.39	0.48

The major faunal groups experienced wide temporal variation throughout the period of study, polychaetes recorded low count before the winter storm of 2014, while they increased after the winter storm of 2014 then decreased through spring 2015 to the minimum in spring 2017 and increased again in April 2018 (Fig. 3a). The total count of crustaceans was high in winter 2014 before the storm, then decreased gradually to the minimum in March 2018 and increased again in April and May 2018 (Fig. 3b). The mollusks sustained variable high counts during winter 2014 (before and after the storm) but they decreased to the lowest value during the other sampled times (Fig. 3c). In contrast, the relative abundance of the three dominant groups displayed different pattern, where polychaetes formed the highest percent of the total faunal count in spring 2018 (Fig. 3a), crustaceans in spring 2017 (Fig.3b) and mollusks before the winter storm of 2014 (Fig. 3c).

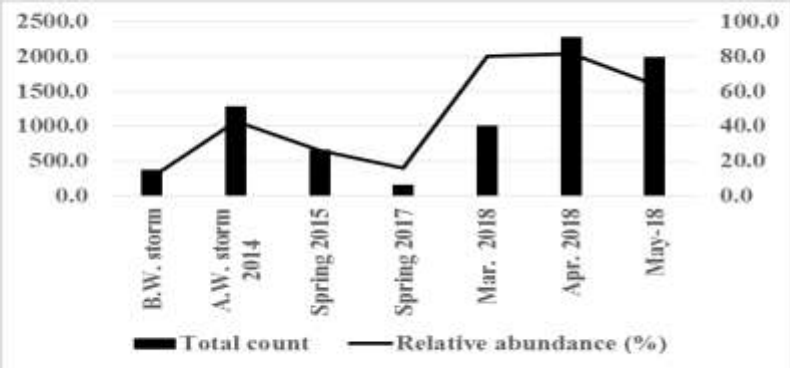

Fig. 3a: The total count (ind/m^2) and relative abundance (% to total fauna) of polychaetes in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

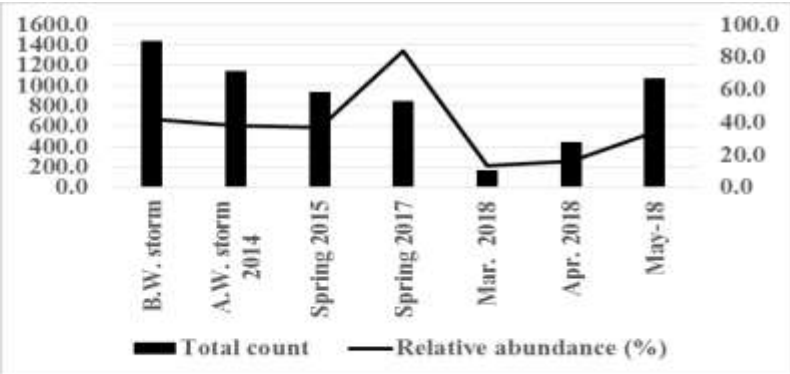

Fig. 3b: The total count (ind/m^2) and relative abundance (% to total fauna) of crustaceans in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

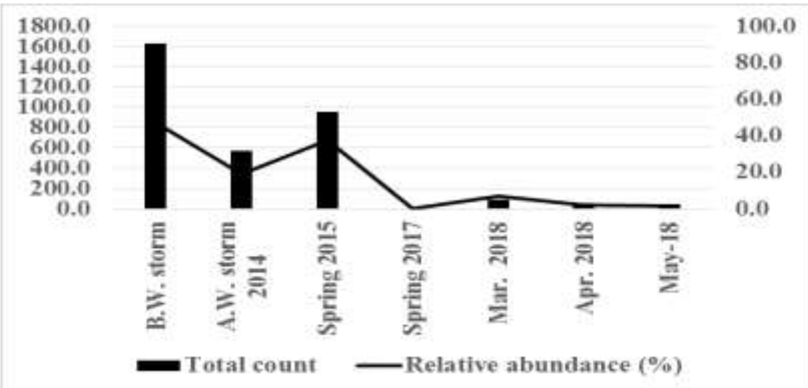

Fig. 3c: The total count (ind/m^2) and relative abundance (% to total fauna) of mollusks in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

The dominant assemblages displayed variable count and contribution (percentage) to the abundance of benthic community, *Elasmopus pectenicrus* sustained high count over the whole period, attaining the maximum before the winter storm of 2014, after then it decreased gradually toward the lowest in March 2018 and then increased again; the relative abundance of this species still stable from winter 2014 to spring 2015, jumped to the highest percentage in spring 2017 and dropped drastically in March 2018 (Fig.4a). *Cirolana bovina* attained the highest count before the winter storm of 2014 and in May 2018 and dropped markedly in March 2018, whereas its relative abundance displayed little differences among the successive samples, except the high percentage in March 2017 (Fig. 4b). The mussel *B. pharaonis* recorded pronouncedly high abundance in winter 2014 and spring 2015, while it was missed later on or found in a few specimens, showing the same pattern of variation in its relative abundance (Fig. 4c). In contrast, *P. anomala* attained pronouncedly high count during spring 2018 as compared to its very low count during the other sampling times, the total count and relative abundance of this species displayed similar trend of variation (Fig. 4d). *Spirobranchus triqueter* had the highest count after the storm of winter 2014 against less abundance before the winter storm of 2014 and spring 2015, but it was absent at other times (Fig. 4e).

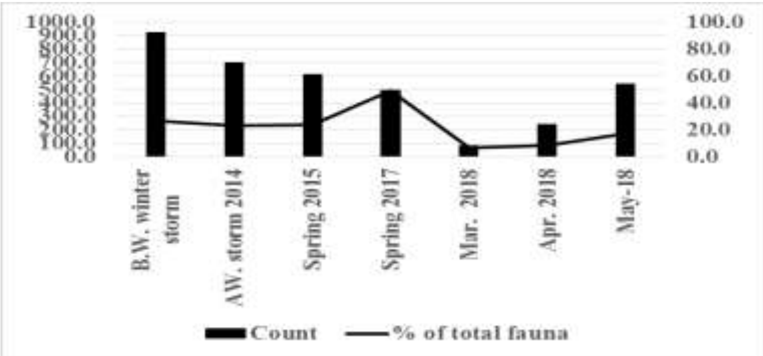

Figure 4a- The total count (ind/m^2) and relative abundance (% to total fauna) of *E. pectenicrus* in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

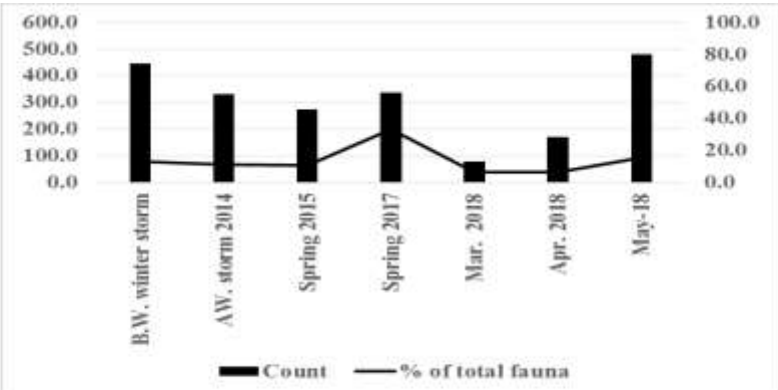

Fig. 4b: The total count (ind/m^2) and relative abundance (% to total fauna) of *C. bovina* in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

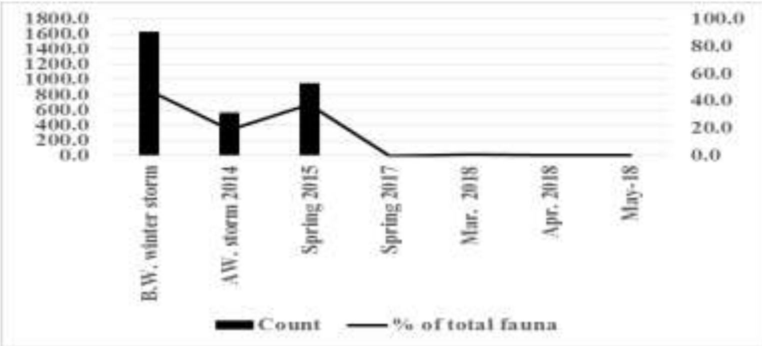

Fig. 4c: The total count (ind/m^2) and relative abundance (% to total fauna) of *B. pharaonis* in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

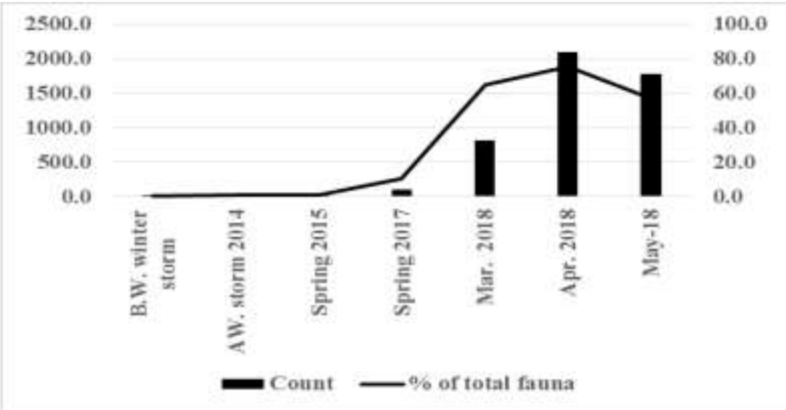

Fig. 4d: The total count (ind/m^2) and relative abundance (% to total fauna) of *P. anomala* in the Eastern Harbour of Alexandria (winter 2014 – spring 2018).

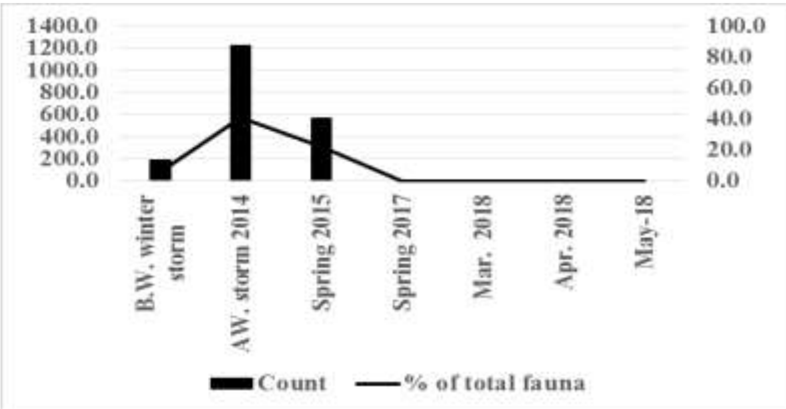

Fig. 4e: The total count (ind/m^2) and relative abundance (% to total fauna) of *S. triqueter* in the Eastern Harbour of Alexandria (winter 2014 – spring 2018**)**.

Generally speaking, the communities of winter 2014 and spring 2015 were dominated by the mytilid *B. pharaonis*, the amphipod *E. pectenicrus*, the polychaete *S. triqueter* and the isopod *C. bovina*, but with pronouncedly different counts and relative abundance, while in spring 2017 and 2018 both *B. pharao*nis and *S. triqueter* were replaced by *P. anomala* (Fig. 5).

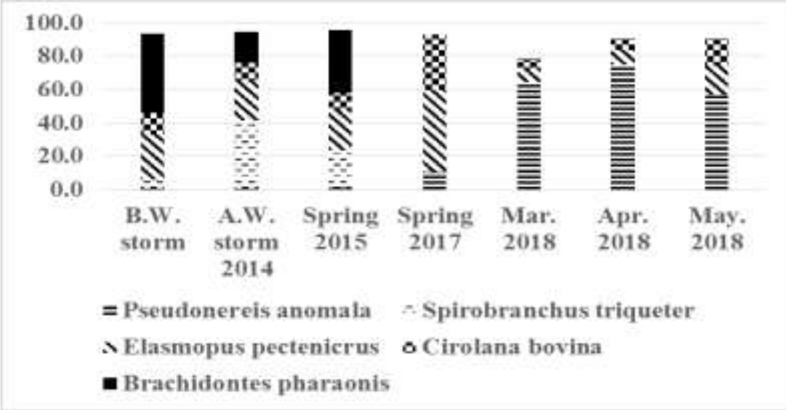

Fig. 5: Relative abundance of the major groups to total count of benthic fauna in the Eastern Harbour of Alexandria (winter 2014 - spring 2018).

DISCUSSION

The present study revealed the low diversity of the hard bottom communities (26 species) in the Eastern Harbour which seems to be characteristic for the harbour, where close number of species (23 – 29) were recorded in fouling assemblages colonizing the artificial panels in the harbor (Ghobashy, 1976; El-Komi, 1992, 1998; Ramdan *et al.*, 2006a). Higher diversity (35-36 species) was observed also on artificial panels (El-Komi, 1991; 1992), and in natural benthic fauna (43 species) associated with the bryozoan *C. alexandriensis* (Hamdy and Dorgham, unpublished data) that was newly found in the harbor (Abdel Salam *et al.* 2017). On the other hand, the benthic fauna on the natural rocky habitat in the Eastern Habitat displayed pronouncedly lower diversity than that (39 species) observed for crustacean by Soliman (1997) and for polychaete (73 species) by Dorgham et al. (2014) along the Alexandria coast. Such pattern seems to be well known in shallow areas which are usually exposed to wave action, sedimentation, high turbidity and strongly variable conditions. Low species richness was frequently found at very variable conditions (Giangrande, 1990) and at high sedimentation (Airoldi, 2003), in disturbed areas such as harbors (Chintiroglou *et al.* 2004; Çinar *et al.* 2008; Antoniadou *et al.* 2011) and in brackish waters (Marchini *et al.* 2004). Spatial and temporal variations in the distribution of benthic marine assemblages are driven by the interplay of various abiotic and biotic factors (Hamdy *et al*. 2017) such as temperature, salinity, wave action and others (Sousa, 2001; Witman and Dayton, 2001). Nutrients significantly affect the composition of marine fouling communities (Rastetter and Cooke, 1979) as they stimulate phytoplankton production as food sources for these communities (Ramdan *et al.* 2006a). These observations may explain the low diversity in the Eastern Harbour, which is more frequently exposed to disturbance by strong wave action, human activities and anthropogenic effects.

The Low species diversity in the Eastern Harbour was accompanied by pronounced variation in the faunal abundance. No comparison was done with earlier records, since the earlier studies were dealt with fouling assemblages settling on artificial panels. However, the variation range in the faunal count during the present study (1007 ind/m^2 - 3442 ind/m^2) was different from that (1026 - 2882 ind/kg) observed in association with the bryozoan *C. alexandriensis* in the harbor. The fauna on the bryozoan colonies was dominated (90.5%) by the crustaceans *E. pectenicrus* beside polychaetes (7.9%), while the present study recorded 35.1% for crustaceans, 45.3% for polychaetes and 19.4% for mollusks. Eleven species were observed on both the rocky site of the present study and on the bryozoan colonies, namely the polychaetes, *S. hyalina* Grube, 1863, *S. schulzi* Hartmann-Schröder, 1960, *S. varigata* Grube, 1860, *C. bioculata* Keferstein, 1862, *L. medusa* Savigny, 1822, *L. coccinea* Renier, 1804, *S. rudolphi* Delle Chiaje, 1828, the mollusks *B. pharaonis* P. Fischer, 1870 and *Fissurella* sp. and the crustaceans, *J. marmorata* Holmes, 1905 and *E. verrucosa* Forskål, 1775. In contrast, both communities were extremely different from those recorded earlier in the harbour, with the exception of three species (*E. pectenicrus, C. bovina,* and *S. serratum*) which were observed only by (Ramadan *et al.* 2006a). It seems that the difference in habitat nature could be one of the factors playing a crucial role in the structure of the benthic community. The natural rocky substrate provides more suitable habitat for the benthic assemblages due to its oldness which may be biologically conditioned and enhance the accumulation of different plant and animal assemblages, meanwhile, the artificial panels represent a temporal substrate which is not favourable for many benthos to colonize. Furthermore, *Capitella capitata* has never been recorded in the Easter Harbour before.

It appeared that the winter storm of 2014 caused the decrease of both the number of species and the individual abundance of the benthic fauna, that was accompanied by pronounced increase in the count of some species (*E. pectenicrus*, *C bovina*, *B. pharaonis*, *S. schulzi*) and decrease of others (*S. triqueter, D. bidentata*, *P. anomala*). However, algal coverage is well known factor enhancing small scale habitat variation and supporting a higher number of polychaete species than less complex habitats (Abbiati *et al.* 1987; Giangrande, 1988), particularly the red alga *Jania rubens* coverage as its structural complexity might represent a suitable habitat for these worms (Tena *et al*. 2000; Dorgham *et al*. 2014). This may explain the relatively high diversity of polychaetes in the study area.

Despite the high diversity of crustaceans in the Mediterranean Sea (Coll *et al.* 2010) they appear sensitive to habitat alteration and are considered as biological indicators of environmental changes (Conradi *et al*. 1997). The pronounced drop in the crustacean diversity along the Alexandria coast after Soliman (1997) confirmed Conradi *et al*. (1997), since the coast of Alexandria was exposed to intensive urban activities during the past two decades. The numerical abundance of crustaceans experienced also great drop on the long term, especially *S. serratum* (Table 3). In contrary, the polychaete community experienced pronounced historical variations along the Alexandria coast between 34 polychaete species (Abdel Naby, 1999), 114 species (Abdel Naby, 2005), 73 species (Hamdy, 2008), 56 species (Massoud, 2018), and 11 species during the present study. Regardless of the pronounced long term difference in species richness of crustaceans and polychaetes along the Alexandria coast several species could withstand the environmental changes, with wide variation in the numerical abundance (Tables 3 and 4).

Table 3: Long term variation in the abundance of some persistent crustaceans on the Alexandria coast

	Soliman, 1997	**Hamdy *et al.* 2017**	**Present study**
Elasmopus pectenicrus	46 - 567	6.47 - 27.1	49.5 - 923.3
Jassa marmorata	27 - 921	0.31 - 39.9	0 - 13.3
Tanais dulongi	92 - 620	11.7 - 133.3	1.7 - 12.5
Dynamene bidentata	1 - 4	0.03 - 87.5	3.3 - 100
Cirolana bovina	7 - 62	0.08 – 2.3	76.7 - 480
Sphaeroma serratum	1 - 1209	0.08 – 63.5	0 – 5.3

Table 4: Long term variation in the abundance of some persistent polychaetes on the Alexandria coast

	Dorgham *et al.* 2014	**Present study**	**Massoud, 2018**
Capitella capitata	23 - 3547	0 - 1	0 -14
Loimia medusa	7 - 113	1.7 - 172.5	0 – 15
Lumbrinereis coccinea	3 -10	0 - 7.5	0 -1
Polyopthalmus pictus	10 - 300	0 - 3.3	0 – 9
Spirobranchus triqueter	1350 - 7667	0 - 1226.7	3 - 2554
Pseudonereis anomala	355 - 4493	20 - 2098.3	17 - 204
Schistomeringos rudolphi	10 - 57	0 - 1.5	0 - 2
Syllis hyalina	43 -2543	0 - 1.3	0 - 2
Syllis schulzi	1067- 8350	22.5 - 150	10 - 230
Syllis variegata	13 - 270	2 - 23.3	1 – 51
Caulleriella bioculata	NR	0 - 5.0	0 – 1

The long term persistence of some crustacean and polychaete species in the study area may be related to the type of the algal cover of their hard substrates and other benthic assemblages. This agrees with Hamdy *et al*. (2017) who observed that the crustaceans *T. dulongi, S. serratum,* and *D. bidentata* were positively related with the bryozoan *Bowerbankia* sp., while *E. pectenicrus* and *J. marmorata* showed positive correlation with the bryozoan *Schizoporella* sp., but all these species showed positive correlation with different algal species. The green alga *U. rigida* and the bryozoan *Bowerbankia neritina* are all known as pollution indicators (Soule and Soule, 1979). However, *Cerolana bovina* showed abnormal increase during the present study as compared to the previous studies, and its distributions was positively related to variations in the algal cover of different species, but according to Hamdy *et al.* (2017) it showed no relation with typical fouling forms.

The distributional pattern of polychaetes abundance appeared different from that of crustaceans, *P. anomala* still one of the dominant polychaetes along the Alexandria coast since the first collection in 1933 (Fauvel, 1937). *Spirobranchus triqueter* was recorded for the first time among the most abundant species on the Alexandria coast by Hamdy (2008) and it still abundant in the Eastern Harbour. The drop in most polychaetes in the Eastern Harbour may be related to the strong wave effect on the benthic community and to environmental differences between the harbor and other areas. This statement was in accordance with Dorgham *et al.* (2014), who suggested that the distribution patterns of the Alexandria polychaete assemblages are mostly driven by the local features of the sampling sites and their variation along the analyzed stretch of coast.

The crustacean, E. *pectenicrus* and the polychaetes *P. anomala*, *S. triqueter*, *L. medusa*, and *S. schulzi* are alien for the Mediterranean Sea. *Syllis schulzi* was dominant along the Alexandria coast (Hamdy, 2008), while it had low counts in the Eastern Harbour and in a recent record on the Alexandria coast (Massoud, 2018), indicating serious environmental changes. In contrast, *P. anomala* still withstanding these changes and could establish healthy populations but with ariable density. This species has ability of compete with other native species for space and existing in both undisturbed and polluted habitats (Çinar and Ergen, 2005). The long term synchronized occurrence of *P. anomala* and the mussel *B. pharonis* in the Eastern Harbour may be attributed to the fact that *B. pharonis* is more suitable for settlement of *P. anomala* because *B. pharonis* forms dense populations on rocky substrates and sediments trapped among its shells (Çinar and Ergen, 2005).

The higher abundance of *S. triqueter* after the winter storm of 2014 than before the storm agrees with the findings of Hiscock (1983), who observed that a community under the stress of scour and abrasion from stones and boulders moved by storms, developed into a community consisting of fast growing species such as *S. triqueter*.

Loimia medusa is a widely distributed worm in different habitats and is usually abundant in the lower polyhaline (>18%o) (Schaffner, 1990), common in estuarine habitats, tolerating prolonged periods of hypoxia (Llanso and Diaz, 1994) and make large-scale colonization at rates similar to opportunistic species (Schaffner, 1993) and existing in disturbed areas (Seitz and Schaffner, 1995). During the present study, *L. medusa* attained higher count than the earlier records along the Alexandria coast (Table 4) and in other world areas (60 ind/m^2, Seitz and Schaffner, 1995). This mean that this species could adapt to the environmental conditions in the Eastern Harbour and started to establish dense population.

As conclusions, the benthic faunal community on the hard bottom of the Eastern Harbour of Alexandria appeared to be low diverse as compared to the fauna of the Alexandria coast, but with pronouncedly variable numerical abundance. Some species recorded high count over the whole period of study confirming their persistence regardless of the serious changes in the environmental conditions, while others showed high abundance at some times and dropped markedly at other times, reflecting their susceptibility to these variations. The community of the present study comprised some alien species that have been early recorded along the Alexandria coast, but their counts displayed wide fluctuations.

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ARABIC SUMMARY

دراسة متقطعة على أحياء القاع فى الميناء الشرقى بالأسكندرية

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تناول البحث دراسة الحيوانات التى تعيش على الأماكن الصخرية من قاع البحر عند مكان ثابت فى الميناء الشرقى بالأسكندرية خلال فصل الربيع فى سنوات متقطعة. سجل البحث ٢٦ نوعا من حيوانات القاع، انتمى أغلبها إلى الديدان عديدة الأشواك (١١ نوعا)، القشريات (٩ أنواع)، بالإضافة إلى نوعين من الرخويات ونوع لكل من الجوفمعويات، الإسفنجيات، البريوزوا، والديدان الشوكية الأخرى. تباين عدد الأنواع فى سنوات الدراسة من ٩ أنواع بعد عاصفة شتاء ٢٠١٤ إلى ٢١ نوعا خلال ربيع ٢٠١٥، فى حين كانت الكثافة العددية لأحياء القاع الأقل (١٠٠٧ فرد فى المتر المربع) فى ربيع ٢٠١٧ والأعلى (٣٤٤٢ فرد فى المتر المربع) قبل عاصفة شتاء ٢٠١٤. معامل التنوع البيولوجى سجل قيما منخفضة (.٩٨ – ١.٥١) وكذلك كان الحال لمعامل الديمومة (.٣٩ -.٦٩). كونت الديدان عديدة الأشواك ٤٥.٢% من الكثافة العددية لأحياء القاع، تبعتها القشريات (٣٥.٢%) ثم الرخويات (١٩.٤%)، وقد بينت النتائج أن خمسة أنواع فقط كانت مسؤولة عن ٩١.٧% من كثافة أحياء القاع فى حين أن بعض الأنواع قليلة الكثافة تواجدت أحيانا بأعداد كبيرة نسبيا مكونة نسبة مئوية عالية. كما بينت الدراسة التغيير الواضح فى كثافة أحياء القاع وفى مساهمات المجموعات السائدة وكذلك الأنواع السائدة فى تلك الكثافة خلال سنوات الدراسة.