Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 22(5): 483 - 498 (2018)
www.ejabf.journals.ekb.eg

Community structure of Echinoderms in littoral zone of the Red Sea Coast of Egypt

Aldoushy Mahdy[1], Hamdy A. Omar[2], Saif A. M. Nasser[3,4], Khaleid F. Abd El-Wakeil[3,*], Ahmad H. Obuid-Allah[3]

1- Department of Zoology, Faculty of Science, Al-Azhar University (Assiut Branch), Assiut 71524, Egypt
2- National Institute of Oceanography and Fisheries, Kayet Bay, Alexandria, Egypt.
3- Department of Zoology, Faculty of Science Assiut University, Egypt.
4- Department of Biology, Faculty of Educaion, Aden University, Yemen.

* Corresponding author; E-mail: kfwakeil@yahoo.com

ARTICLE INFO

Article History:
Received: Dec. 2, 2018
Accepted:Dec. 30, 2018
Online: Jan. 2019

Keywords:
Echinoderms
Red Sea
Seagrass
Suez Gulf
Ras Mohamed
Diversity
Egypt

ABSTRACT

The present work aimed to investigate Echinoderm communities in the Red Sea Coast of Egypt. A survey on Echinoderms done during the period between February 2016 to August 2017. Fourteen sites (42 locations) were selected to represent all Egyptian Red Sea habitats (Seagrass, mangrove, coral reef, rocky, sandy and muddy shore). A total of 33 species of echinoderms belonging to 5 classes, 12 orders and 18 families were recorded. The study revealed that the Eudominant species in this survey were: *Ophiocoma scolopendrina*, *Diadema setosum*, *Echinometra mathaei* and *Holothuria atra* while the Dominant species included *Linckia multifora*, *Ophiolepis cincta* and *Tripneustes gratilla*. Echinoderms community showed different class and species composition in the investigated sites. Class Echinoidea recorded the highest percentage of species composition. Species richness of echinoderms ranged between three species in site 4 and twenty four species in site 1. Species diversity showed changes in different sites. The Shannon diversity (H') ranged from 0.06 to 2.24. Suez Gulf sites (sites 4, 5, 6 and 7) recorded the lowest values of diversity, while the highest value was recorded at Ras Mohamed site (site 3). The abundance and distribution differences in echinoderm communities were discussed.

INTRODUCTION

The Red Sea is a long narrow water body of nearly 2000 km long with an average width of about 280 km (Morcos, 1970). The total area of the Red Sea was estimated between 438 and 450 thousand square km, and the average depth of the Red Sea is about 491 meters, with a maximum depth recorded 2850 meters (Head, 1987).

Echinoderms are one of the most interesting invertebrates' organisms. They are widely distributed throughout the world. The phylum Echinodermata contains approximately 6500 living species and holds a unique phylogenetic position in kingdom Animalia as the only major group of deuterostomous invertebrates (Ruppert and Barnes, 1994).

Echinodermata is an abundant phylum with nearly 200 species recorded and it plays an important role in the bioerosion of the coral reef matrix (Campbell, 1987).It represents an ecologically important group of reef- associated invertebrates that could profoundly affect reef structures in both tropical and subtropical waters (Tokeshi and Tanaka, 2010; Tokeshi and Daud, 2011). Echinoderms are important marine animals, which have both economic and ecological values. Many echinoderms are detritus feeders, so their role in an ecosystem is to break down the organic material that remains unused by other species but can be utilized by some species of Echinodermata (Birkeland, 1989; Hernández *et al*., 2006).Some echinoderms, such as sea cucumbers are an important source of food and medicine industries in many countries (Kamarudin *et al*., 2010; Bordbar *et al*., 2011; Jontila *et al*., 2014).

Echinoderms are globally distributed in almost all depths, latitudes and environments in the ocean. They reach highest diversity in reef environments but are also widespread on shallow shores, around the poles where crinoids are most abundant and throughout the deep ocean, where bottom dwelling and burrowing sea cucumbers are common sometimes accounting for up to 90% of organisms. There are about 7,000 species found usually on the sea floor in every marine habitat from the intertidal zone to the ocean depths. They have a wide variety of colors. There are at least 800 species of echinoderm on the Great Barrier Reef (McClintock, 1994).

Monographs and catalogs as well as many scattered papers resulting from previous expeditons added many new species and new records from the Red Sea. Some of these published works were catalogues of asteroids by Theel (1882-1886), ophiuroids by Sladen (1882-1883), echinoids by (Agassiz and Desor 1847; Carpenter (1884- 1888); Mortensen (1928-1951), and crinoids by Lyman (1878-1882).

The distribution of shallow water echinoderm species in some of the sub-regions of the Indo-west pacific, where the Red sea lying on the north western extremity is compared with the east Indies and Malaysian region. The proportion of endemism in the Red sea is small probably reflecting its disturbed recent history. Taking deep water species into account may raise the proportion of endemics, but few data are available apart from the deep water crinoids, which Ekman (1967) notes as comprising 70% of the Red sea crinoids' fauna and gave data showing that below 300 m the Red sea is the warmest marine region in the world. The various habitats of Red sea provide a wealth of niches for echinoderms. There are number of species recorded in the Red sea indicated at least one Red sea endemic in the genus (Clark and Rowe, 1971).

Echinoderm reproductive periodicity was reviewed by Boolootian (1966). Red sea species seem rather variable in their spawning seasons (Mortensen, 1937, 1938). Most holothurians spawn from June until August, some echinoids such as Eucidaris metularia are les restricted, spawning from April through to September. Crinoids show similar variability. The asteroid *Asterina burtonii* spawns in the Red sea from December to March, and takes two years to reach maturity (Achituv, 1973). *Acanthaster planci* probably spawns from July to August (Crump, 1971).

Most of the mentioned previous studies about echinoderms focused on the northern part of the Red Sea of Egypt and neglected the southern part. So the present study covered all Egyptian Red Sea coast to fulfill the gap. The study aimed to investigate the community structure of echindoderms inhabiting littoral zone of different habitat structures of the Egyptian Red Sea cost; Seagrass, mangrove, coral reef, rocky, sandy and muddy shore.

MATERIALS AND METHODS

Sampling and study area:

Echinoderm species were collected from littoral zone by snorkeling and SCUBA diving in the depth ranged from 1m – 7m. Fourteen sites (42 locations) (Fig. 1) were selected along the Red Sea coast. At each location the abundance of echinoderms were counted using (10×10m) quadrate with five replicates during the period from February 2016 to August 2017. At each site, some notes, such as date, time, shore type, human activities, associated fauna and flora and substrate type, were recorded directly onto pre-printed waterproof data sheets. Photographs of all recorded species were taken using digital camera. Collected specimens were kept in labeled plastic jars, reserved in 10% seawater formalin, and transported to the Laboratory, Faculty of Science- Assiut University. In the laboratory, samples were sorted and identified to the species level according to keys.

Fig. 1. A map showing sites of study in the littoral zone of the Red Sea Coast of Egypt.

Species Identification:

In the laboratory, samples were sorted and identified to the species level according to keys by the following authors: Clark (1967); Clark and Rowe (1971); Fishelson (1971); Sharabati (1984); Sefton and Webster (1986); Vine (1986) Head (1987); Cherbonnier, (1988); Erwin and Picton (1990); Lieske and Myers (2004); Coppard and Campbell (2006).

Data analysis:

SPSS software (Version 20) and Excel (Office 2010) were used to summarize the collected data. The dominancy of the collected echinoderm species was calculated according to Engelmann (1978) as follows: Subrecedent (bellow 1.3%), Recedent (1.3- 3.9%), Subdominant (4-12.4%), Dominant (12.5-39.9%), Eudominant (40-100%). PRIMER 5 for Windows V5.2 was used to analyse species diversities as well as sites and species Bray-Curtis similarities according to the abundance of echinoderms species (species density was transformed to log (n+1)).

RESULTS

The present survey covered more than 1300 km of the Egyptian Red Sea coast (Fig. 1). The investigated 14 sites (42 locations) represent all Egyptian Red Sea coast habitats (Seagrass, mangrove, coral reef, rocky, sandy and muddy shore). Site (1) is characterized by sandy beach, separated from a narrow fringing coral reef by a small shallow lagoon covered by vegetation of macroalgae and moderate density of seagrass bed, the sea-side boundaries of this lagoon is characterized by considerable living coral cover especially massif species. Site (2) is represented by two locations; mangrove vegetation (Al-Sohop) and healthy coral reef (Ras Gamila) and seagrass Mat. Site (3) represented amazing coral reef diving site at Ras Mohamed National park.

Sites (4, 5, 6 and 7) locate on Suez Gulf; the beach of these sites are covered by dense oil spills coat. The nature of the coast is rocky with sediment in the form of small dig with some seagrasses. Site (8) is characterized by mixed habitats of rocky provided with coral reef and sandy shore with scattered seagrass mat. Site (9) is influenced by the long-term underground domestic sewage and maintenance of fishing boats. Site (10) is a habitat of mono-specific forests of *Avicennia marina*, its bottom is covered by a thin layer of sand intermixed with mud.

Site (11) locates near the phosphate Harbor, which suffer from phosphate residues that fall into the water and highly affected by the different pollutants as a result from the localized shipyards, sewage from surrounding population. Site (12) is characterized by amazing mixed habitat seagrass, sandy lagoon and very healthy coral reef. Site (13) locates at Wadi El Gemal National Park full protected areas which characterized by mangrove, seagrass, sandy habitat and very healthy coral reef. Site (14) is characterized by mixed habitats of coral reef, seagrass, rocky and sandy shore.

The numbers of individuals recorded were 22609 distributed in 14 sites. A total of 33 species of echinoderms belonging to 5 classes, 12 orders and 18 families were reported from the Red Sea coast (Table 1).

The dominancy structure of the collected echinoderms showed that the Eudominant species were: *Ophiocoma scolopendrina*, *Diadema setosum, Echinometra mathaei* and *Holothuria atra* while the Dominant species were: *Linckia multifora, Ophiolepis cincta*, *Tripneustes gratilla*.

The Subdominant species were: *Aquilonastra burtonii*, *Fromia ghardaqana, Echinothrix diadema, Heterocentrotus mammillatus, Clypeaster humilis, Holothuria leucospilota, Bohadschia vitiensis, Pearsonothuria graeffei, Stichopus hermanni* and *Synapta maculate*. The Recedent species were: *Acanthaster planci*, *Astropecten hemprichii*, *Astropecten polyacanthus, Ophiocoma erinaceus, Phyllacanthus imperialis, Actinopyga mauritiana*, *Bohadschia marmorata,* and *Heterometra savignii* and the Subrecedent species were: *Aquilonastra marshae*, *Ophiactis savignyi*, *Lovenia elongata*, *Holothuria nobilis, Holothuria scabra*, *Holothuria fuscogilva, Synaptula reciprocans*, and *Synaptula* sp.

Class Echinoidea recorded the highest percentage of species composition in study area (8 species) constituting 61.48% of the total echinoderms while the lowest percentage was recorded for Class Crinoidea (1 species) constituting 0.05%, of echinoderms. Classes Ophiuroidea (4 species), Holothuroidea (13 species) and Asteroidea (7 species) were represented by 31.50%, 5.33% and 1.64% of the total echinoderms, respectively (Fig. 2).

Table 1: Echinodermata species recorded in study sites with their percentages of frequency and dominance.

Class	Order	Family		Genus/Species	F%	Dominance
Asteroidea	Valvatida	Asterinidae	sp1	*Aquilonastra burtonii*	11.0	Subdominant
			sp2	*Aquilonastra marshae*	0.6	Subrecedent
		Acanthasteridae	sp3	*Acanthaster planci*	3.2	Recedent
		Ophidiasteridae	sp4	*Linckia multifora*	19.7	Dominant
			sp5	*Fromia ghardaqana*	7.4	Subdominant
	Paxillosida	Astropectinidae	sp6	*Astropecten hemprichii*	1.3	Recedent
			sp7	*Astropecten polyacanthus*	1.9	Recedent
Ophiuroidea	Ophiurida	Ophiocomidae	sp8	*Ophiocoma scolopendrina*	56.1	Eudominant
			sp9	*Ophiocoma erinaceus*	3.5	Recedent
			sp10	*Ophiactis savignyi*	0.3	Subrecedent
			sp11	*Ophiolepis cincta*	17.7	Dominant
Echinoidea	Diadematoida	Diadematidae	sp12:	*Diadema setosum*	61.3	Eudominant
			sp13	*Echinothrix diadema*	10.6	Subdominant
	Echinoida	Echinometridae	sp14	*Echinometra mathaei*	81.6	Eudominant
			sp15	*Heterocentrotus mammillatus*	6.8	Subdominant
	Temnopleuroida	Toxopneustidae	sp16	*Tripneustes gratilla*	30.6	Dominant
	Clypeasteroida	Clypeasteridae	sp17	*Clypeaster humilis*	9.0	Subdominant
	Spatangoida	Loveniidae	sp18	*Lovenia elongata*	1.0	Subrecedent
	Cidaroida	Cidaridae	sp19	*Phyllacanthus imperialis*	3.2	Recedent
			sp20	*Actinopyga mauritiana*	1.9	Recedent
Holothuroidea	Aspidochirotida	Holothuriidae	sp21	*Holothuria atra*	43.7	Eudominant
			sp22	*Holothuria nobilis*	0.6	Subrecedent
			sp23	*Holothuria leucospilota*	7.7	Subdominant
			sp24	*Holothuria scabra*	0.3	Subrecedent
			sp25	*Holothuria fuscogilva*	0.3	Subrecedent
			sp26	*Bohadschia marmorata*	1.9	Recedent
			sp27	*Bohadschia vitiensis*	11.9	Subdominant
			sp28	*Pearsonothuria graeffei*	9.7	Subdominant
		Stichopodidae	sp29	*Stichopus hermanni*	7.4	Subdominant
	Apodida	Synaptidae	sp30	*Synapta maculate*	9.0	Subdominant
			sp31	*Synaptula reciprocans*	0.3	Subrecedent
			sp32	*Synaptula* sp	1.0	Subrecedent
Crinoidea	Comatulida	Himerometridae	sp33	*Heterometra savignii*	3.9	Recedent

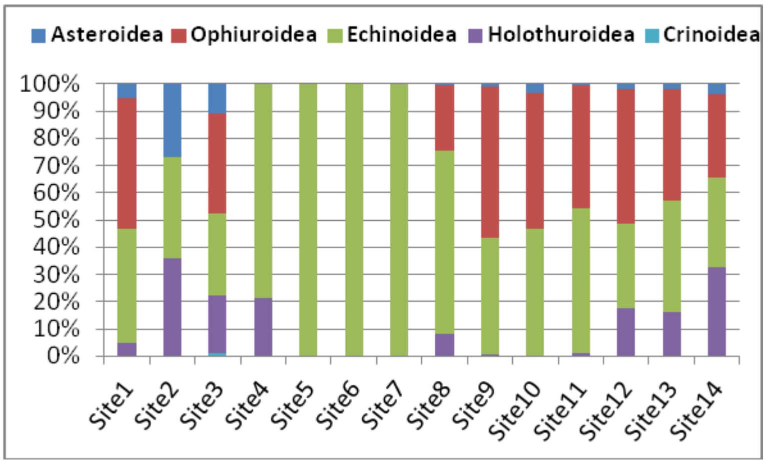

Fig. 2. Percentage composition of echinoderm classes at studied sites.

Echinoderms community showed different class and species composition in investigated sites. Echinoidea represented in all studied sites by different percentage while Crinoidea recorded by very low percentage only in sites 1, 3, 8, 12, 13 and 14. The latter sites represented all recorded echinoderms classes (Fig. 3).

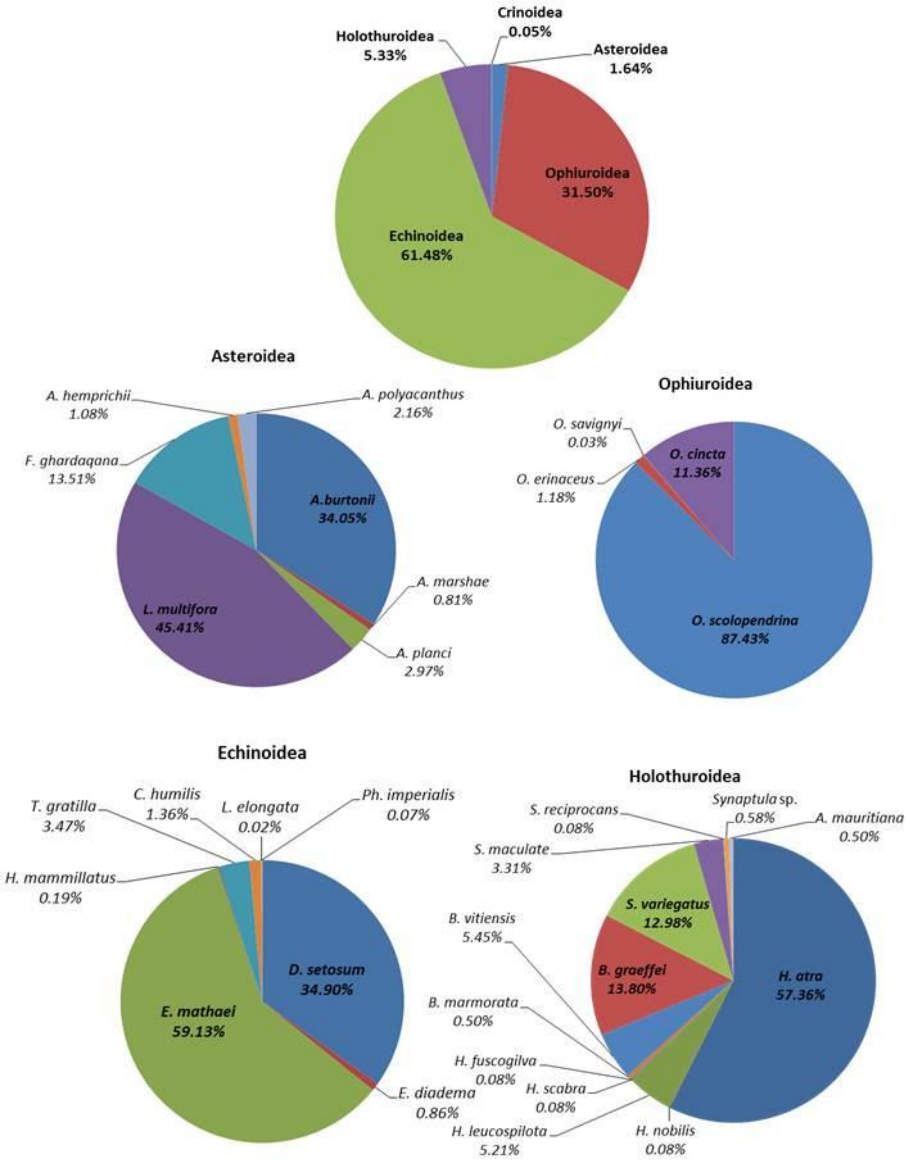

Fig. 3: Percentage of classes and species composition of echinoderms in the littoral zone of the Red Sea Coast of Egypt.

Table (2) shows the density (individuals/100m^2) and relative abundance (%) for the echinoderm species recorded in the investigated sites. Echinoids recorded the highest densities corresponded to all echinoderms. *Echinometra mathaei*, *Diadema setosum* and *Ophiocoma scolopendrina* showed the relatively higher density in the recorded sites. *E. mathaei* was found in all 14 sites with mean highest density 142.1 individuals/100m^2 with relative abundance 99.02 % in site 7, where the highest density of *D. setosum* was 64.23 individuals/100m^2 (46.03 % in site 8). The highest density of *O. scolopendrina* was 59.71 individuals/100m^2 represented 39.61 % of echinoderms in site 11. The holothurian species *H. atra* recorded the relatively highest density 8.09 individuals/100m^2 with 25.64% in site 14. The relative abundance of this species was relatively high in site 2 (29.9%).

Table 2: The mean values of density (D: individuals/100m^2) and relative abundance (%) for the echinoderm species recorded in the littoral zone of the Red Sea Coast of Egypt at the investigated sites.

Species	Site1		Site2		Site3		Site4		Site5		Site6		Site7		Site8		Site9		Site10		Site11		Site12		Site13		Site14	
	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%	D	%
A.burtonii	0.75	2.37			0.47	3.45							0.10	0.07	0.31	0.23			1.48	1.67	0.37	0.25	0.05	0.27			0.09	0.27
A. marshae	0.03	0.08													0.06	0.04												
A. planci	0.05	0.16	0.10	1.03	0.07	0.49																	0.10	0.53	0.16	0.36	0.03	0.09
L. multifora	0.33	1.03	1.60	16.49	0.40	2.96											0.60	1.02	1.68	1.90	0.63	0.42	0.05	0.27	0.60	1.37	0.71	2.26
F. ghardaqana	0.43	1.34	0.90	9.28	0.33	2.46									0.03	0.02							0.20	1.07	0.04	0.09	0.37	1.18
A. hemprichii									0.07	0.09					0.09	0.06												
A. polyacanthus	0.13	0.40			0.20	1.48																						
O. scolopendrina	13.50	**42.68**			3.80	**28.09**									23.37	16.75	32.60	**55.63**	41.78	**47.42**	59.71	**39.61**	8.95	**47.86**	17.36	**39.53**	7.86	**24.91**
O. erinaceus	1.65	5.22			1.20	8.87																						
O. savignyi															0.06	0.04												
O. cincta															10.09	7.23			1.83	2.07	8.54	5.67	0.30	1.60	0.64	1.46	1.77	5.62
D. setosum	1.36	4.30	0.50	5.15	0.60	4.43			15.47	19.75	3.40	4.11	1.25	0.87	64.23	**46.03**			16.00	18.16	38.09	**25.27**	1.45	7.75	7.00	15.94	2.37	7.52
E. diadema	1.08	3.40	0.40	4.12	0.13	0.99																			2.20	5.01	0.43	1.36
E. mathaei	9.43	**29.80**	1.60	16.49	2.87	21.19	2.00	**60.61**	62.00	**79.15**	79.00	**95.41**	142.10	**99.02**	19.34	13.86	25.00	**42.66**	22.18	**25.17**	38.49	**25.53**	3.85	20.59	8.80	20.04	7.43	23.55
H. mammillatus	0.25	0.79	0.10	1.03	0.13	0.99									0.11	0.08					0.03	0.02	0.15	0.80	0.08	0.18	0.09	0.27
T. gratilla	0.70	2.21	0.60	6.19			0.60	18.18	0.73	0.94	0.20	0.24			5.69	4.07			3.08	3.49	2.91	1.93	0.30	1.60				
C. humilis	0.25	0.79			0.13	0.99					0.20	0.24	0.05	0.03	4.94	3.54					0.03	0.02	0.05	0.27				
L. elongata	0.05	0.16			0.07	0.49																						
Ph. imperialis	0.13	0.40	0.20	2.06	0.13	0.99			0.07	0.09																		
A. mauritiana	0.05	0.16	0.20	2.06																							0.06	0.18
H. atra	0.68	2.13	2.90	**29.90**	1.87	13.80									0.80	0.57	0.40	0.68	0.05	0.06	1.74	1.16	3.20	17.11	6.80	15.48	8.09	**25.64**
H. nobilis															0.00	0.00			0.03	0.03	0.00	0.00						
H. leucospilota	0.05	0.16			0.07	0.49									0.20	0.14					0.06	0.04			0.08	0.18	1.40	4.44
H. scabra															0.03	0.02												
H. fuscogilva																									0.04	0.09		
B. marmorata	0.05	0.16			0.07	0.49																					0.09	0.27
B. vitiensis															1.06	0.76					0.11	0.08			0.08	0.18	0.66	2.08
B. graeffei	0.15	0.47	0.10	1.03	0.07	0.49									4.54	3.26												
S. variegatus	0.10	0.32			0.13	0.99									4.31	3.09												
S. maculate	0.43	1.34	0.50	5.15	0.67	4.93									0.20	0.14					0.03	0.02						
S. reciprocans																			0.03	0.03								
Synaptula sp.							0.70	21.21																				
H. savigni	0.05	0.16			0.13	0.99									0.09	0.06							0.05	0.27	0.04	0.09	0.11	0.36

Species richness of echinoderms ranged between three species in site 4 and 24 species in site 1. The species eveness index which represents maximum number of species in study sites shows higher value in northern Red sea coast (site 1) and lowest value in Suez Gulf sites (site 4,5, 6, and 7) and increased in Hurghada site 8. The summations of mean densities of echinoderms showed two peaks in sites 7 and 11 (Fig 4).

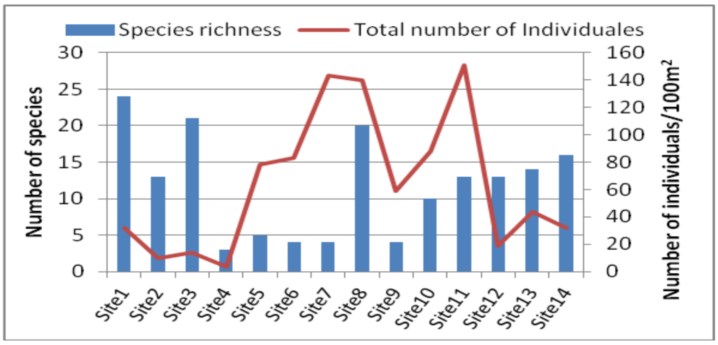

Fig. 4. Species richness (number of species) and total number of the mean densities (individuals/ 100m²) of echinoderm species recorded in the investigated sites.

Species diversity showed changes in different sites. Suez Gulf sites (sites 4, 5, 6 and 7) recorded the lowest values of Shannon diversity (H') index especially Ras Gharieb (site 7), while the highset value was recorded at Ras Mohamed site (site 3) Shannon Equitability (J') index showed the highest value in site 4 (Fig. 5).

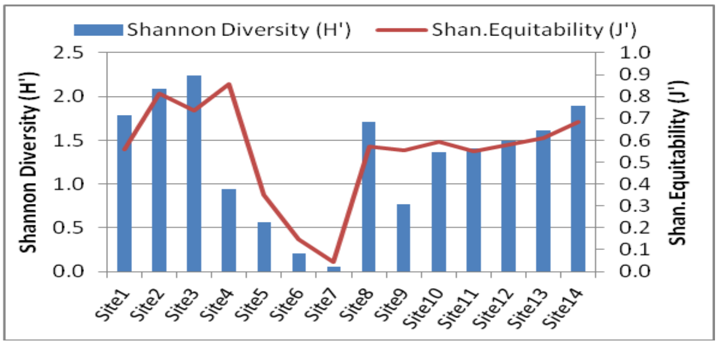

Fig. 5: Shannon-Wiener's index of general diversity (H') and Shannon Equitability (J') of echinoderm species recorded in the investigated sites.

The cluster analysis was done to estimate the Bray-Curtis similarity between sites depending on the abundance of echinoderm species. Dendrogram analysis (Fig. 6) showed that at similarity 60%, the sites can be classified into 4 categories. Each of sites 4 and site 2 represented separated category while, Sites 5, 6 and 7, represented one category and the last category included the other sites (Fig. 6).

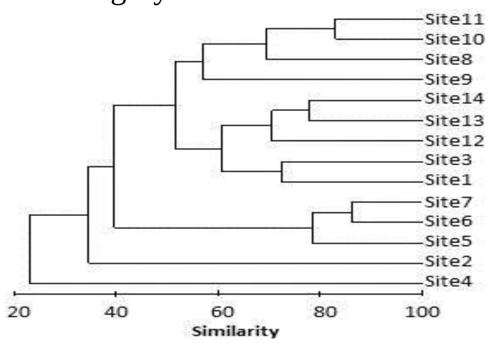

Fig. 6: Dendrogram showing classification of the studied 14 sites based on the abundances of the recorded echinoderms. Abundances were log (n+1) transformed (n= mean density of species/100m²) before comparing sites using the Bray-Curtis similarity measure.

Figure (7) is a dendrogram showing classification of the recorded echinoderm species based on the log (n+1) transformed (n= density of species) of their abundance in the studied 14 sites. The cluster showed that at similarity 50%, the species can be classified into 18 categories while at 30% they can be classified into 9 categories. The highly closely related species are sp22 (*Holothuria nobilis*) and sp31 (*Synaptula reciprocans*) similarity 100% followed by sp28 (*Pearsonothuria graeffei*) and Sp29 (*Stichopus hermanni*) with similarity 93.9%. Sp17 (*Clypeaster humilis*) is closely related to sp29 (*S. hermanni*) and sp28 (*P. graeffei*) with similarity 87.3% and 86.2 %, respectively.

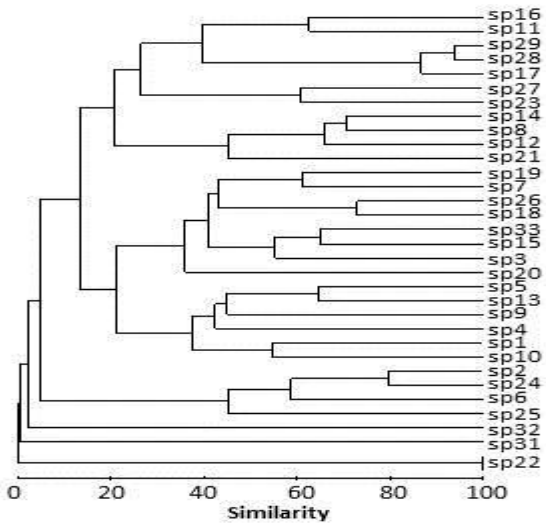

Fig. 7: Dendrogram showing classification of the recorded echinoderms based on their abundances in the studied 14 sites. Abundances were log (n+1) transformed (n= mean density of species/ 100m2) before comparing sites using the Bray-Curtis similarity measure.

DISCUSSION

Few scattered studies were focused on the echinoderms in the Red Sea, Egypt. Most of these studies focused on the northern part of the Red Sea (Hasan, 1995; El-Haddad, 2011; EL-Sadek, 2015) or on specific locations on the northren Red Sea; Gulf of Suez (Mortensen, 1926) and Gulf of Aqaba (James and Pearse, 1969) or on specific class of Echinodermata; Asteroidea (Fauda and Hellal, 1987), Echinoidea (Fathy, 1991a; Fathy, 2001; Zeina *et al*., 2016), Holothuroida (Ahmed and Lawrence, 2007; Lawrence, 2009; Hasan and Abd El-Rady, 2012), Ophiuroids (Fathy 1989; Fathy, 1990; Hellal, 1990; Fathy,1991b) and Crinoidea (Hellal, 2012). To the best of the present authors' knowledge, the current research can be considered the first study covering the whole echinoderm species inhabiting littoral zone (Seagrass, sandy shore, mangrove, and coral reef) alonge the whole length of the Red Sea Coast of Egypt.

Thirty three echinoderm species belonging to 5 classes, 12 orders and 18 families were recorded during the present study. Seven species represented Asteroidea, 4 Ophiuroidea, 8 Echinoidea, 13 Holothuroidea, and one species from Crinoids. Surveys on Red Sea echinoderms have been carried out many years ago. The monograph of Clark and Rowe (1971) is considered the first intensive work on the Indo-pacific region echinoderms including the Red Sea. They recorded 189 echinoderm species from the Red Sea. The holothuriods were the major group (64 species) followed by the echinoids (43 species), ophiuroids (40 species) and asteroids (30 species), while crinoids had the lowest recorded diversity, only 20 species were recorded. Price (1982) made an intensive work on the Red Sea echinoderms. He recorded 163 species from the Red Sea, 136 from the Gulf of Aqaba and 84 species from the Gulf of Suez. The study conducted by Campbell (1987) concluded that

Echinodermata is an abundant phylum in the Red Sea with nearly 200 species. The present results are very similar to that found by Hasan (1995) who recorded 34 Echinoderm species from the Gulf of Suez; 7 (Asteroids), 3 (Ophiuroides), 17 (Echinoids) and 7 (Holothuroids). In 2001, he added 32 species of Holothuroidea to the Red Sea list. In contrast, the present study is higher in biodiversity than that recorded by El-Haddad (2011) who found that the composition of associated fauna with coral reef habitats at Abu Galum comprises 22 echinoderm species belonging to 4 different systematic groups (Echinoids, Ophiuroids, Holothuroids and Asteroids). The high biodiversity recorded in the present study compared with the above mentioned study may be due to that the current study is conducted in the whole length of the Red Sea coast which included many different habitats with different biodiversity and human impacts. The hight echinoderm diversity in the northern Red Sea coast recorded by EL-Sadek (2015) was related to the less human impacts as these places are mosty protected area. The study of EL-Sadek (2015) which was conducted in Abu Galum protected area recorded 54 echinoderm species; 14 (Echinoids), 19 (Holothuriods), 8 (Ophiuroids), 8 (Asteroids and 5 (Crinoids) from, South Sinai, Egypt. In the same site Hellal et al. (1995) recorded echinoderm fauna that were represented with 43 species belonging to 5 classes. Special work were done in echinoids such as Zeina *et al*. (2016). They found a total of 16 species of echinoids (sea urchins), belonging to 13 genera lie under 6 families and 4 orders, which were collected during a period from January to November 2015 from Gulf of Aqaba, Red Sea, Egypt.

In the current study, the dominancy structure of the collected echinoderms showed that Class Echinoidea had the highest percentage of species composition in the study area (8 species) constituting 62% of the total echinoderms. This may be related to that they have the ability to inhabit different kinds of Red Sea habitats; at sea grass (Lipkin, 1977), Mangroves, (Hamilton and Snedaker, 1984; Mandura *et al*., 1988 and Saifullah, 1996), sandy and rocky shore (Chiffings, 2003), coral reef (Mergner, 1971; Head, 1987; Hasan, 1995). *Echinometra mathaei* was present in site 7 (Ras Gharieb) with highest density (142 individuals/100m^2) with relative abundance 99%. *E. mathaei* is widely distributed in Egyptian coast and has the largest abundance in shallow reef environment (Hasan, 1995). Many studies such as (Bender *et al*., 1988; Coccheri *et al*., 1990; Balch *et al*., 1995) reported that oil influence all groups of marine organisms. Increasing the number of *E. mathaei* in site (7) may be related to the absence of the fish predators of the species due to oil pollution of this site and the overfishing where this site suffers from oil pollution and illegal fish hunting by Harpoon that collect only the large fish individual that predate on *E. mathaei*. Another reason is the ability of *E. mathaei* to resist and deals very well in oil pollution sites as recorded by Khalaf *et al*. (2002).

Only one species of Crinoidea *Heterometra savignii* was recorded at sites 1, 3, 8, 12, 13, and 14. Hellal (2012) recorded a total of 15 species of Crinoidea during the period 1992-2003 at Red Sea coast during a survey included both tidal and subtidal habitats. This diffrence between the present study and his study may relate to many reasons. Firstly, Crinoidea are nocturnal animals while in the present study sampling was done during day time. Secondly, they like clear habitats, this interprets the dectection of *H. savignii* at previous sites which characterized by mixed habitats of coral reef, rocky and sandy shore with high transparency.

In the present study Ophurodian species *Ophiocoma scolopendrina* had the highest density with 60 individuals/100m^2, it represented 40 % of echinoderms in site 11 (Al- Hamraween) near to the phosphate Harbor. This site is enriched with phosphate residues that fall into the water. So, one can conclude that this species has high ability to tolerate phosphate pollution. Abu-Hilal (1985) studied phosphate pollution and related problems in the unique and very sensitive to marine communities in the Gulf of Aqaba. Hellal *et al.* (1995) recorded echinoderm fauna at Abu Galum and he found that members of family Ophiotrichidae recorded a great number of individuals and the most abundant species were brittle stars, *Ophiocoma erinaceus* and *O. scolopendrina*. In the present study Holothuroidea were represented by 13 species. Holothurians are one of the most important members of Red Sea ecosystem and influence the structure and functioning of coral reef ecosystems (Bakus, 1973). In the recent years the holothurian species have overfishing all over the Red Sea especially in southern part (Yuval *et al*., 2014). Ahmed (2009) recorded 18 different species of sea cucumber in the Egyptian coast in the Red Sea and Gulf of Aqaba. Sea cucumbers have a high economic value due to their high market demand and high prices (Holland, 1994). Lawrence *et al*. (2009) stated that the commercial species of holothurian were mostly found in the depth range of 5–10 m in the Red Sea. This confirm the decease of sea cucumber species according to anthropognic impacts; even pollution or/and overfishing.

The holothurian species *H. atra* was recorded with relatively highest density 8 individuals/100m^2 in site (14) the relative abundance of this species was relatively high in site (2). This result can be related that these sites are good habitats for sea cucumber which characterized by mixed habitats of coral reef, seagrass, rocky and sandy shore (Yuval *et al*., 2014). The reef has many cracks and groove like channels separating the reef areas and extends from the reef surface to high depths, all that give well sheltered and refuge place from enemy (Ahmed, 2009).

The species evenness index which represents maximum number of species in study sites shows higher value in northern Red sea coast (site 1) and lowest value in Suez Gulf sites (site 4,5, 6, and 7) and increased in Hurghada (site 8). On the other side, Suez Gulf (sites 4, 5, 6 and 7) recorded the lowest values of Shannon diversity (H') index especially Ras Gharieb (site 7), while the highest value was recorded at Ras Mohamed (site 3). The differences amonge sites according to echinoderms assemblage related to limiting enverionmental factors (Said, 1962; El-Maghraby *et al*., 1963). The Gulf of Aqaba is valued for its unique environment and wide range of habitats and outstanding biodiversity (Head, 1987). While in the case of the Gulf of Suez, the level of hydrocarbon pollution and the destruction of coral reefs are noticed (Khalaf *et al*., 2002). The remnant sites 8-14 located in the southern part of the red sea and most of them are protected areas. This may explain the relatively high species richness and diversity at these sites.

The present results showed highly closely related species in abundance such as *Holothuria nobilis* and *Synaptula reciprocans, Pearsonothuria graeffei* and *Stichopus hermanni*, *Clypeaster humilis* and *S. hermanni* and *P. graeffei*. These similarties between species can be due to that they have the same niche with the same taxonomical position and selected habitats. They were collected from Safaga site that is characterized by mixed habitat of coral reef, rock with sandy batches contain seagrass. Holothuroidea, *Pearsonothuria graeffei* and *Stichopus hermanni* have the highest similarity index where it was 94% compared with all other species. The reason for that because the two species sharing the same food and habitat (Ahmed, 2009). *Pearsonothuria graeffei* and *Stichopus hermanni* were collected from site 8 (NIOF Hurghada) that characterized by mixed habitat with scattered rocks that contain coral baches and mixed of sandy and seagrass mate.

CONCLUSION

The present study illustrated that there is a marked decrease in the number of echinoderms in the Red Sea Coast of Egypt. The reasons can be attributed to the anthropogenic effects which includes different types of pollution, increasing of human activities that damage the environment. So, more environmental studies to promote environmental awareness among people to preserve the environment are highly recommended and appreciated.

ACKNOWLEDGMENT

We are very grateful to Mr. Ahmed Ghalab, WGNP, Elba NP, Mr. Islam M. ElSadk, Mr. Ahmed A. Mostafa, Mr. Mahmoud S. Abdelhafez, Environmental affier agency, and Mr. Esmail Abdelazem (Napq Protoqtrate for their helps in facilitating sampling during this study.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

REFERENCES

Abu-Hilal, A. (1985). Phosphate pollution in the Jordan Gulf of Aqaba. Marine pollution Bull. Pergamon press Ltd., 16(7): 281-285.

Achituv, Y. (1973). The genital cycle of *Asterina burtonii* Gray (Asteroidea) from the Gulf of Eilat, Red Sea. Cah. Biol. Mar., 14: 547-53.

Agassiz, L. and Desor, E. (1847). Catalogne raisonne des especes, des geners et des Famillis d'Echinids. Annales des Sciences Naturelles, Zoologie, 38: 5-35 P 1-16 from Vol.6].

Ahmed, M.I. and Lawrence, A.J. (2007). The status of commercial sea Cucumbers from the northern Red Sea coast of Egypt. Beche-de-Mer Information Bulletin, 26:14–19.

Ahmed, M. I. (2009). Morphological, Ecological and Molecular examination of the Seacucumber species along the Red Sea Coast of Egypt and Gulf of Aqaba, with the investigation of the possibility of using DNA barcoding technique as a standard method for Sea cucumber ID. Ph.D Thesis Marine Biology in the University of Hull, 258 PP.

Bakus, G.J. (1973). The biology and ecology of tropical holothurians. p. 325–367. In: Jones O.A. and Endean R. (Eds). Biology and ecology of coral Reefs, Vol. 2. New York: Academic press.

Bender, M.E.; Hagris, W.J.; Hugget, R.J. and Roberts, J.R. (1988). Effect of polynuclear aromatic hydrocarbons on fishes and shellfish, an overview of research in Virginia. Mar. Envir. Res., 24: 237 – 241.

Birkeland, C. (1989). The influence of echinoderms on coral-reef communities in Jangoux M. and Lawrence J.M. (EDS), Echinoderm Studies .A. A. Balkema, Rotterdam, The Netherlands, 1-79.

Balch, G.C.; Metcalfe, C.D. and Huestis, S.Y. (1995). Identification of potential fish carcinogens in sediments from Hamilton Harbour, Ontario, Canada. Enviro. Toxicol. Chem., 14(1): 79 – 91.

Boolootian, R.A. (1966). The Physiology of Echinodermata. Wilev Interscience, New York.

Bordbar, S.; Anwar, F. and Saari, N. (2011). High value components and bioactives from sea cucumbers for functional foods – a review. Mar. Dru., 9: 1761–1805.

Campbell, A.C. (1987). Echinoderms of the Red Sea, In: Edwards, A.J. and Head, S.M. (eds.). *Key Environments, Red Sea*. Oxford, Pergamum Press, pp. 215-232.

Carpenter, P.H. (1884). Crinoidea 1. The stalked crinoids. Report of the scientific result of the voyage of H.M.S. "Challenger" 1873 -1876, Zoology, 11: 1- 440 figs 1-21 pls1-82.

Carpenter, P.H. (1888). Crinoidea 11. The comatulate. Report of the scientific result of the voyage of H.M.S. "Challenger" 1873 -1876, Zoology, 26: 1-399 pls 1-70.

Cherbonnier, (1988). Echinoderms: Holothuries. Fauna de Madagascar,70, ORSTOM, Paris, 292 pp.

Chiffings, T. (2003). Marine Region 11: Arabia Seas. A Global Representative System of Marine Protected Areas. (Accessed12/1/04).

Clark, A. M. (1967). Echinoderms from the Red Sea. Part 2. Crinoids, Ophiuroids, Echinoids and more Asteroids. Sea Fish. Red Stn. Israel, 41: 26 -58.

Clark, A.M. and Rowe, F.W.E. (1971). Monograph of the shallow water Indo West pacific Echinoderms, 1-238pp. Brit. Mus. (Nat. Hist.) London.

Coccheri, R.W.; Antonio, A. and Anna, M.M. (1990). Polycyclic aromatic hydrocarbons in marine organisms from Italian central Mediterranean coasts. Mar. Poll. Bull., 22(1): 15 – 18.

Coppard, S.E. and Campbell, A.C. (2006). Taxonomic significance of test morphology in the echinoid genera *Diadema* Gray, 1825 and *Echinothrix* Peters, 1853 (Echinodermata). Zoosystema, 28 (1): 93–112.

Crump, R. (1971). Reproductive condition of *Acanthaster planci* in the Port Sudan area of the Red Sea. In New studies on the coral predating crown of Thorms Starfish. Eds. C.H. Roads and R.F.G. Ormond, pp. 50-2. Cambridge Coral Starfish Research Group.

Ekman, S. (1967). Zoogeography of the Sea. Sedgwick and Jackson, London.

El-Haddad, Kh.M. (2011). Ecological studies on macro invertebrate's species inhabiting Abu Galum reef South Sinai. Msc. Thesis, Azh. Univ. Egy., 182pp.

El-Maghraby, A.I.; Wahby, S.D. and Shaheen, A.H. (1963). The Ecology of zooplankton in Lake Menzalah. Alex.Inst. Hydrobiol. Notes & Mem., 70:1- 43.

EL-Sadek, A.M.M. (2015). Spatial and temporal distribution patterns of Crustacean and Echinodermata communities in Abu Galum protected area, South Sina. Ms.C Thesis Degree in zoology (Marine Biology) Marine Ecology Zoology Department Faculty of Science, Al-Azhar University – Cairo.

Engelmann, H.D. (1978). Zur Dominanzklassifizierung von Bodenarthropoden. Pedobiologia, 18: 378–380.

Erwin, D.G. and Picton, B.E. (1990). Guide to Inshore Marine Life. Immell. Publi. Lond., p 219.

Fathy, E.l.S. (1989). Studies on the Egyptian Echinodermata. *Ophiocoma latilanaxa* (Ophiuroidea: Ophiocomidae). A new record from the red sea. Bull. Fac. Sci., Assiut Univ., 18 (2-E), PP. 97-105: 1989.

Fathy, E.l.S. (1990). *Ophiocoma Schoenleini*, *Ophiocoma anaglyptica* and *Ophiocoma afvajaxa* (Ophiuroidea: Echinodermata) a new record from the red sea with some notes on the other related species. Assiut Vet. Med., 23: (46)1991.

Fathy, E.l.S. (1991a). Studies on the Egyptian Echinodermata: *Ophiocoma aegyptiaca* Sp.Nov. (Ophiuroidea: Echinodermata) from the red sea. Galaxea, 10: 79-88.

Fathy, E.l.S. (1991b). Spatial pattern and inter-locality variations of adults and juveniles of common Red Sea echinoid *Echinometra mathaei* (Echinoidea: Echinodermata). Bull.Fac.Sci. Assiut Univ., 20(2-E)., pp. 235-251.

Fathy, E.l.S. (2001). Population dynamics and life history traits of the sea Urchin *Diadema setosum* (Leske) (Echinoidea: Echinodermata) in the northwestern coast of the red sea. Egypt. J. Zool., 36: 329-351.

Fauda, M.M. and Hellal, A.M. (1987). Echinoderms of the North-Western Red Sea. 1-Asteroidea. Fauna and Flora of Egypt. PP. 71 VX plts.

Fishelson, L. (1971). Ecology and distribution of the benthic fauna in the shallow water of the Red Sea. Mar. Biol., 10: 113-133.

Hamilton, L.S. and Snedaker, S.C. (1984). Handbook for mangrove area management, UNESCO, Paris, 123 p.

Hasan, M.H. (1995). Ecological and biological studies on echinoderms from the Gulf of Suez, Red Sea, Egypt. Ms.C thesis, Faculty of Science, Suez Canal Univ.

Hasan, M.H. and Abd El-Rady, S.A. (2012). The effect of fishing pressure on the ecology of sea cucumber populations in the Gulf of Aqaba, Red Sea. SPC Beche-de-mer Information Bulletin, 32: 53-59.

Head, S.M. (1987). Coral and Coral Reef of the Red Sea. In the 'Red Sea'. (Eds Edwards, A. J. and Head, S. M.), Perg. Pre., 128-151.

Hellal, A.M. (1990). Taxonomical studies and zoogeography of echinoderm species (Brittle Stars) from the northern Red Sea. Ph.D thesis Al-Azhar Univ.

Hellal, A.M. (2012). Taxonomic Study on the Feather Stars (Crinoidea: Echinodermata) from Egyptian Red Sea Coasts and Suez Canal, Egypt. J. Mar. Sci., 2: 51- 57.

Hellal, A.M.; Abu Zeid, M. and El-Sayed, A.A.M. (1995). Final Report on Macro-Invertebrate Fauna at Protected Areas of South Sinai. EEAA., 115 pp.

Hernández, J.C.; Brito, A.; García, N., *et al*. (2006) Spatial and seasonal variation of the gonad index of *Diadema antillarum* (Echinodermata: Echinoidea) in the Canary Islands. Scientia Marina, 70(4): 689-698.

Holland, A. (1994). The status of global beche-de-mer fisheries with special reference to the Solomon Islands and the potentials of holothurian culture M.Sc. Thesis. Newcastle, Australia: University of Newcastle., 134p.

James, D.B. and Peares, J.S. (1969). Echinoderms from the Gulf of Sues and Northern Red Sea. J.Mar. Biol. Ass. India, 11: 87-125.

Jontila, J.B.S.; Balisco, R.A.T. and Matillano, J.A. (2014). The Sea cucumbers (Holothuroidea) of Palawan, Philippines. AACL Bioflux., 7 (3): 194-206.

Kamarudin, K.R.; Rehan, A.M.; Hashim, R. and Usup, G. (2010). An update on diversity of sea cucumbers (Echinodermata: Holothuroidea) in Malaysia. Mala Nat J., 62 (3): 315-334.

Khalaf, F.I.; Ali, A.F. and Gab-Alla, A. I. (2002). Ecological study of the impact of oil pollution on the fringing reef of Ras Shukeir, Gulf of Suez, Red Sea, Egypt. Egyptian Journal of Biology, 4: 119-126.

Lawrence, A.J.; Afifi, R.; Ahmed, M.; Khalifa, S. and Paget, T. (2009). Bioactivity as an Options Value of Sea Cucumbers in the Egyptian Red Sea. Conservation Biology, 1-9 DOI: 10.1111/j.1523-1739.01294.x.

Lieske, E. and Myers, R.F. (2004). Coral Reef Guide Red Sea: The Definitive Guide to Over 1200 Species of Underwater Life. Lond. Harp. Colli., 211p.

Lipkin, Y. (1977). Seagrasses vegetation of Sinai and Israel. In seagrasses ecosystem: A scientific perspective. Ed.c.p. McRoy & c. Helfferich, 263-93.

Lyman, T. (1878). Ophiuroidea and Asterophytidae of the exploring voyage of H.M.S. Challenger, under prof. Sir Wyville Thomson. F.R.S. Part 1. Bulletin of the Museum of comparative Zoology Harvard, 5(7): 65-168 pls 1-10.

Lyman, T. (1882). Ophiuroidea. Report of the scientific result of the voyage of H.M.S. "Challenger" 1873 -1876, Zoology, 5: 1-385 pls 1-48.

Mandura, A.S.; Saifullah, S.M. and Khfaji, A.K. (1988). Ecology of a mangrove stand of central Red Sea coast, Ras Hatiba (Saudi Arabia). Proc. Saudi Biol. Soc., 11: 85-112.

McClintock, J.B. (1994). Trophic biology of Antarctic shallow water echinoderms. Mar. Ecol. Prog. Ser., 111: 191–202.

Mergner, H. (1971). Structure, ecology and zonation of Red Sea reefs (in comparison with south Indian and Jamaican reefs). Syrup. zool. Soci. Lond. 28: 141-161.

Morcos, S.A. (1970). Physical and chemical oceanography of the Red Sea. Oceanog. Mar. Biol. Ann. Rev., 8:73-202.

Mortensen, T. (1926). Cambridge expedition to the Sues Canal, 1924. V1. Report on the Echinoderms. Trans. Zool. Soc. Lond., 117 – 80.

Mortensen, T. (1928). A monograph of the Echinoidea. l. Cidaroidea Copenhagen: C.A. Reitzel 551pp. 73 figs 88 pls.

Mortensen, T. (1937). Contribution to the study of the development and larval forms of Echinoderms.111. Kgl. Dan. Vidensk .Selsk, Skr. Naturvid.Math. Afd., 9: 1-59.

Mortensen, T. (1938). Contribution to the study of the development and larval forms of Echinoderms. 1v. Kgl. Dan. Vidensk .Select, Skr. Naturvid. Math. Afd., 9: 1-59.

Mortensen, T. (1951). A monograph of the Echinoidea. V (2). Spatangoida 11. Amphisternata ll, Spatangidae Loveniidae Pericosmeda, Schizasteridae, Brissidae. Copenhagen: C. A. Reitzel 593 pp. 286 figs 64 pls.

Price, A. R. G. (1982). Echinoderms of Saudi Arabia. Comparison between echinoderm faunas of Arabia, Red Sea and Gulfs of Aqaba and Suez. Fauna of Saudi Arabia, 4: 3-21.

Ruppert, E. and Barnes, R. (1994). Invertebrate Zoology. New York: Saunders College.

Saifullah, S.M. (1996). Mangrove ecosystem of Saudi Arabian Red Sea coast. An overview J.K.A.U. Mar. Sci., 7: 263- 270.

Said, R. (1962). The Ecology of Egypt. Elsevier, New York, 377: 140, 3562 pp.

Sefton, N. and Webster, S.K. (1986). Caribbean Reef Invertebrates. Tokyo, Japan: Dai Nippon Printing Co. Ltd., 3: 119-132.

Sharabati, D. (1984). Red Sea Shells. KPI, Lond. etc, 127 pp.

Sladen, W.P. (1882). The Asteroidea of H.M.S. Challenger Expedition part 1. Pterasteridae. Journal of the Linnean society of London, Zoology Zoo., 16: 189-246.

Sladen, W.P. (1883). The Asteroidea of H.M.S. Challenger Expedition part 11. Astropectinidae. Journal of the Linnean Society of London, Zoology Zoo.,17: 214-269.

Theel, H. (1882). Holothuroidea. Part 2. Report of the Scientific Results of the Voyage of H.M.S. 'Chaiienger' 1873-1876. Zoology, 4(13): 1-176 pls 1-46.

Theel, H. (1886). Holothuroidea. part 2. Report of the Scientific Results of the Voyage of H.M.S. 'Chaiienger' 1873-1876. Zoology, 39: 1-290 pls 1-16.

Tokeshi, M. and Daud, J.R.P. (2011). Feeding electivity in *Acanthaster planci*: a null model analysis. Coral Reefs, 30: 227-235.

Tokeshi, M. and Tanaka, K. (2010). Dominance of tabular Acroporid species and the abundance of echinoid grazers in high-latitude coral assemblages of Amakusa, southwestern Japan. Galaxea, J. Coral Reef, Stud., 12: 87.

Vine, P. (1986). Red Sea Invertebrates (London: Immel Publishing), 224 pp.

Yuval B, Sudai L, Ziv Y (2014) Abundance and Diversity of Holothuroids in Shallow Habitats of the Northern Red Sea. Journal of Marine Biology Article, ID 631309, 7 pp. doi: 10.1155/2014/631309.

Zeina, A.F.; Darweesh, K.F. and Hellal, A.M. (2016). Sea urchins (Echinoidea: Echinodermata) from Gulf of Aqaba, Red Sea, Egypt. International Journal of Development, 5(1): 27-45.

ARABIC SUMMARY

التركيب النوعى لعشائر الجلدشوكيات بالمنطقة الساحلية للبحر الأحمر بمصر

الدوشي مهدى[1]، حمدى عمر[2]، سيف ناصر[3،4]، خالد عبدالوكيل[3] و أحمد عبيدالله[3]

1- قسم علم الحيوان، كلية العلوم- جامعة الأزهر (فرع أسيوط)، مصر
2- المعهد القومي لعلوم المحيطات والمصايد، الإسكندرية، مصر
3- قسم علم الحيوان، كلية العلوم- جامعة أسيوط، مصر
4- قسم البيولوجي، كلية التربية- جامعة عدن، اليمن

يهدف هذا البحث إلى عمل دراسة لعشائر الجلدشوكيات بساحل البحر الأحمر بمصر. تم عمل مسح حقلى لهذه المجموعه خلال الفترة من شهر فبراير 2016 إلى أغسطس 2017 بطول ساحل البحر الأحمر .

تم اختيار أربعة عشرموقعا (أربعين مكانا) لتمثل معظم بيئات البحر الأحمر (مثل الحشائش البحرية ، ونبات الشورى ، والشعاب المرجانية ، والشواطئ الصخرية ، والرملية والطينية). تم حصر حوالى 33 نوعا من شوكيات الجلد تندرج تحت 5 طوائف و 12 رتبة و 18 عائلة. تعتبر أنواع : *Ophiocoma scolopendrina*, *Diadema Setosum*, *Echinometra mathaei* and *Holothuria atra* هى السائدة (Eudominant) يأتى بعدها فى التوزيع الأنواع المهيمنة (Dominant) *Linckia multifora*, *Ophiolepis cincta* and *Tripneustes gratilla*. أظهرت النتائج التنوع الكبير فى طوائف وأنواع عشائر الجلد شوكيات بأماكن الدراسة. أظهرت طائفة القنفذيات أعلى نسبة مئوية فى الأنواع. وقد أظهرت نتائج دراسة الأنواع للجلدشوكيات أنها تتراوح بين ثلاثة أنواع بموقع 4 و (24) أربعة وعشرين نوعا بموقع 1. أظهر معامل التنوع الحيوي فى الأنواع اختلافا بالمواقع المختلفة. تراوح معامل شانون من 0.06 إلى 2.24. وجد أن المواقع التى تتواجد على خليج السويس (موقعا 4 و 5و 6) أقل قيمة فى التنوع بينما سجل موقع رأس محمد (موقع 3) أعلى نسبة فى التنوع . نوقش فى هذا البحث الكثافة العددية والاختلاف فى التوزيع فى عشائر الجلدشوكيات بالبحر الأحمر بمصر.