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Ecology and Taxonomy of Some Mollusk Species at El Malaha Ryan Offshore Area, Gulf of Aqaba, Egypt

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Abstract

This paper deals with the taxonomy and ecology of 35 shells of Mollusk species identified from 12 samples collected from El Malaha Rayan offshore area. The study area is situated between south wadi El Malaha Rayan and Wadi El Malaha El Atchan offshore area. The study area has a length of 300 m and a width of 150 m. and El Malaha Rayan offshore areas represent the tidal and littoral zones.There are four wadies passing through the area of Wadi El Malaha Rayan and they pour their Flash flood in the Gulf of Aqaba. The marine environment of the study area is not influenced by the flash flood of the four wadies (Wadi El Wageran, Wadi El Malaha Rayan, Wadi El Malaha El Atchan and Wadi El Mohaymed).

There are two groups of cluster analyses in the dendogram. The first group (A) located in the Tidal zone and include 33 Mollusk species (14 species from class Bivalvia and 19 species from class Gastropoda). These species exists in warm turbid water mostly caused by flash floods and they represent the tidal zone.The other group (B) located in the littoral zone and include 35 Mollusk species (14 species from class Bivalvia and 21 species from class Gastropoda).

Keywords: Environmental Geology, Mollusk, Gastropoda, Ecology.

Introduction

Wadi El Malaha Rayan offshore area is influenced by four wadies and it is situated between Taba and Newiba city in the Gulf of Aqaba. Marine environment of the area is not influenced by the flash floods of the four wadies (Wadi El Wageran, Wadi El Malaha Rayan, Wadi El Malaha El Atchan and Wadi El Mohaymed) (Fig. 1) the amount of flash flood of wadies are less than 8 mm/day (Table 1). Ball 1937 used this equition $V = 750 \times A$ (R - 8).

V= maximum volume of runoff (m^3), R= Average maximum rain fall (in one day mm), A= Basin area of wadi (km^2).

The amount of water runoff in the study area is less than 1.6 mm/ month, therefore The marine environment of the study area is not affected by flash floods, thus it is characterized by diversity of the mollusk shells.

The study area is situated in the offshore area of wadi El Malaha Rayan. The length of the study area is 300 m and width is 150 m from shoreline of El Malaha Rayan. It represents two types of environment (tidal and littoral zone).

The northern beach of the study area is gravels with coarse sand and the southern beach area is sandy. Some sea grasses are growing in the sandy rock bottom. Also some pitches of sand

and shale were found growing with sea grasses and algae in the littoral zone.

The present study deals with the taxonomy and ecology of 35 shells of Mollusk species identified from 12 samples collected from El Malaha Rayan offshore area. Four samples were collected from tidal zone in a depth ranges between 0.5 m and 1 m. Beginning from sample 1 (29 08 25.62 N 34 41 24.96 E) to sample 4 (29 08 16.90 N 34 41 19.43 E) (Fig. 2). Another 8 samples were collected from littoral zone within a depth range between 3 m and 7 m. These samples collected from four profiles, the distance between profiles is 100 m and distance between samples in each profile is 50 m.

Physical condition of marine water is quite currents, warm water, sim–clear and turbid water during two seasons winter and autumn. Table (2) shows frequency of species in each sample, depth and marine environment in the study area.

The taxonomy of the recognized species was revised according to the classification scheme of Treatise on Invertebrate Paleontology (Moore 1969, 1971).

Table 1. Ratio of Rain in the Four wadies

Month	1	2	3	4	5	6	7	8	9	10	11	12
Rain mm\month	Trace	0.6	1.6	Trace	-	-	-	-	-	0.8	Trace	1

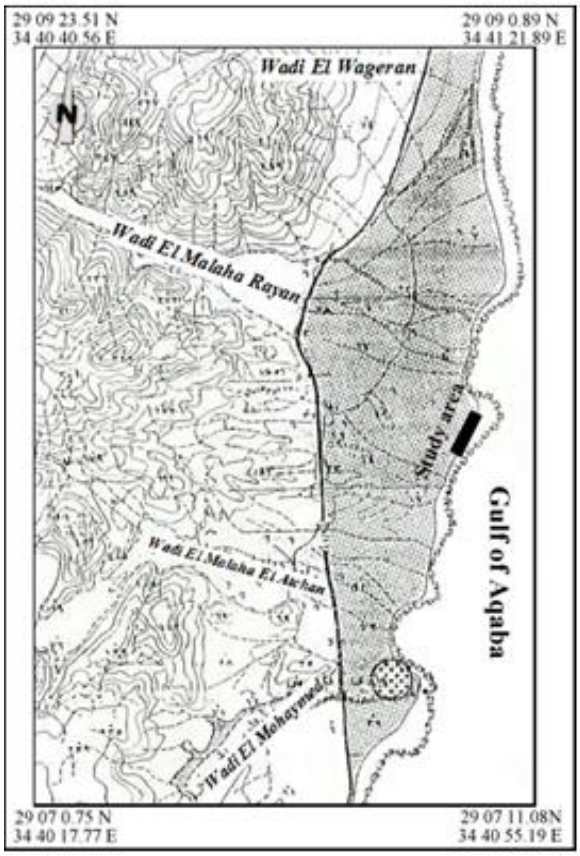


Fig. 1 Location of study offshore area in Gulf of Aqaba

Diversity of Mollusk assemblages

To better evaluate the nature of the recognized assemblages, the diversity distribution of Mollusk among samples has been mapped. For each sample, the diversity has been calculated by using the Yule-Simpson Index.

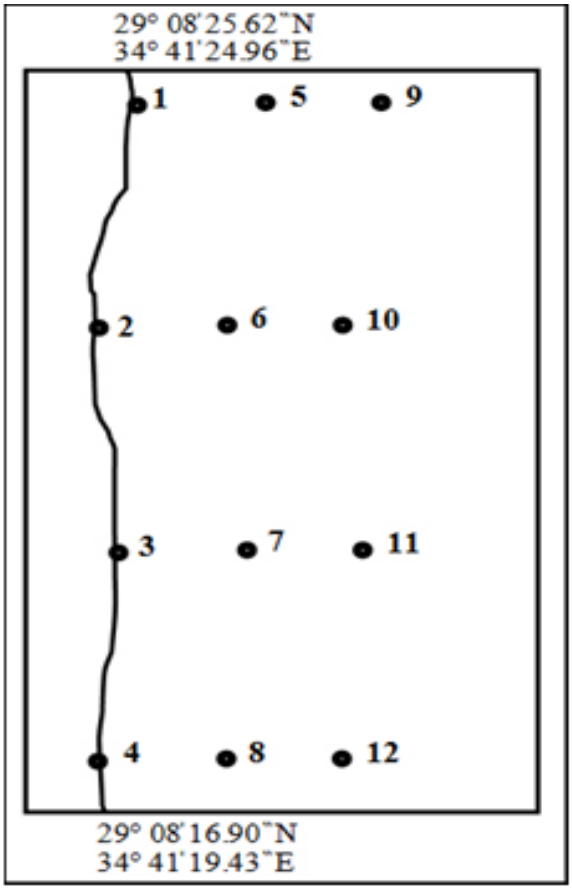


Fig. 2 Location of samples in study offshore area.

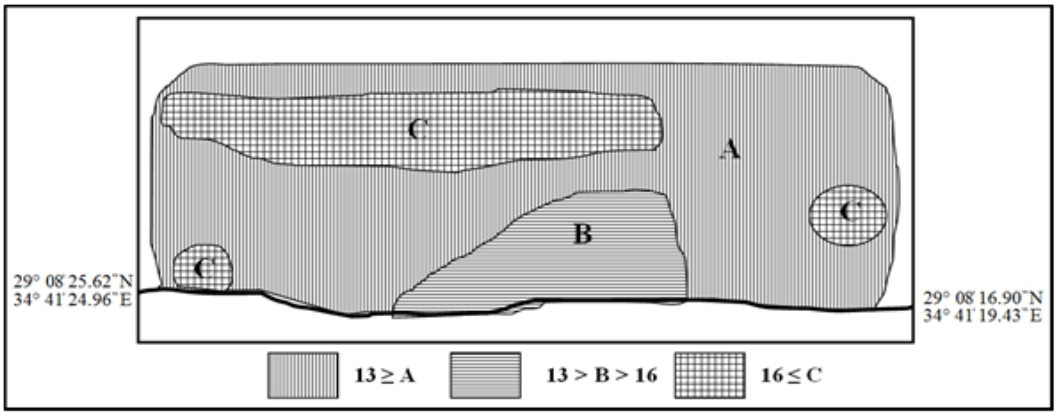


Fig. 3 Diversity map of study area.

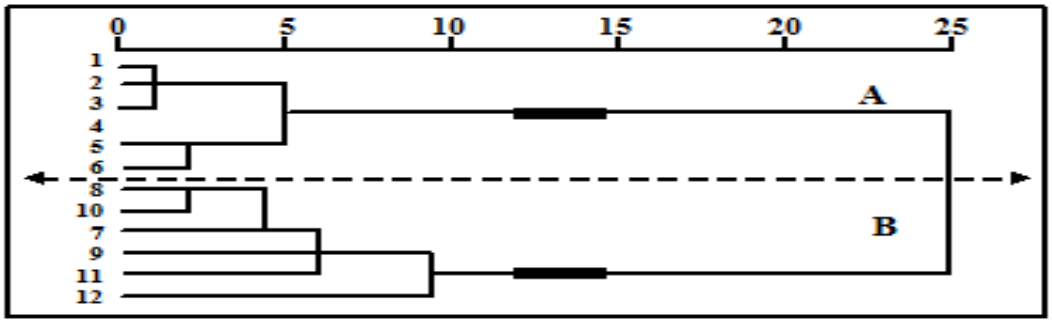


Fig. 4 Dendogram of cluster analysis of samples.

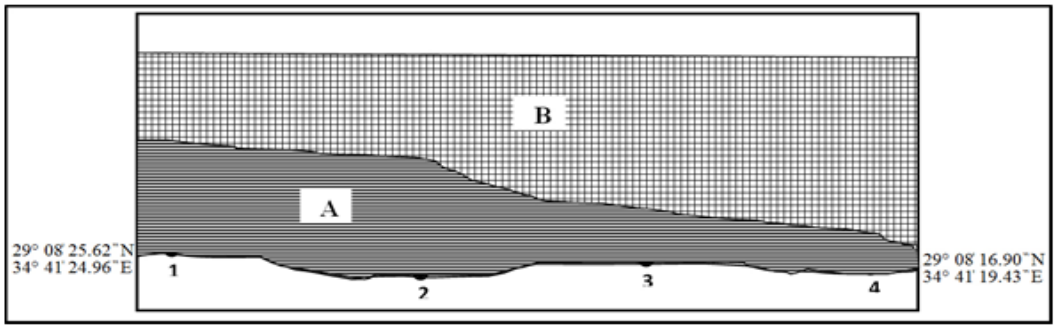


Fig. 5 The two group of cluster analysis in study area.

Cluster analysis

Cluster analysis of samples enables to segregate two groups of samples after their Mollusk content. The analysis of variance determined highly significant species for the segregation of these groups (Table 3 and Fig. 5).

Analysis of variance

Analysis of variance used on group of cluster analysis. Each group of cluster analysis content on several frequencies of species it detected significantly species in each group of cluster analysis depending on compare between frequencies of species in each sample.

To detect the species which are significantly affecting the clustering of each one of the clustering procedures, a multivariante (ANOVA) has been performed for each species to test the difference between the variance in the frequencies of the species in all the samples of a given area and the variance of the averages of the frequencies of the same species in each cluster group (between the groups) (Table 3).

Table 2. Frequency of species and depth of samples.

Marine environment	Tidal zone				Littoral zone							
Depth m. / Species	0.2	0.5	0.4	0.3	1.5	1.4	3.6	3.2	5.8	6.4	5.7	7
Samples Species / Species	1	2	3	4	5	6	7	8	9	10	11	12
Glycymeris pectunculus	2	4	2	3	6	0	1	0	1	0	0	1
Modiolus auriculatus	4	5	2	6	7	8	0	0	2	0	2	0
Chama squamosa	12	10	11	13	14	15	3	0	0	2	4	3
Mactra glauca	4	3	4	2	3	0	1	0	0	0	0	0
Asaphis deflorata	2	4	6	8	0	0	0	0	2	2	3	1
Tellina pulchella	2	5	6	0	0	0	0	1	2	1	0	0
Tellina radiata	3	2	4	1	0	0	1	2	2	1	1	1
Tellina rugosa	4	3	1	2	1	1	2	2	0	0	0	0
Tridacna gigas	0	0	1	5	0	1	2	0	0	1	2	0
Tridacna squamosa	2	0	2	0	5	2	0	1	0	3	0	0
Venerupis aurea	4	6	5	2	4	5	0	1	0	0	0	2
Circe pectinata	11	13	14	15	12	10	3	2	3	0	3	5
Circe scripta	5	4	6	2	1	0	1	1	0	0	0	0
Venus reticulata	2	3	1	5	0	2	2	2	0	2	0	2
Total Bivalvia	57	62	65	64	53	44	16	12	12	12	15	15
Bathybembix argenteonitens (Lschke)	1	0	3	0	0	0	0	0	1	2	0	2
Tegula Fasciata	0	0	0	1	0	0	1	2	0	2	2	1
Tegula omphalius	2	0	3	0	0	1	0	0	3	0	5	2
Clanculus pharaonium	0	0	0	2	0	1	0	3	0	1	0	2
Tectus dentatus	0	1	0	0	1	0	1	2	0	2	3	4
Umbonium giganteum	0	0	0	1	0	0	2	0	4	2	0	1
Turbo argyrostomus	1	3	1	2	2	1	11	8	7	6	0	9
Rissoa violacea	0	0	2	0	0	2	1	5	5	2	4	6
Barleeia rubra	0	1	0	1	0	0	0	5	6	6	7	2
Amaea magnifica	2	1	0	0	3	3	5	3	0	0	6	8
Strombus gibberulus albus	2	1	4	3	2	1	9	11	3	10	11	2
Conus daucus	4	2	4	5	3	2	15	10	14	15	12	17
Conus arenatus	1	1	1	0	0	0	4	3	5	7	5	0
Conus glaucus	0	0	0	1	1	1	3	6	4	7	3	1
Conus flavidus	2	1	1	0	1	5	5	8	8	3	0	0
Conus textile	4	0	0	0	0	3	2	2	2	5	4	1
Terebra dislocate	2	2	1	1	4	5	9	10	9	8	9	11
Harpa costata	0	0	0	0	0	0	1	0	0	0	2	1
Harpa davidis	0	0	0	0	0	0	0	2	0	2	0	0
Vasum muricatum	2	1	0	1	0	1	3	5	2	1	4	3
Bulla striata	2	1	0	0	2	2	5	6	4	5	7	9
Total Gastropoda	25	15	20	18	19	28	77	91	77	86	84	82
Total species	82	77	85	82	72	72	93	103	89	98	99	97

Highly significant species in group A

This group (A) was recorded in the tidal zone and the analysis of variance enables to determine 6 highly significant species in this environment. These species belonged to 4, 2 species from highly significant class bivalvia and class gastropoda respectively (table 3).

Highly significant species in group B

This group (B) was recorded in the littoral zone which is an area of sea grasses growing on shale.

The analysis of variance determined 14 highly significant species in this environment. These species belonged to 2, 12 species from highly significant class bivalvia and class gastropoda respectively (Table 3).

Table 3. Cluster analysis and highly significant species in group (highly significant species < 0.005).

Species	Cluster analysis		Significant species	
	Group A	Group B	Group A	Group B
Glycymeris pectunculus (Linnaeus 1780)	3.62	0.52	0.019	0.037
Modiolus auriculatus Krauss 1848	6.81	0.69	0.002	0.109
Chama squamosa (Solander 1761)	15.96	2.07	0	0.013
Mactra glauca Born 1778	3.40	0.17	0.007	0.28
Asaphis deflorata (Linnaeus 1758)	4.26	1.38	0.054	0.018
Tellina pulchella Lamarck 1818	2.77	0.69	0.108	0.055
Tellina radiata Linnaeus 1758	2.13	1.38	0.054	0
Tellina rugosa Born 1778	2.55	0.69	0.012	0.109
Tridacna gigas (Linnaeus 1758)	1.49	0.86	0.201	0.049
Tridacna squamosa Lamarck 1819	2.34	0.69	0.058	0.16
Venerupis aurea Gmelin 1791	5.53	0.52	0.001	0.132
Circe pectinata (Linnaeus 1758)	15.96	2.76	0	0.003
Circe scripta Linnaeus 1758	3.83	0.35	0.027	0.109
Venus reticulata Linnaeus 1758	2.77	1.38	0.027	0.009
Bathybembix argenteonitens (Lschke 1871)	0.85	0.86	0.235	0.049
Tegula Fasciata (Born 1778)	0.21	1.38	0.363	0.003
Tegula omphalius Philippi 1847	1.28	1.73	0.111	0.057
Clanculus pharaonium (Linnaeus 1758)	0.64	1.04	0.203	0.061
Tectus dentatus (Forskal 1775)	0.43	2.07	0.175	0.006
Umbonium giganteum (Lesson 1831)	0.21	1.55	0.363	0.028
Turbo argyrostomus Linnaeus 1758	2.13	7.08	0.004	0.002
Rissoa violacea Desmarest 1814	0.85	3.97	0.175	0.001
Barleeia rubra (J. Adams 1795)	0.43	4.49	0.175	0.004
Amaea magnifica (Sowerby 1844)	1.91	3.80	0.045	0.017
Strombus gibberulus albus Morch 1852	2.77	7.94	0.006	0.002
Conus daucus Bruguiere 1792	4.26	14.34	0.001	0
Conus arenatus Bruguiere 1792	0.64	4.15	0.076	0.003
Conus glaucus Linnaeus 1758	0.64	4.15	0.076	0.002
Conus flavidus Lamarck 1822	2.13	4.15	0.067	0.018
Conus textile Linnaeus 1758	1.49	2.76	0.18	0.002
Terebra dislocata (Say 1822)	3.19	9.67	0.014	0
Harpa costata Linnaeus 1758	-	0.69	.	0.055
Harpa davidis Röding 1798	-	0.69	.	0.109
Vasum muricatum (Born 1778)	1.06	3.11	0.042	0.001
Bulla striata Bruguiere 1792	1.49	6.22	0.034	0
Total highly significant species			6	14

Systematic

All the species considered in the present study are well known and described in the literatures. Their description is not repeated in this paper, Only the work giving the diagnosis followed in identifying the different species are given as synonymy. For each species, already known geographic and ecological distributions are discussed. The classification of Moore (1969 - 1971) in the Treatise on Invertebrate Paleontology is followed (table 5).

Class Bivalvia

In El Malaha Rayan offshore area three orders are recorded *Arcoida, Mytiloida* and *Veneroida*. This order includes in the study area 10 genera which are known to live in the brackish water and in turbid water (table 5).

Subclass Pteriomorphia
Order Arcoida
In El Malaha Rayan offshore area, this order includes one species. This species live in the shallow water, agitated currents and turbid water. It is associated with many species of aquatic plants.

Superfamily Limopsacea
Family Glycymeridae
Subfamily Glycymeridinae
Genus Glycymeris Da Costa 1778
1- *Glycymeris pectunculus* (Linnaeus 1780)
Pl. 1, Fig. 1a,b

Table 4. Percentage, diversity and standard deviation of each species.

Species	No. St.	Total Sp.	Percentage.	Diversity	Std.
Glycymeris pectunculus (Linnaeus 1780)	8	20	1.91	7.30	1.87
Modiolus auriculatus Krauss 1848	8	36	3.43	7.59	2.92
Chama squamosa (Solander 1761)	10	87	8.29	8.26	5.74
Mactra glauca Born 1778	6	17	1.62	7.16	1.68
Asaphis deflorata (Linnaeus 1758)	8	28	2.67	6.78	2.57
Tellina pulchella Lamarck 1818	6	17	1.62	5.04	2.07
Tellina radiata Linnaeus 1758	10	18	1.72	12.75	1.17
Tellina rugosa Born 1778	8	16	1.53	10	1.3
Tridacna gigas (Linnaeus 1758)	6	12	1.14	6.56	1.6
Tridacna squamosa Lamarck 1819	6	15	1.43	5.50	1.48
Venerupis aurea Gmelin 1791	8	29	2.76	11.05	1.42
Circe pectinata (Linnaeus 1758)	11	91	8.67	8.29	2.27
Circe scripta Linnaeus 1758	7	20	1.91	8.90	5.4
Venus reticulata Linnaeus 1758	9	21	2.00	5.94	2.15
Bathybembix argenteonitens (Lschke 1871)	5	9	0.86	7.20	1.06
Tegula Fasciata (Born 1778)	6	9	0.86	12.00	0.87
Tegula omphalius Philippi 1847	6	16	1.53	6.67	1.67
Clanculus pharaonium (Linnaeus 1758)	5	9	0.86	7.20	1.06
Tectus dentatus (Forskal 1775)	7	14	1.33	8.27	1.34
Umbonium giganteum (Lesson 1831)	5	10	0.95	5.63	1.27
Turbo argyrostomus Linnaeus 1758	11	51	4.86	7.97	3.74
Rissoa violacea Desmarest 1814	8	27	2.57	7.98	2.22
Barleeia rubra (J. Adams 1795)	7	28	2.67	6.10	2.81
Amaea magnifica (Sowerby 1844)	8	31	2.96	7.38	2.64
Strombus gibberulus albus Morch 1852	12	59	5.62	8.31	4.06
Conus daucus Bruguiere 1792	12	103	9.82	9.14	5.79
Conus arenatus Bruguiere 1792	8	27	2.57	7.31	2.38
Conus glaucus Linnaeus 1758	9	27	2.57	7.02	2.45
Conus flavidus Lamarck 1822	9	34	3.24	7.01	2.98
Conus textile Linnaeus 1758	8	23	2.19	9.04	1.78
Terebra dislocata (Say 1822)	12	71	6.77	9.78	3.8
Harpa costata Linnaeus 1758	3	4	0.38	6.00	0.65
Harpa davidis Röding 1798	2	4	0.38	3.00	0.78
Vasum muricatum (Born 1778)	10	23	2.19	10.54	1.56
Bulla striata Bruguiere 1792	10	43	4.10	8.94	2.87

Distribution: In the present study, this species is recorded from 8 stations and it has diversity 7.3 and a standard deviation 1.87 (table 2). It has a medium areal distribution and is represented by a low number of shells in the study area. Ebaid Alla 1988 described it along the Red Sea coastal plain between Marsa Alam and Ras Banas and recorded in Pleistocene of Sinai by Abed 1982.
Ecology: It is generally found in sandy bottoms. It is common in tidal and littoral zone of marine environment. It is including running, slowly flowing and stagnant water.
Relative abundance: El Malaha Rayan offshore area, 1.91 % of mollusk fauna

Order Mytiloida
In El Malaha Rayan offshore area, this order includes one species. This species live in the shallow water, agitated currents and turbid water. They are associated with many species of aquatic plants.
Superfamily Mytilacea
Family Mytilidae
Subfamily Mytilinae
Genus Modiolus Lamarck 1799
2- *Modiolus auriculatus* Krauss 1848
Pl. 1, Fig. 2a,b
Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a medium areal distribution and is represented by a medium number of shells. It has diversity 7.59 and a standard deviation 2.92 (table 4). Bernard 1964 is described this species from South Africa, Madagascar and Red Sea Also Ebaid Alla 1988 described it along the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in sand and interspaces between rock coral. It lives in slowly currents, warm water, shallow and calm water. It usually occurs in colonies on and under rocky limestone ledges near the shoreline associated with many species of aquatic plants. It is common in tidal and littoral zone of marine environment and highly significant in tidal zone.
Relative abundance: El Malaha Rayan offshore area 3.43 % of mollusk fauna

Subclass Heterodonta
Order Veneroida
In El Malaha Rayan offshore area, this order includes 12 species (table 5). These species live in the shallow water, agitated currents and turbid water. They are associated with many species of aquatic plants.
Superfamily Chamacea
Family Chamidae
Genus Chama Linnaeus 1758
3- *Chama squamosa* (Solander 1761)
Pl. 1, Fig. 3a,b
Distribution: In the present study, this species is recorded from 10 stations (table 4). It has a high areal distribution and is represented by a high number of shells. It has diversity 8.26 and a standard deviation 5.74 (table 4). Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in sand and rocky beach. It lives in slowly currents, warm water, shallow and calm water. It is highly significant in tidal zone of marine environment.
Relative abundance: El Malaha Rayan offshore area, 8.29 % of mollusk fauna

Superfamily *Mactracea*
Family *Mactridae*
Subfamily *Mactrinae*
Genus *Mactra* Linnaeus 1767
4- *Mactra glauca* Born 1778
Pl. 1, Fig. 4a,b
Distribution: In the present study, this species is recorded from 6 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 7.16 and a standard deviation 1.68 (table 4). Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in sand beach. It lives in agitated currents, warm and shallow water. It is common in tidal and littoral zone of marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.62 % of mollusk fauna

Superfamily Tellinacea
Family Psammobiidae

Subfamily Psammobiinae
Genus Asaphis Modeer 1793
5- *Asaphis deflorata* (Linnaeus 1758)
Pl. 1, Fig. 5a,b
Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 6.78 and a standard deviation 2.57 (table 4). It is recorded by Ebaid Alla 1988 from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas and also Dance 1974 and Lindner 1982 are

recorded from Atlantic Ocean, Indian Ocean and Red Sea.
Ecology: It is generally found in sand beach. It lives in agitated currents, warm and shallow water. It is common in tidal and littoral zone of marine environment.
Relative abundance: El Malaha Rayan offshore area, 2.67 % of mollusk fauna

Superfamily Tellinacea
Family Tellinidae
Subfamily Tellininae
Genus Tellina Linnaeus 1758
6- *Tellina pulchella* Lamarck 1818
Pl. 1, Fig. 6a,b
Distribution: In the present study, this species is recorded from 6 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 5.04 and a standard deviation 2.07 (table 4). It is described by El Halaby 2004 from beach of the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in sand beach and it lives in agitated currents, warm and shallow marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.62 % of mollusk fauna

7- *Tellina radiata* Linnaeus 1758
Pl.1, Fig. 7a
Distribution: In the present study, this species is recorded from 10 stations (table 4). It has a high areal distribution and is represented by a low number of shells. It has diversity 12.75 and a standard deviation 1.17 (table 4). It is described by El Halaby 2004 from beach of the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in sand beach and it lives in agitated currents, warm and shallow marine environment. It is highly significant in littoral zone of marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.72 % of mollusk fauna

8-*Tellina rugosa* Born 1778
Pl. 1, Fig. 8a,b
Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a high areal distribution and is represented by a low number of shells. It has diversity 10 and a standard deviation 1.3 (table 4). It is described by El Halaby 2004 from beach of the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in sand beach and it lives in agitated currents, warm and shallow marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.53 % of mollusk fauna

Superfamily Tridacnacea
Family Tridacnidae
Genus Tridacna Bruguiere 1797
9- *Tridacna gigas* (Linnaeus 1758)
Pl. 1, Fig. 9a,b
Distribution: In the present study, this species is recorded from 6 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 6.56 and a standard deviation 1.6 (table 4). Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas. This species is recorded from Red Sea, East Africa and Philippine by Dance 1974 and Oliver 1980. Also it is recorded from the Pleistocene of Zanzibar by Cox 1927 and Pleistocene of Sinai by Abed 1982. Also El Halaby 2004 described this species from the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in sand and rocky beach. It lives in agitated currents, warm and turbid water and shallow marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.14 % of mollusk fauna

10- *Tridacna squamosa* Lamarck 1819
Pl. 1, Fig. 10a,b
Distribution: In the present study, this species is recorded from 6 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 5.5 and a standard deviation 1.48 (table 4). It is recorded by El Halaby 2004 from the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in sand and rocky bottom of marine environment. It lives in agitated currents, warm and turbid water and shallow marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.43 % of mollusk fauna

Superfamily Veneracea
Family Veneridae
Genus Venerupis Lamarck 1801
11-*Venerupis aurea* Gmelin 1791
Pl. 1, Fig. 11a,b
Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a wide areal distribution and is represented by a high

number of shells. It has diversity 11.05 and a standard deviation 1.42 (table 4). Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in coralline sandy beach. It is highly significant in tidal zone of marine environment (table 3).
Relative abundance: El Malaha Rayan offshore area, 2.76 % of mollusk fauna

Genus Circe Schumacher 1817
12- *Circe pectinata* (Linnaeus 1758)
Pl. 1, Fig. 12a,b
Distribution: In the present study, this species is recorded from 11 stations (table 4). It has a wide areal distribution and is represented by a high number of shells. It has diversity 8.29 and a standard deviation 2.27 (table 4). Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in coralline sandy beach and it lives in agitated currents, warm and shallow marine environment. It is common in tidal and littoral zone of marine environment and highly significant in tidal zone (table 3).
Relative abundance: El Malaha Rayan offshore area, 8.67 % of mollusk fauna

13- *Circe scripta* Linnaeus 1758
Pl. 1, Fig. 13a,b
Distribution: In the present study, this species is recorded from 7 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 8.9 and a standard deviation 5.4 (table 4). Dance 1974 recorded this species from Indian Ocean and Abed 1982 recorded it from the Pleistocene of Sinai. Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in coralline sandy beach and it lives in agitated currents, warm and shallow marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.91 % of mollusk fauna

Subfamily Venerinae
Genus Venus Linnaeus 1758
14-*Venus reticulata* Linnaeus 1758
Pl. 1, Fig. 14a,b
Distribution: In the present study, this species is recorded from 9 stations (table 4). It has a wide areal distribution and is represented by a low number of shells. It has diversity 5.94 and a standard deviation 2.15 (table 4). Ebaid Alla 1988 described it from beach of the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in coralline sandy beach. It is common in tidal and littoral zone of marine environment (table 3).
Relative abundance: El Malaha Rayan offshore area, 2 % of mollusk fauna

Class Gastropoda
In El Malaha Rayan offshore area, the five orders of gastropoda are recorded *Archaeogastropoda, Caenogastropoda, Mesogastropoda, Neogastropoda* and *Pleurocoela*. These orders include in the area 14 genera (table 5), which are known to live in marine water with agitated currents, warm and sim-clear water.

Subclass Prosobranchia
Order Archaeogastropoda
In El Malaha Rayan offshore area, this order is include 7 species (table 5). These species are live in the quite currents, shallow, warm and clear water. They are associated with many species of aquatic plants.
Suborder Trochina
Superfamily Trochacea
Family Turbinidae

Subfamily Monodontinae
Genus Bathybembix Crosse 1893
15- *Bathybembix argenteonitens* (Lschke 1871)
Pl. 2, Fig. 1
Distribution: In the present study, this species is recorded from 5 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 7.2 and a standard deviation 1.06 (table 4). El Halaby 2004 described this species from Abu Sumah bay, north Safaga, Red Sea coast.
Ecology: It is generally found in sand beach and it lives in quite currents, warm, shallow and clear water.
Relative abundance: El Malaha Rayan offshore area, 0.86 % mollusk fauna

Genus Tegula Lesson 1835
16- *Tegula fasciata* (Born 1778)
Pl. 2, Fig. 2
Distribution: In the present study, this species is recorded from 6 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 12 and a

standard deviation 0.87 (table 4). El Halaby 2003 recorded this species from Old Quay bay, Ras Mohammed National Park, Gulf of Aqaba and also El Halaby 2004 is described it from the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in sand and sometimes in rocky beach. It lives in slowly currents, warm, shallow, clear and calm water. It usually lives on rocky limestone or in coarse sand. It is common in tidal and littoral zone of marine environment and highly significant in littoral zone (table 3).
Relative abundance: El Malaha Rayan offshore area, 0.86 % of mollusk fauna

17- *Tegula omphalius* Philippi 1847
Pl. 2, Fig. 3
Distribution: In the present study, this species is recorded from 6 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 6.7 and a standard deviation 1.67 (table 4). Ziko *et al.* 2001 are described from recent sediment of El Hamrawein, Gemsha and Gebel Zeit in the Red Sea coastal plain.
Ecology: It is generally found in sand and sometimes in rocky beach. It lives in slowly currents, warm, shallow, clear and calm water and it usually lives on rocky limestone or in coarse sand.
Relative abundance: El Malaha Rayan offshore area, 1.53 % of mollusk fauna

Subfamily Trochinae
Genus Clanculus Montfort 1810
18- *Clanculus pharaonium* (Linnaeus 1758)
Pl. 2, Fig. 4
Distribution: In the present study, this species is recorded from 5 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 7.2 and a standard deviation 1.06 (table 4). Ziko *et al* 2001 are described from recent sediment of El Hamrawein, Gemsha and Gebel Zeit in the Red Sea coastal plain. Abed 1982 is recorded this species from Indian Ocean, Red Sea, Gulf of Suez and Gulf of Aqaba. El Halaby 2003 recorded this species from Old Quay bay, Ras Mohammed National Park, Gulf of Aqaba coast
Ecology: It is generally found in sand and sometimes in rocky beach. It lives in slowly currents, warm, shallow, clear and calm water and it usually lives on rocky limestone or in coarse sand.
Relative abundance: El Malaha Rayan offshore area, 0.86 % of mollusk fauna

Genus Tectus Montfort 1810
19- *Tectus dentatus* (Forskal 1775)
Pl. 2, Fig. 5
Distribution: In the present study, this species is recorded from 7 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 8.27 and a standard deviation 1.34 (table 4). El Halaby 2004 is described it from the Abu Sumah bay, North Safaga, Red Sea coast and also Ebaid Alla 1988 described it along the Red Sea coastal plain between Marsa Alam and Ras Banas. Oliver 1980 is recorded this species from Indian Ocean.
Ecology: It is generally found in sand and sometimes in rocky beach. It lives in slowly currents, warm, shallow, clear and calm water. It usually lives on rocky limestone or in coarse sand. It is common in tidal and littoral zone of marine environment.
Relative abundance: El Malaha Rayan offshore area, 1.33 % of mollusk fauna

Subfamily Umboniinae
Genus Umbonium Link 1807
20- *Umbonium giganteum* (Lesson 1831)
Pl. 2, Fig. 6
Distribution: In the present study, this species is recorded from 5 stations (table 4). It has a medium areal distribution and is represented by a low number of shells. It has diversity 5.63 and a standard deviation 1.27 (table 4).
Ecology: It is generally found in sand beach. It lives in quite currents, warm, shallow and clear water.
Relative abundance: El Malaha Rayan offshore area, 0.95 % of mollusk fauna

Subfamily Turbininae
Genus Turbo Linnaeous 1758
21- *Turbo argyrostomus* Linnaeus 1758
Pl. 2, Fig. 7
Distribution: In the present study, this species is recorded from 11 stations (table 4). It has a wide areal distribution and is represented by a moderate number of shells. It has diversity 7.97 and a standard deviation 3.74 (table 4).
Ecology: It is generally found in sand beach. It lives in quite currents, warm, shallow and clear water. It is highly significant in tidal and littoral zone of marine environment (table 3).

Relative abundance: El Malaha Rayan offshore area, 4.86 % of mollusk fauna

Order Caenogastropoda
In El Malaha Rayan offshore area, this order is include 2 species (table 5). These species are live in the quite currents, shallow, warm and clear water and they are associated with many species of aquatic plants.
Superfamily Rissoacea
Family Rissoidae
Subfamily Rissoinae
Genus Rissoa Muehfldt 1824
22- *Rissoa violacea* Desmarest 1814
Pl. 2, Fig. 8
Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a medium areal distribution and is represented by a low number of shells in the study area. It has diversity 7.98 and a standard deviation 2.22 (table 4).
Ecology: It is generally found in medium sandy bottom and sometimes in the rocky of limestone. It lives common in all kinds of the tidal and littoral zone of water and it is including running, slowly flowing. It is common in tidal and littoral zone of marine environment and highly significant in littoral zone (table 3).
Relative abundance: El Malaha Rayan offshore area, 2.57% of mollusk fauna

Subfamily Barleeiinae
Genus Barleeia J. Adams 1795
23- *Barleeia rubra* (J. Adams 1795)
Pl. 2, Fig. 9
Distribution: In the present study, this species is recorded from 7 stations (table 4). It has a medium areal distribution and is represented by a low number of shells in the study area. It has diversity 6.1 and a standard deviation 2.81 (table 4). El Halaby 2003 recorded this species from Old Quay bay, Ras Mohammed National Park, Gulf of Aqaba coast.
Ecology: It is generally found in medium or coarse sandy bottom and sometimes in the rocky of limestone. It is common in the tidal and littoral zone of water and highly significant in littoral zone (table 3). It is including running, slowly flowing in running water and it is recorded in quite currents, clear, calm and warm water.
Relative abundance: El Malaha Rayan offshore area, 2.67 % of mollusk fauna

Order Mesogastropoda
In El Malaha Rayan offshore area, this order is include 2 species (table 5). These species are live in the quite currents, shallow, warm and clear water. They are associated with many species of aquatic plants.
Superfamily Epitoniacea
Family Epitoniidae
Genus Amaea H.A. Adams 1853
24- *Amaea magnifica* (Sowerby 1844)
Pl. 2, Fig. 10
Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a medium areal distribution and is represented by a low number of shells in the study area. It has diversity 7.38 and a standard deviation 2.64 (table 4). El Halaby 2004 described this species from the Abu Sumah bay, North Safaga, Red Sea coast and it is recorded by El Halaby 2003 in lake Burullus protectorate.
Ecology: It is generally found in coarse sandy bottom and sometimes in the rocky of limestone. It is common in the tidal and littoral zone of water. It is including running, slowly flowing in running water and it is recorded in quite currents, clear, calm and warm water.
Relative abundance: El Malaha Rayan offshore area, 2.96 % of mollusk fauna

Superfamily Strombacea
Family Strombidae
Genus Strombus Linnaeus 1758
25- *Strombus gibberulus albus* Morch 1852
Pl. 2, Fig. 11
Distribution: In the present study, this species is recorded from 12 stations (table 4). It has a wide areal distribution and is represented by a moderate number of shells in the study area. It has diversity 8.31 and a standard deviation 4.06 (table 4). Dance 1974 recorded this species from Indian Ocean and also Oliver 1980 recorded from Red Sea and Kenya. El Halaby 2004 described it from the Abu Sumah bay, North Safaga, Red Sea coast.
Ecology: It is generally found in the rocky bottom of limestone and it is significant in the littoral zone of environment (table 3). It is including running, slowly flowing in running water and it is recorded in quite currents, clear, calm and warm water.
Relative abundance: El Malaha Rayan offshore area, 5.62 % of mollusk fauna

Order Neogastropoda

In El Malaha Rayan offshore area, this order is include 9 species (table 5). These species are live in the quite currents, shallow, warm and clear water. They are associated with many species of aquatic plants.

Superfamily Conacea

Family Conidae

Genus Conus Linnaeus 1758

26- *Conus daucus* Bruguiere 1792

Pl. 2, Fig. 12

Distribution: In the present study, this species is recorded from 12 stations (table 4). It has a wide areal distribution and is represented by a high number of shells in the study area. It has diversity 9.14 and a standard deviation 5.79 (table 4). El Halaby 2004 described it from the Abu Sumah bay, North Safaga, Red Sea coast.

Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is highly significant in the tidal and littoral zone of water (table 3). It is including running, slowly flowing. In running water, they have been found attached to rubber wheels, plastic packets, debris and rocks.

Relative abundance: El Malaha Rayan offshore area, 9.82 % of mollusk fauna

27- *Conus arenatus* Bruguiere 1792

Pl. 2, Fig. 13

Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a medium areal distribution and is represented by a low number of shells in the study area. It has diversity 7.31 and a standard deviation 2.38 (table 4). Ebaid Alla 1988 recorded this species along the Red Sea coastal plain between Marsa Alam and Ras Banas.

Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is highly significant in the littoral zone (table 3). It is including running, slowly flowing. In running water, they have been found attached to rubber wheels, plastic packets, debris and rocks.

Relative abundance: El Malaha Rayan offshore area, 2.57% of mollusk faun

28- *Conus glaucus* Linnaeus 1758

Pl. 2, Fig. 14

Distribution: In the present study, this species is recorded from 9 stations (table 4). It has a wide areal distribution and is represented by a low number of shells in the study area. It has diversity 7.02 and a standard deviation 2.45 (table 4). Ebaid Alla 1988 recorded this species along the Red Sea coastal plain between Marsa Alam and Ras Banas.

Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is highly significant in the littoral zone (table 3). It is including running, slowly flowing. In running water, they have been found attached to rubber wheels, plastic packets, debris and rocks.

Relative abundance: El Malaha Rayan offshore area, 2.57% of mollusk faun

29- *Conus flavidus* Lamarck 1822

Pl. 2, Fig. 15

Distribution: In the present study, this species is recorded from 9 stations (table 4). It has a wide areal distribution and is represented by a high number of shells in the study area. It has diversity 7.01 and a standard deviation 2.98 (table 4). Ebaid Alla 1988 recorded this species along the Red Sea coastal plain between Marsa Alam and Ras Banas.

Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is common in the tidal and littoral zone. It is including running, slowly flowing. In running water, they have been found attached to rubber wheels, plastic packets, debris and rocks.

Relative abundance: El Malaha Rayan offshore area, 3.24% of mollusk faun

30- *Conus textile* Linnaeus 1758

Pl. 2, Fig. 16

Distribution: In the present study, this species is recorded from 8 stations (table 4). It has a wide areal distribution and is represented by a low number of shells in the study area. It has diversity 9.04 and a standard deviation 1.78 (table 4). Sharabati 1984 described this species from red sea. Ebaid Alla 1988 recorded this species along the Red Sea coastal plain between Marsa Alam and Ras Banas.

Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is highly significant in the littoral zone (table 3). It is including running, slowly flowing. In running water, they have been found attached to corals, rubber wheels, plastic packets, debris and rocks.

Relative abundance: El Malaha Rayan offshore area, 2.19% of mollusk faun

Family Terebridae

Genus Terebra Bruguiere 1789

31- *Terebra dislocata* (Say 1822)

Pl. 2, Fig. 17

Distribution: In the present study, this species is recorded from 12 stations (table 4). It has a wide areal distribution and is represented by a high number of shells in the study area. It has diversity 9.78 and a standard deviation 3.8 (table 4). Ebaid Alla 1988 recorded this species along the Red Sea coastal plain between Marsa Alam and Ras Banas.
Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is highly significant in the littoral zone (table 3). It is including running, slowly flowing. In running water, they have been found attached to rubber wheels and rocks.
Relative abundance: El Malaha Rayan offshore area, 6.77% of mollusk fauna

Superfamily Volutacea
Family Harpidae
Genus Harpa Walch 1771
32- *Harpa costata* Linnaeus 1758
Pl. 2, Fig. 18
Distribution: In the present study, this species is recorded from 3 stations (table 4). It has a small areal distribution and is represented by a rare number of shells in the study area. It has diversity 6 and a standard deviation 0.65 (table 4).
Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is common in the littoral zone of water. It is including running, slowly flowing. In running water, they have been found attached to rubber wheels and rocks.
Relative abundance: El Malaha Rayan offshore area, 0.38 % of mollusk fauna

33-*Harpa davidis* Röding 1798
Pl. 2, Fig. 19
Distribution: In the present study, this species is recorded from 2 stations (table 4). It has a small areal distribution and is represented by a rare number of shells in the study area. It has diversity 3 and a standard deviation 0.78 (table 4).
Ecology: It is generally found in sandy and sometimes on the rocky of limestone. It is common in the littoral zone. It is including running, slowly flowing. In running water, they have been found attached to rubber wheels and rocks.
Relative abundance: El Malaha Rayan offshore area, 0.38 % of mollusk fauna

Family Turbinellidae
Genus Vasum Linnaeus 1758
34- *Vasum muricatum* (Born 1778)
Pl. 2, Fig. 20
Distribution: In the present study, this species is recorded from 10 stations (table 4). It has a wide areal distribution and is represented by a low number of shells in the study area. It has diversity 10.54 and a standard deviation 1.56 (table 4).
Ecology: It is generally found in medium or coarse sandy bottom and sometimes in the rocky of limestone. It is highly significant in the littoral zone (table 3). It is including running, slowly flowing in running water and it is recorded in quite currents and clear, calm and warm water.
Relative abundance: El Malaha Rayan offshore area, 2.19 % of mollusk fauna

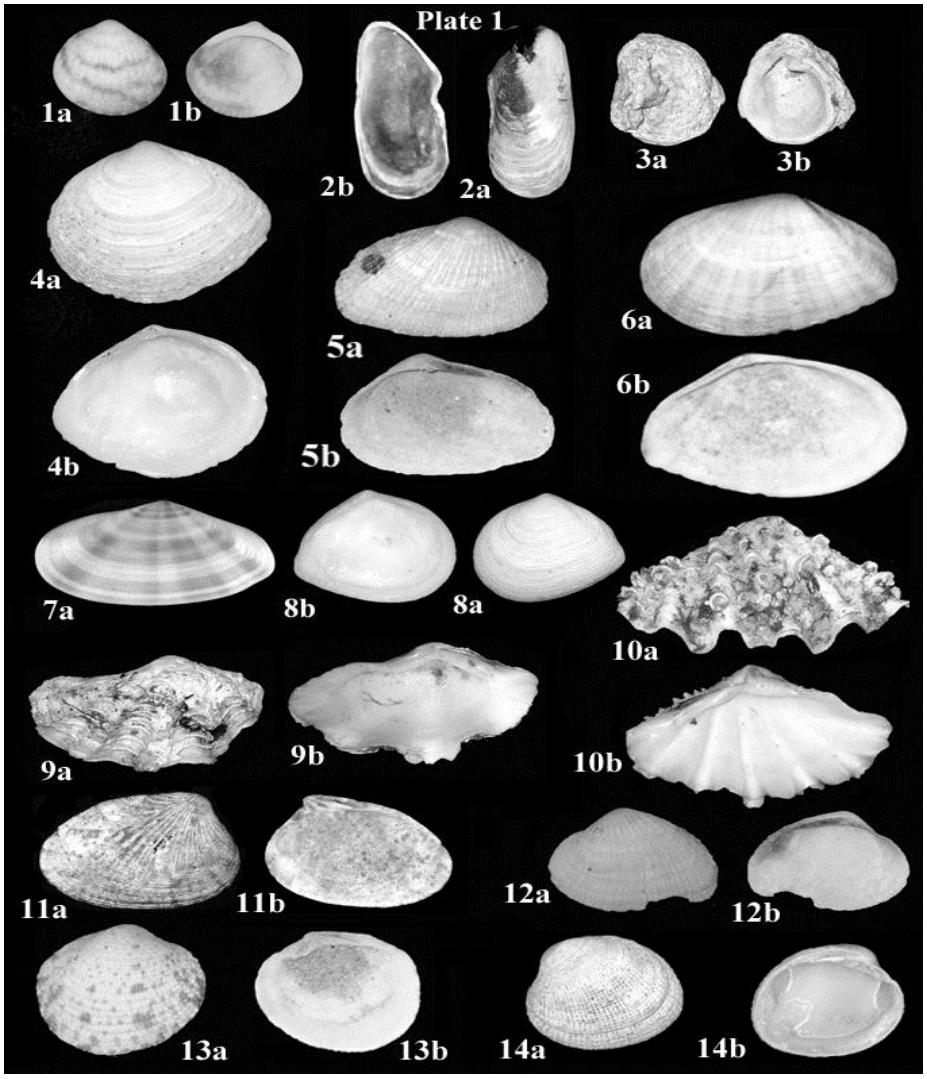
Subclass Opisthobranchia
Order Pleurocoela
In El Malaha Rayan offshore area, this order is include one species (table 5). This species is live in the quite currents, shallow, warm and clear water. They are associated with many species of aquatic plants.
Superfamily Bullacea
Family Bullidae
Genus Bulla Linnaeus 1758
Bulla striata Bruguiere 1792
Pl. 2, Fig. 21
Distribution: In the present study, this species is recorded from 10 stations (table 4). It has a wide areal distribution and is represented by a moderate number of shells in the study area. It has diversity 8.94 and a standard deviation 2.87 (table 4). El Halaby 2004 is described it from the Abu Sumah bay, North Safaga, Red Sea coast and also it is recorded from old Quay bay, Ras Mohammed National Park by El Halaby 2002.
Ecology: It is generally found in medium sandy bottom and sometimes in the rocky of limestone. It is highly significant in the littoral zone (table 3). It is including running, slowly flowing. It is running water.
Relative abundance: El Malaha Rayan offshore area, 4.1 % of mollusk fauna.

Conclusion

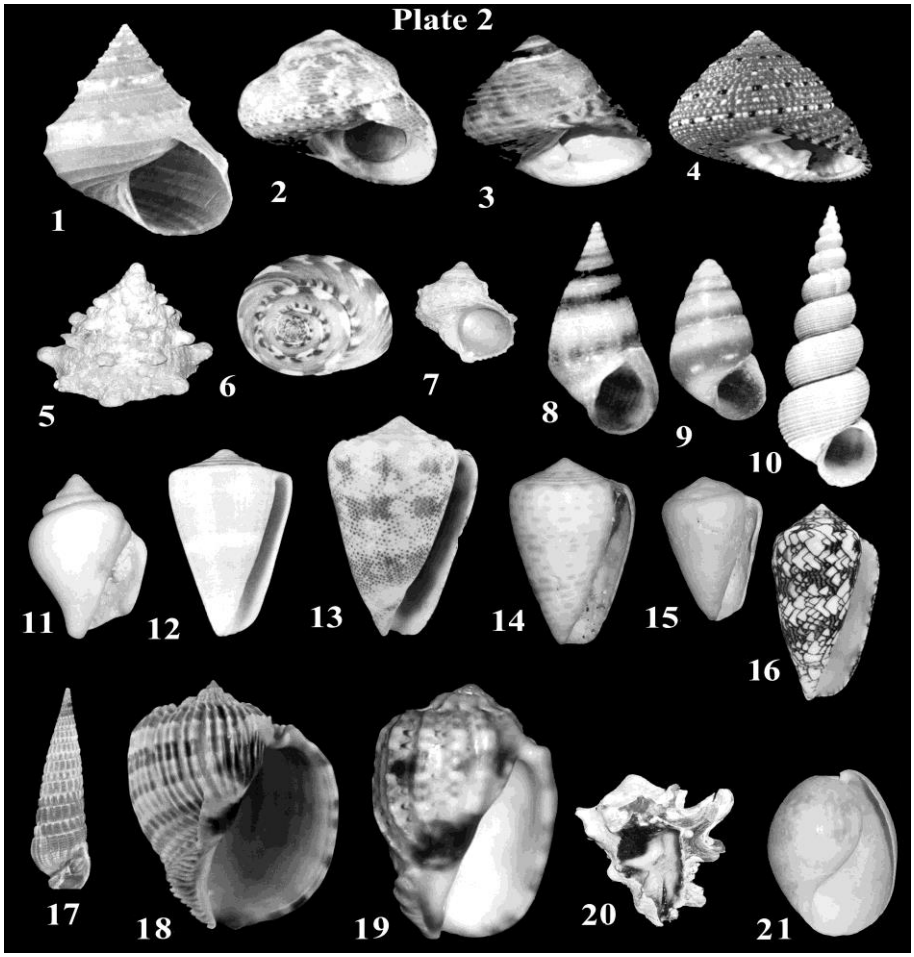
The analysis of variance proved to be useful in the recognition of significant species in segregating cluster groups of samples. These cluster groups are determined depending on their content of Mollusk species. The highly significant species can be considered as

important species for the recognition of various environmentally distinct areas in the investigated locality.

There are two groups of cluster analyses in the dendogram. The first group (A) located in the Tidal zone and include 33 Mollusk species (14 species from class Bivalvia and 19 species from class Gastropoda). The other group (B) located in the littoral zone and include 35 Mollusk species (14 species from class Bivalvia and 21 species from class Gastropoda).



1- *Glycymeris pectunculus* (Linnaeus 1780) 1a dorsal view, 1b ventral view, sample 1
2- *Modiolus auriculatus* Krauss 1848 2a dorsal view, 2b ventral view, sample 1
3- *Chama squamosa* (Solander 1761) 3a dorsal view, 3b ventral view, sample 1
4- *Mactra glauca* Born 1778 4a dorsal view, 4b ventral view, sample 1
5- *Asaphis deflorata* (Linnaeus 1758) 5a dorsal view, 5b ventral view, sample 1
6- *Tellina pulchella* Lamarck 1818 6a dorsal view, 6b ventral view, sample 1
7- *Tellina radiate* Linnaeus 1758 7a dorsal view, sample 1
8- *Tellina rugosa* Born 1778 8a dorsal view, 8b ventral view, sample 1
9- *Tridacna gigas* (Linnaeus 1758) 9a dorsal view, 9b ventral view, sample 1
10- *Tridacna squamosa* Lamarck 1819 10a dorsal view, 10b ventral view, sample 1
11- *Venerupis aurea* Gmelin 1791 11a dorsal view, 11b ventral view, sample 1
12- *Circe pectinata* (Linnaeus 1758) 12a dorsal view, 12b ventral view, sample 1
13- *Circe scripta* Linnaeus 1758 13a dorsal view, 13b ventral view, sample 1
14- *Venus reticulata* Linnaeus 1758 14a dorsal view, 14b ventral view, sample 1



1- *Bathybembix argenteonitens* (Lschke 1871)	sample 12
2- *Tegula Fasciata* (Born 1778)	sample 12
3- *Tegula omphalius* Philippi 1847	sample 12
4- *Clanculus pharaonium* (Linnaeus 1758)	sample 12
5- *Tectus dentatus* (Forskal 1775)	sample 12
6- *Umbonium giganteum* (Lesson 1831)	sample 12
7- *Turbo argyrostomus* Linnaeus 1758	sample 12
8- *Rissoa violacea* Desmarest 1814	sample 12
9- *Barleeia rubra* (J. Adams 1795)	sample 12
10- *Amaea magnifica* (Sowerby 1844)	sample 12
11- *Strombus gibberulus albus* Morch 1852	sample 12
12- *Conus daucus* Bruguiere 1792	sample 11
13- *Conus arenatus* Bruguiere 1792	sample 12
14- *Conus glaucus* Linnaeus 1758	sample 12
15- *Conus flavidus* Lamarck 1822	sample 10
16- *Conus textile* Linnaeus 1758	sample 12
17- *Terebra dislocata* (Say 1822)	sample 12
18- *Harpa costata* Linnaeus 1758	sample 12
19 - *Harpa davidis* Röding 1798	sample 10
20- *Vasum muricatum* (Born 1778)	sample 12
21- *Bulla striata* Bruguiere 1792	sample 12

Group (A) include 33 species, but only 6 species are highly significant (*Modiolus auriculatus*, *Chama squamosa*, *Venerupis aurea*, *Circe pectinata*, *Turbo argyrostomus* and *Conus*

daucus) . These species exists in warm turbid water mostly caused by flash floods of and they represent the tidal zone.

Group (B) include 35 species, but only 14 species are highly significant (*Tellina radiata*, *Circe pectinata* , *Tegula Fasciata*, *Turbo argyrostomus*, *Rissoa violacea*, *Barleeia rubra*, *Strombus gibberulus albus*, *Conus daucus*, *Conus arenatus*, *Conus glaucus*, *Conus textile*, *Terebra dislocata*, *Vasum muricatum* and *Bulla striata*). These species exist in warm, turbid water and agitate currents usually caused by flash floods. They represent the littoral zone.

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الملخص العربي

الوضع البيئى والتقسيمى لبعض المحاريات بالمنطقة الشاطئية فى منطقة وادى الملاحة الريان – خليج العقبة – مصر

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تناول البحث دراسة التقسيم والأوضاع البيئية ل 35 نوع من المحاريات حيث تم تعريفها من 12 عينة جمعت من قرب الشاطئ عند مصب وادى الملاحة الريان. وتنحصر منطقة الدراسة بين جنوب وادى الملاحة الريان و وادى الملاحة العطشان والتى يبلغ طولها حوالى 300 متر وعرضها حوالى 150 متر وهى منطقة شاطئية وتمثل منطقة المد والجذر

تم اجراء التحليل الاحصائى للنتائج بواسطة برنامج كلستر دندوجرام حيث قسمت المحاريات الى مجموعتين: الأولى (A) وتضم 33نوع وتمثل المحاريات التى تتواجد فى المنطقة الدافئة العكرة بسبب مياه السيول

والمجموعة الثانية(B) وتضم 35 نوع وتوجد فى النطقة الساحلية.