



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

Macro-Invertebrates Fauna of Mangrove Ecosystem in South Sinai, Egypt.

Ahmed R. M. Ibrahim¹, Maged M. A. Fouda² and Nahed Abdou^{1,*}

1. Biology and Geology Dept., Faculty of Education, Ain Shams University, Cairo, Egypt.

2. Zoology Dept., Faculty of Science, Al-Azhar University, Assuit Branch, Assuit, Egypt.

Manuscript Info

Manuscript History:

Received: 14 September 2015

Final Accepted: 25 October 2015

Published Online: November 2015

Key words:

Macro-Invertebrates, Mangrove,
South Sinai, Egypt

*Corresponding Author

Nahed Abdou

Abstract

A field survey was carried out on the macro-invertebrate fauna of the mangrove ecosystem in Ras Mohamed and Nabq Protectorates in South Sinai-Egypt, during the period from June 2013 to May 2014. The studied area of Nabq known as Wadi-Kid, it has four sites of mangrove: El-Gharqana, Arwashia, El-Manqata and Abu Zubad. A total of 122 species from the five sites of study was recorded; these species are belonging to the following phyla of invertebrates: Cnidaria, Crustacea, Mollusca and Echinodermata. The highest number of species is represented by molluscan invertebrates, dominated by 108 species followed by Crustacea with 11 species, Echinodermata with two species and finally the Cnidaria represented by one species. The highest diversity of species recorded from Nabq at El-Gharqana site (92 species), followed by Abu Zubad (67 species), El-Manqata (57 species), and Arwashia (49 species). The number of species recorded from Ras Mohamed is 55 species. The pattern of distribution of the species in the present work is different from one site to the others. The highest similarity in the distribution of macro-invertebrates is 69.18 %, calculated between El-Gharqana and Abu Zubad, while the lowest similarity is 48.28 %, detected between Arwashia and Abu Zubad.

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INTRODUCTION

The mangrove swamp represents one of the most important saline habitats received a special interest from numerous ecologists. The mangrove jungle or mangal is a general term used to describe a variety of tropical inshore communities dominated by several species of peculiar trees or shrubs that have the ability to grow in salt water (Schwamborn and Saint-Paul, 1996). Mangroves in the Red Sea tend to be found in sheltered waters associated with enclosed soft-bottom habitats. The Sinai mangal is the northernmost mangal of the Indo-Pacific at 28° N (Ormond, 1987).

Two mangrove species have been recorded in Egypt extending along the Red Sea coastline from Ras Mohamed to Marsa-Halaib. The first species is *Avicennia marina* found along the Red Sea coastline as scattered patches in the north; however they are increased to form large stands extending for 9 km along sea coast in South Shalateen (Marsa Sha'ab). The second species is *Rhizophora mucronata* appears to form pure stands or co-dominating with *A. marina* in Shalateen region (Zahran, 1993).

The prop-roots and pneumatophores of mangrove trees extend from the intertidal into subtidal areas where they become a rare feature. Mangrove roots become home to marine plants, algae, invertebrates and vertebrates. It forms a habitat for a wide variety of species, some occurring in high densities (Ellison and Farnsworth, 1992). Mangroves are inhabited by a variety of benthic invertebrates, such as brachyuran crabs, hermit crabs, gastropods, bivalves, barnacles, sponges,

tunicates, polychaetes and sipunculids. Mangrove invertebrates often show marked zonation patterns (Sasekumar, 1974 and Ashton, 1999).

The conservation of Marine biodiversity is important for many reasons; it allows the environment to adapt to changing conditions, it is a source of food and raw materials and marine ecosystems are the most important elements controlling global climate (Norse, 1993). Preserving marine biodiversity is also important for the sake of knowledge itself (Gray, 1997).

Mangal and other sedimentary habitats of the Red Sea received less attention scientifically, therefore the objective of the present work is to study the diversity of the species composition of the macro-invertebrate fauna inhabiting in the mangal at Nabq and Ras Mohamed Protectorates, South Sinai, Egypt.

Materials and Methods

The present survey is carried out on the macro-invertebrates of mangrove of Ras Mohamed and Nabq Protectorates in period of June 2013 and May 2014. The specimens of the present work were collected seasonally from five mangrove swamps: the first swamp from Ras Mohamed and the other four swamps from Nabq protectorate (as following El-Gharqana, Arwashia, El-Manqata and Abu Zubad). A brief description for each mangrove area was given (Fig.1).

Specimens were collected during low tide by hand from different places of the upper and lower levels of shore and within the mangrove swamps. The burrowing species were dug out and sieved using hand sieve of mesh size (5×5 mm). The collected specimens were preserved in 70% ethyl alcohol and kept in labeled plastic jars.

In the laboratory, samples were sorted and identified to the species level or to the nearest taxa according to the classification of (Clark and Rowe, 1971; Sharabati, 1984; Campbell, 1987; Fitt and Costley, 1998; Mary, 2008; Ng et al., 2008; Niggl and Wild, 2010). A complete systematic list of the collected samples of macro-invertebrates (Cnidaria, Crustacea, Mollusca and Echinodermata) that are collected during the present survey was established.

The Similarity between different mangrove sites during the present study was calculated by using the formula of Morton and Davidson (1988) as follow:

$$\text{Similarity} = 2w / a+b$$

Where w: The common species found in two areas (a and b)

a: Species found in the first area b: Species found in the second area

The Sinai mangrove thickets are carried on the south-eastern tip of the Sinai Peninsula that is consisting of five stands (Fig.1). The first site of study carried on a small group of *Avicennia* trees growing along a channel that cuts across Ras Mohammed at the southern extension of the peninsula. The other four stands are denser and found along a 20km, stretch from the coast of the alluvial fan of Wadi Kid to the north of Nabq. These are stands (from north to south): Shura El- Manqata, Shura Arwashia, Marsa Abu Zubad and Shura El-Gharqana, *Avicennia marina* is the species of mangrove stands in Sinai (Khalil, 2004).

1- Mangrove channel at Ras Mohamed (27° 44'N, 34° 15'E):

The mangrove is relatively small stand at Ras Mohamed; it is grow along both banks of a shallow channel 500m in length. The mangrove of mean tree height is 2.6m, and the maximum height is 4.5m (Sheberd et al., 1992).

2- Shura El-Manqata Mangroves (28° 12.5'N, 34° 25'E):

The mangrove stand at this site is considered as the northerly limit of the Western Indian Ocean Region. Mean tree height is 2.6m, while some trees attain up to 5.6m in height (Galal, 2003).

3- Shura Arwashia Mangroves (28° 11'N, 34° 27'E):

This is the largest stand in the study sites, extending for more than 3km along the shoreline. The outer zone is occupied by stunted trees not exceeding 1.5m in height. Fully-grown trees "up to 5-6m height" grow in the middle and inner zone (Hellal et al., 1997).

4- Marsa Abu Zubad Mangroves (28° 09'N, 34° 27'E):

The mangrove stand at this site extends approximately 1.2 km. Due to highly saline substrate beneath, the stand consists of mostly low growing shrubs (Hellal et al., 1997).

5- Shura El-Gharqana Mangroves (28° 07'N, 34° 26.5'E):

The Gharqana lagoon is a small embayment 1.4-4.0 m, which is partly separated from the sea by a wide fringing reef (Hellal et al., 1997).

Results

A complete systematic list of the classified macro-invertebrate species from the five mangrove sites at Ras Mohamed (one site), and Nabq (four sites names: El-Manqata, Arwashia, Abu Zubad and El-Gharqana) Protectorates is given in (Table 1). The list comprised 122 species belonging to 97 genera and 59 families. Mollusca is the highest number of recorded species, reached to 108 species (88.5%) belonging to 86 genera and 50 families (69 species of Gastropoda, 38 species of Bivalvia and one species of Polyplacophora). Crustacea comes after Mollusca in order and represented by 11 species (9.1%) belonging to seven families, of which nine species of Brachyura and two species of Anomura. Phylum Echinodermata is the third representing by two species (1.6%) belonging to one genus. Cnidaria is the lowest number of recorded species, being one species (0.8%) (Table 1).

The number of macro-invertebrate species was also different with different mangrove sites. El-Gharqana in Nabq Protectorate has the highest number of species, (92 species: 75 genera and 51 families). Abu Zubad came next and representing by 67 species (58 genera and 37 families), followed by El-Manqata (57 species: 50 genera and 35 families) and finally Arwashia was the lowest number of recorded species, (49 species: 43 genera and 35 families). Ras Mohamed represented by 55 species (46 genera and 32 families). The distribution of these species among different sites of study of the present work was not the same. Four species of Crustacea and 18 species of Mollusca recorded from the five sites of study, whereas four species of crustacean, 29 species of molluscan and two species of echinoderm recorded from one site of study. In the same time, other species were found to be distributed in two sites and others in three or four sites, as shown in Table 2 and Fig. 2.

A great diversity of species among macro-invertebrate groups and within each mangrove sites was reported. Generally, El-Gharqana inhabits by the highest number of molluscan species (82), crustacean species (seven), Echinodermata (two) and a species of Cnidaria. Abu Zubad came in the second order, and includes 62 species of Mollusca, five species of Crustacea, both Echinodermata and Cnidaria are not detected. El-Manqata came in the third order, includes 49 species of Mollusca, seven species of Crustacea, and one species of Cnidaria, there is no species of Echinodermata. However, the mangrove swamps at Ras Mohamed and Arwashia have the lowest of species diversity, in Ras Mohammed Mollusca are (48), Crustacea (seven), declined at Arwashia to 43 and 6 species from Mollusca and Crustacea respectively, while Echinodermata and Cnidaria did not detected at the two sites (Table 3).

The similarity indices between the different mangrove sites of the present study are given in (Table 4). The highest similarity is found between El-Gharqana and Abu Zubad, being 69.18 %. Whereas, the lowest similarity is recorded between Arwashia and Abu Zubad, being 48.28 %. The other indices varied from 52.48 % between El-Gharqana and Arwashia to 66.67 % between Ras Mohamed and El-Gharqana.

Discussion

The mangrove jungles or mangal are typical life community of the tropical shores and equal in importance to coral reefs (Por et al., 1977). Mangroves of south Sinai are monospecific forests of *Avicennia marina*, and represented by five distinct swamps: four at Nabq Protectorate located on the coast of Gulf of Aqaba and one swamp at Ras Mohamed protectorate, lies at the point of meeting of the two Gulfs in south Sinai (Fishelson, 1971; Por et al., 1977; Jones et al., 1987). The mangal fauna at Nabq protectorate may not be distinctive so far. It has many species of invertebrates that found within the mangal, seagrass-beds, coral reef and even sandy and rocky beaches. Most of the recorded species in the present study are recorded from other localities in the Red Sea and Indo-Pacific regions recorded by: Abbott, (1962); Clark and Rowe (1971); Serene (1984); Hellal et al. (1997).

The mangrove swamps in south Sinai accommodate more than 180 macro-invertebrate species "mostly molluscs" and many species of micro-invertebrate as well as small fishes (Fishelson, 1971; Por et al., 1977, Por, 1984; Price et al., 1987; Fouda and Al-Muharrami, 1996; Hellal et al., 1997). 108 molluscan species, 11 crustacean species, two echinoderm species and one cnidarian species were recorded from south Sinai mangal during the present study, whereas 33 crustacean species, 17 molluscan

species and one echinoderm species recorded by **Por et al. (1977)** and 46, 41 and 14 species of the same invertebrate groups respectively reported by **Hellal et al. (1997)** from the same area.

In the present study, El-Gharqana accommodates the highest diversity of species than the other sites. This is may be due to the presence of lagoons, pools and sandy flats as well as stretches of beach rocks that provide a diversity of habitats suitable for many species.

As regards to the distribution of Cnidaria, *Cassiopea* spp. is found in tropical inshore marine environments along soft and sandy substrates, generally associated with mangrove dominated habitats (**Holland et al., 2004**). In the present study, *Cassiopea* was abundant in El-Gharqana region, Nabq, all the year, it could be due human activities, but it is recorded during winter in El-Manqata region with a few numbers. At Ras Mohamed, *Cassiopea* was not detected.

The second studied group is the Decapoda crustaceans that are the common invertebrates inhabiting different marine environment. Brachyuran crabs comprise approximately 6793 species worldwide so, it considered as one of the most relevant groups of the marine benthos, in terms of biomass and community structure (**Ng et al., 2008**).

Vine (1986) reported 35 species of hermit crabs that are belonging to three families: Diogenidae, Paguridae, and Coenobitidae, and 14 genera are reported from the Red Sea. However **Khaleid et al. (2009)** recorded the above mentioned families represented by 12 species and only seven genera mentioned by **Vine (1986)**. In the present study, two families: Diogenidae and Coenobitidae represented by two genera (*Clibanarius* sp. and *Coenobita scaevola*) as in the case of **Vine's** research in **1986**. Comparing the present data with the list of **Vine (1986)** from the Red Sea, the number of species that are recorded from Ras Mohamed and Nabq protectorates is limited and the reason of that is may be due to the limited area of research.

At Ras Mohamed, there are 49 species of true crabs, belonging to 32 genera and 11 families. Also, at Nabq, the brachyuran fauna shown high diverse, represent by 51 species, belonging to 34 genera and 12 families (**El-Sayed, 1996**). The true crabs were reported from mangrove areas surveyed during the present study was five species, belonging to four genera and four families from Ras Mohamed. In Nabq nine species of true crabs were recorded, belonging to seven genera and five families. The limiting number of crab species in these mangrove sites is may be attributed to low temperature and high salinity.

The roots of mangrove trees are critical to the mollusc's distribution providing refuge from high tides; adult specimens climb these roots after feeding on the substrate during the low tide to avoid drowning during the high tide (**Maia and Tanaka, 2007**). The number of Mollusca comes after Crustacea at Nabq, represented by 41 species (26 species of Gastropoda and 15 species of Bivalvia) (**Hellal et al., 1997**). The present study differs from the previous data in the number of species of Mollusca, that are bigger (107 species: 69 of Gastropoda, 37 of Bivalvia and one of Polyplacophora) than crustacean species (11) at four sites of Nabq Protectorate. On the other hand, the mangrove channel at Ras Mohamed represented by 48 species of Mollusca (27 species of Gastropoda and 21 species of Bivalvia).

Phylum Echinodermata has the lowest number of recorded species at Nabq, 14 species belonging to 11 genera and 11 families are present during the survey carried out by **Hellal et al. (1997)**. The invertebrates belonging to Ophiuroidea and Holothuroidea are represented by four species, while three species belong to Asteroidea and Echinoidea reported by **Hellal et al. (1997)**. The present study may be coincided to some extent with the previous findings, whereas two species belonging to one genus of family (Ophiocomidae) were recorded from Nabq. At Ras Mohamed, there is no species detected from Echinodermata.

It was noticed that the mangrove swamps of El- Gharqana and Abu Zubad areas are similar in their characteristics, so the highest similarity index was found between them. In contrast, the lowest similarity index was found between Arwashia and Abu Zubad. These results are in contravention with the studies carried out by **Fouda and Al-Muharrami (1996)** and **Hellal et al. (1997)**.

Mangrove swamps along the Egyptian Red Sea coast are unique to Egypt and attractive habitats; it can be used for rearing and culturing many marine invertebrates (**Fouda et al., 2003**). Due to their great important ecological role in maintaining the terrestrial, marine and coastal environments, it is necessary to conserve and protect, all the mangrove patches along the Egyptian Red Sea coast. So, this research is a part of thesis, and there is another integral part of him that will be published later.

Acknowledgment

The authors are greatly thankful to the department of Biological and Geological sciences, faculty of education, Ain Shams University for financial support and to all staff members in Nature conservation training center for providing facilities necessary for the collection of the materials of the present work. Special thanks to Prof. Dr. Magdy Al-Alwany, marine department, faculty of science, Suez Canal University, for his support during this work manuscript, and Prof. Dr. Awaad El-sayed, zoology department, faculty of science, Al-Azhar University for his advices for samples identification and classification of species.

Table (1): List of Macro-invertebrate Fauna Recorded from the Mangroves at Ras Mohamed and Nabq Protectorates during the Period of Study:

Phylum	Class	Order	Family	Species		
Cnidaria	Scyphozoa	Rhizostomae	Cassiopidae	<i>Cassiopea</i> sp.		
Crustacea	Malacostraca	Decapoda	Calappidae	<i>Calappa hepatica</i> (Linnaeus, 1758)		
			Dotillidae	<i>Dotilla sulcata</i> (Forsk., 1775)		
		Brachyura	Grapsidae	<i>Grapsus granulosus</i> (H.M. Edwards, 1853)		
			Ocypodidae		<i>Macrophthalmus depressus</i> (Ruppell, 1830)	
				<i>Macrophthalmus telescopicus</i> (Owen, 1839)		
				<i>Ocypode saratan</i> (Forsk., 1775)		
				<i>Uca inversa</i> (Hoffman, 1874)		
				<i>Uca tetragonon</i> (Herbst, 1790)		
				Varunidae	<i>Pseudograpsus elongates</i> (H.M. Edwards, 1873)	
			Anomura	Coenobitidae	<i>Coenobita scaevola</i> (Forsk., 1775)	
				Diogenidae	<i>Clibanarius</i> sp.	
		Mollusca	Gastropoda		Acteonidae	<i>Acteon tornatilis</i> (Linnaeus, 1758)
					Architectonicidae	<i>Psilaxis oxytropis</i> (A. Adams, 1855)
	Buccinidae			<i>Engina mendicaria</i> (Linnaeus, 1758)		
	Bullidae			<i>Bulla ampulla</i> (Linnaeus, 1758)		
	Bursidae			<i>Bursa granularis</i> (Roding, 1798)		
	Cerithiidae				<i>Cerithium caeruleum</i> (Sowerby, 1834)	
					<i>Cerithium columna</i> (Sowerby, 1834)	
					<i>Cerithium rostratum</i> (Sowerby, 1855)	

Table (1) Continued

Phylum	Class	Order	Family	Species
				<i>Clypeomorus bifasciata</i> (Sowerby, 1855)
				<i>Clypeomorus concisus</i> (Hombron & Jacquinot, 1852)
				<i>Colina pinguis</i> (A.Adams, 1855)
			Columbellidae	<i>Euplica festiva</i> (Deshayes in labored, 1834)
				<i>Pyrene testudinaria</i> (Link, 1807)
			Conidae	<i>Conus arenatus aequipunctatus</i> (Dantzenberg, 1937)
				<i>Conus miliaris</i> (Hwass in Bruguiere, 1792)
				<i>Conus namocanus</i> (Hwass in Bruguiere, 1792)
				<i>Conus nigropunctatus</i> (Sowerby II, 1857)
				<i>Conus taeniatus</i> (Hwass in Bruguiere, 1792)
			Cypraeidae	<i>Cypraea microdon</i> (Gray, 1828)
				<i>Erosaria annulus</i> (Linnaeus, 1758)
				<i>Erosaria nebrates nebrates</i> (Melvill, 1888)
				<i>Mauritia grayana</i> (F.A. Schilder, 1930)
				<i>Purpuradusta gracilis notata</i> (Gill, 1858)
			Fascioliariidae	<i>Fusinus verrucosus</i> (Gmelin, 1791)
			Fissurellidae	<i>Diodora funicutata</i> (J.E. Gray, 1821)
				<i>Diodora ruppellii</i> (Sowerby, 1834)
			Haminoeidae	<i>Atys cylindricus</i> (Helbling, 1779)
			Littorinidae	<i>Echinolittorina marisrubri</i> (Reid, 2007)

Table (1) Continued

Phylum	Class	Order	Family	Species
				<i>Echinolittorina millegrana</i> (Phillipi, 1848)
				<i>Littorina scabra</i> (Linnaeus, 1758)
			Melongenidae	<i>Volema paradisiaca nodosa</i> (Lamarck, 1822)
				<i>Morulaanaxeres</i> (Kiener, 1835)
				<i>Morula granulate</i> (Duclos, 1832)
			Muricidae	<i>Murex forskoehlII</i> (Röding, 1798)
				<i>Muricodruga funiculus</i> (Wood, 1828)
				<i>Nassa situla</i> (Reeve, 1846)
				<i>Thais savignyi</i> (Deshayes in Deshayes & Milne Edwards, 1844)
			Nassariidae	<i>Nassarius concinnus</i> (Powys, 1835)
				<i>Nassarius fenistratus</i> (Marrat, 1877)
				<i>Nassarius obvelatus</i> (Deshayes in Laborde, 1834)
			Naticidae	<i>Mammilla melanostoma</i> (Gmelin, 1791)
				<i>Notocochlis gualtieriana</i> (Récluz, 1843)
				<i>Polinices mammilla</i> (Linnaeus, 1758)
			Neritidae	<i>Nerita orbignyana</i> (Récluz, 1842)
				<i>Nerita quadricolor</i> (Gmelin, 1791)
				<i>Nerita sanguinolenta</i> (Menke, 1829)
			Olividae	<i>Ancilla eburnea</i> (Deshayes, 1830)
			Planaxidae	<i>Planaxis sulcatus</i> (Born, 1778)
			Potamididae	<i>Potamides conicus</i> (Blainville, 1826)
			Pyramidellidae	<i>Longchaeus teres</i> (A. Adams, 1853)

Table (1) Continued

Phylum	Class	Order	Family	Species
				<i>Otopleura mitralis</i> (A. Adams, 1855)
			Ranellidae	<i>Cymatium trilineatum</i> (Reeve, 1844)
			Ringiculidae	<i>Ringicula acuta</i> (Philippi, 1849)
			Rissoidae	<i>Rissoina dorbignyi</i> (A. Adams, 1851)
			Siphonariidae	<i>Siphonaria crenata</i> (Blainville, 1827)
			Strombidae	<i>Canarium erythrinum</i> (Dillwyn, 1817)
				<i>Canarium mutabilis</i> (Swainson, 1821)
				<i>Conomurex fasciatus</i> (Born, 1778)
				<i>Gibberulus gibberulus albus</i> (Morch, 1850)
				<i>Tricornis tricornis</i> (Hight foot, 1786)
			Thaididae	<i>Cronia martensi</i> (Dall, 1923)
			Tonnidae	<i>Malea pomum</i> (Linnaeus, 1758)
				<i>Tonna pernix</i> (Linnaeus, 1758)
			Trochidae	<i>Tectus dentatus</i> (Forsskal in Niebuhur, 1775)
				<i>Trochus erithreus</i> (Brocchi, 1821)
				<i>Trochus submorum</i> (Abrard, 1942)
			Turbinellidae	<i>Vasum turbinellus</i> (Linnaeus, 1758)
			Turbinidae	<i>Turbo radiatus</i> (Gmelin, 1791)
			Turridae	<i>Lophiotoma cingulifera erythraea</i> (Weinkauff, 1875)
	Bivalvia		Arcidae	<i>Anadara antiquata</i> (Linnaeus, 1758)
				<i>Arca navicularis</i> (Bruguiere, 1789)
				<i>Barbatia trapezina</i> (Lamarck, 1819)
			Cardiidae	<i>Fragum nivale</i> (Reeve, 1845)

Table (1) Continued

Phylum	Class	Order	Family	Species
			Carditidae	<i>Cardita variegata</i> (Bruguiere, 1792)
			Chamidae	<i>Chama limbula</i> (Lamarck, 1819)
			Glycymerididae	<i>Glycymeris arabica</i> (H. Adams, 1871)
			Isognomonidae	<i>Isognomon nucleus</i> (Lamarck, 1819)
			Lucinidae	<i>Cardiolucina semperiana</i> (Issel, 1869)
				<i>Chavanja erythraea</i> (Issel, 1869)
				<i>Codakia tigerina</i> (Linnaeus, 1758)
				<i>Ctena divergens</i> (Philippi, 1850)
				<i>Divalinga arabica</i> (Dekker & Goud, 1994)
				<i>Divaricella macandreae</i> (H. Adams, 1871)
				<i>Lamellolucina dentifera</i> (Jonas, 1846)
				Mesodesmatidae
			Mytilidae	<i>Brachidontes pharaonis</i> (P. Fischer, 1870)
				<i>Brachidontes</i> sp. (Krauss, 1848)
				<i>Modiolus auriculatus</i> (Krauss, 1848)
			Ostreidae	<i>Saccostrea cucullata</i> (Born, 1778)
			Pinnidae	<i>Pinna muricata</i> (Linnaeus, 1758)
			Psammobidae	<i>Asaphis violascens</i> (Forsskal, 1775)
			Tellinidae	<i>Loxoglypta</i> sp.
				<i>Moerella lactea</i> (H. Adams, 1871)
				<i>Pistris capsoides</i> (Lamarck, 1818)
				<i>Quidnipagus palatam</i> (Iredale, 1929)
				<i>Scutarcopagia delicatula</i> (Selli, 1974)
				<i>Tellinella crucigera</i> (Lamarck, 1818)
				<i>Tellinella staurella</i> (Lamarck, 1818)
			Tridacnidae	<i>Tridacna maxima</i> (Röding, 1798)

Table (1) Continued

Phylum	Class	Order	Family	Species
			Ungulinidae	<i>Diplodonta</i> sp.
				<i>Diplodonta subrotunda</i> (Issel, 1869)
			Veneridae	<i>Callista florida</i> (Lamarck, 1818)
				<i>Circe rugifera</i> (Lamarck, 1818)
				<i>Circenita callipyga</i> (Born, 1778)
				<i>Dosinia hepatica</i> (Lamarck, 1818)
				<i>Gafrarium pectinatum</i> (Linnaeus, 1758)
				<i>Tapes deshayesii</i> (Hanley, 1844)
	Polyplacophora	Chitonida	Chitonidae	<i>Acanthopleura haddoni</i> (Winckworth, 1927)
Echinodermata	Stelleroidea	Ophiurida	Ophiocomidae	<i>Ophiocoma erinaceus</i> (Muller & Troschel, 1842)
				<i>Ophiocoma scolopendrina</i> (Lamarck, 1816)

Table (2): Status of Macro-invertebrate Fauna Recorded from the Mangroves at Ras Mohamed and Nabq Protectorates during the Period of Study:

S.No.	Species	Ras Mohamed	El-Gharqana	Arwashia	El-Manqata	Abu Zubad
1	<i>Cassiopea sp.</i>		+++		+++	
2	<i>Calappa hepatica</i>	++				+
3	<i>Dotilla sulcata</i>	+++	+++	+++	+++	
4	<i>Grapsus granulatus</i>	+++	+++	+++	+++	+++
5	<i>Macrophthalmus depressus</i>				+++	
6	<i>Macrophthalmus telescopicus</i>				++	
7	<i>Ocypode saratan</i>		+++			
8	<i>Uca inversa</i>	+++	+++	+++	+++	+++
9	<i>Uca tetragonon</i>	+++	+++	+++	+++	+++
10	<i>Pseudograpsus elongatus</i>		+			
11	<i>Coenobita scaevola</i>	+++		+++		
12	<i>Clibanarius sp.</i>	+++	++	+++	+	+++
13	<i>Acteon tornatilis</i>		+			
14	<i>Psilaxis oxytropis</i>			+		
15	<i>Engina mendicaria</i>			+		+
16	<i>Bulla ampulla</i>		+	+		
17	<i>Bursa granularis</i>		+			+
18	<i>Cerithium caeruleum</i>	++	++	+++	+++	+++
19	<i>Cerithium columna</i>		+			
20	<i>Cerithium rostratum</i>			+		
21	<i>Clypeomorus bifasciata</i>	++	+++	+++	+++	+++
22	<i>Clypeomorus concisus</i>				+	
23	<i>Colina pinguis</i>			+		
24	<i>Euplica festiva</i>					+
25	<i>Pyrene testudinaria</i>		+			
26	<i>Conus arenatus aequipunctatus</i>		+			
27	<i>Conus miliaris</i>	+	+		+	+
28	<i>Conus namocanus</i>	+	++			+
29	<i>Conus nigropunctatus</i>	+	+			

Table (2) Continued

S.No.	Species	Ras Mohamed	El-Gharqana	Arwashia	El-Manqata	Abu Zubad
30	<i>Conus taeniatus</i>	+	++	+	+++	++
31	<i>Cypraea microdon</i>			+		
32	<i>Erosaria annulus</i>		++		+	
33	<i>Erosaria nebrites nebrites</i>		+			+
34	<i>Mauritia grayana</i>					+
35	<i>Purpuradusta gracilis notata</i>		+			
36	<i>Fusinus verrucosus</i>	+	++	+	++	
37	<i>Diodora funicutata</i>		+			+
38	<i>Diodora ruppellii</i>		+		+	
39	<i>Atys cylindricus</i>		+	+		
40	<i>Echinolittorina marisrubri</i>		+	+	+	++
41	<i>Echinolittorina millegrana</i>			+		
42	<i>Littorina scabra</i>	+++	+++	+++	+++	+++
43	<i>Volema paradisiaca nodosa</i>		+	+		
44	<i>Morula anaxeres</i>					+
45	<i>Morula granulata</i>	+			+	+
46	<i>Murex forskoehlii</i>					+
47	<i>Muricodrupa funiculus</i>					+
48	<i>Nassa situla</i>				+	+
49	<i>Thais savignyi</i>		+		++	++
50	<i>Nassarius concinnus</i>		+	+		+
51	<i>Nassarius fenistratus</i>	++	++	+	+	+++
52	<i>Nassarius obvelatus</i>	+	+		+	++
53	<i>Mammilla melanostoma</i>	+	++		+	++
54	<i>Notocochlis gualtieriana</i>	+++	+++	+++	+++	+++
55	<i>Polinices mammilla</i>			++		
56	<i>Nerita orbignyana</i>	+++	+++	+++	+++	+++
57	<i>Nerita quadricolor</i>	++	++			

Table (2) Continued

S.No.	Species	Ras Mohamed	El-Gharqana	Arwashia	El-Manqata	Abu Zubad
58	<i>Nerita sanguinolenta</i>	+++	+++	+++	+++	+++
59	<i>Ancilla eburnea</i>		+			+
60	<i>Planaxis sulcatus</i>	+++	+++	+++	+++	+++
61	<i>Potamides conicus</i>	++	+++	+++	+++	+++
62	<i>Longchaeus teres</i>	+++	+++		+++	+
63	<i>Otopleura mitralis</i>	+++	+++	+	+++	++
64	<i>Cymatium trilineatum</i>		+	+		+
65	<i>Ringicula acuta</i>			+		
66	<i>Rissoina dorbignyi</i>			+	+	
67	<i>Siphonaria crenata</i>	+++	+		+++	
68	<i>Canarium erythrinum</i>		++			+
69	<i>Canarium mutabilis</i>	+++	+++	++	+++	+++
70	<i>Conomurex fasciatus</i>	+	+++		+	+
71	<i>Gibberulus gibberulus albus</i>	+++	+++	+++	+++	+++
72	<i>Tricornis tricornis</i>	+	++	+	+	
73	<i>Cronia martensi</i>				+	
74	<i>Malea pomum</i>	+	++	+		
75	<i>Tonna perdix</i>				+	+
76	<i>Tectus dentatus</i>		+			+
77	<i>Trochus erithreus</i>		+	+		+
78	<i>Trochus submorum</i>		+	+		
79	<i>Vasum turbinellus</i>		+			+
80	<i>Turbo radiatus</i>	+++	+++			+
81	<i>Lophiotoma cingulifera erythraea</i>		+			
82	<i>Anadara antiquata</i>		+			+
83	<i>Arca navicularis</i>		+			
84	<i>Barbatia trapezina</i>	+	++		+	+
85	<i>Fragum nivale</i>	++	+	+		

Table (2) Continued

S.No.	Species	Ras Mohamed	El-Gharqana	Arwashia	El-Manqata	Abu Zubad
86	<i>Cardita variegata</i>	+	+++			
87	<i>Chama limbula</i>	+	+	+	+	
88	<i>Glycymeris arabica</i>			+	+	
89	<i>Isognomon nucleus</i>	+	+			
90	<i>Cardiolucina semperiana</i>		+			+
91	<i>Chavania erythraea</i>		++			
92	<i>Codakia tigrina</i>	+	+			
93	<i>Ctena divergens</i>	+++	+++	+++	+++	+
94	<i>Divalinga arabica</i>	+++	+++			+
95	<i>Divaricella macandreae</i>		+			
96	<i>Lamellolucina dentifera</i>	++	+			++
97	<i>Atactodea striata</i>	+++	+++			+++
98	<i>Brachidontes pharaonis</i>	+++	+++		+++	+
99	<i>Brachidontes sp.</i>		++			
100	<i>Modiolus auriculatus</i>	+++	+++	+++	+++	+++
101	<i>Saccostrea cucullata</i>		+++	+	+	+
102	<i>Pinna muricata</i>		+		+	+
103	<i>Asaphis violascens</i>		++			+++
104	<i>Loxoglypta sp.</i>	+				
105	<i>Moerella lactea</i>	+	+			
106	<i>Pistris capsoides</i>	++	+			+++
107	<i>Scutarcopagia delicatula</i>		+			
108	<i>Tellinella crucigera</i>	+				+
109	<i>Tellinella staurella</i>	++			++	
110	<i>Quidnipagus palatam</i>	+++	+++		+++	+++
111	<i>Tridacna maxima</i>		+		+++	+++
112	<i>Diplodonta sp.</i>				+	++
113	<i>Diplodonta subrotunda</i>	+++	+++	++	+++	++
114	<i>Callista florida</i>	+++	+	+++	+	+++
115	<i>Circe rugifera</i>		+			
116	<i>Circenita callipyga</i>	+++	+++	+++	+	+++
117	<i>Dosinia hepatica</i>				++	
118	<i>Gafrarium pectinatum</i>		+		++	+
119	<i>Tapes deshayesii</i>			+		
120	<i>Acanthopleura haddoni</i>		+++		+	
121	<i>Ophiocoma erinaceus</i>		+++			
122	<i>Ophiocoma scolopendrina</i>		+++			

- 1) Rare species, 1-3 individuals / m², given (+)
- 2) Common species, 4-10 individuals / m², given (++)
- 3) Abundant species, more than 10 individuals / m², given (+++)

Table (3): The Number of Families (Fa), Genera (Ge) and Species (Sp) of Macro-invertebrate (Cnidaria, Crustacea, Mollusca and Echinodermata) Recorded from Ras Mohamed and Nabq Protectorates during the Present Study:

Station	Taxa	Cnidaria	Crustacea		Mollusca			Echinodermata	Total	
		Scyphozoa	Brachyura	Anomura	Gastropoda	Bivalvia	Polyplacophora	Ophiurida	No.	%
Ras Mohamed	Fa	0	4	2	15	11	0	0	32	54.23
	Ge	0	4	2	21	19	0	0	46	47.42
	Sp	0	5	2	27	21	0	0	55	45.1
El-Gharqana	Fa	1	4	1	28	15	1	1	51	86.44
	Ge	1	5	1	37	29	1	1	75	77.31
	Sp	1	6	1	50	31	1	2	92	75.4
Arwashia	Fa	0	3	2	22	8	0	0	35	59.32
	Ge	0	3	2	28	10	0	0	43	44.32
	Sp	0	4	2	33	10	0	0	49	40.16
El-Manqata	Fa	1	3	1	18	11	1	0	35	59.32
	Ge	1	4	1	27	16	1	0	50	51.54
	Sp	1	6	1	31	17	1	0	57	46.34
Abu Zubad	Fa	0	3	1	22	11	0	0	37	62.71
	Ge	0	3	1	34	20	0	0	58	59.79
	Sp	0	4	1	41	21	0	0	67	54.92

Table (4): The Species Similarity Index between the Five Mangrove Sites during the Present Study:

Stations	Ras Mohamed	El- Gharqana	Arwashia	El-Manqata	Abu Zubad
Ras Mohamed					
El- Gharqana	66.67				
Arwashia	55.77	52.48			
El-Manqata	64.29	59.06	54.72		
Abu Zubad	63.93	69.18	48.28	62.90	

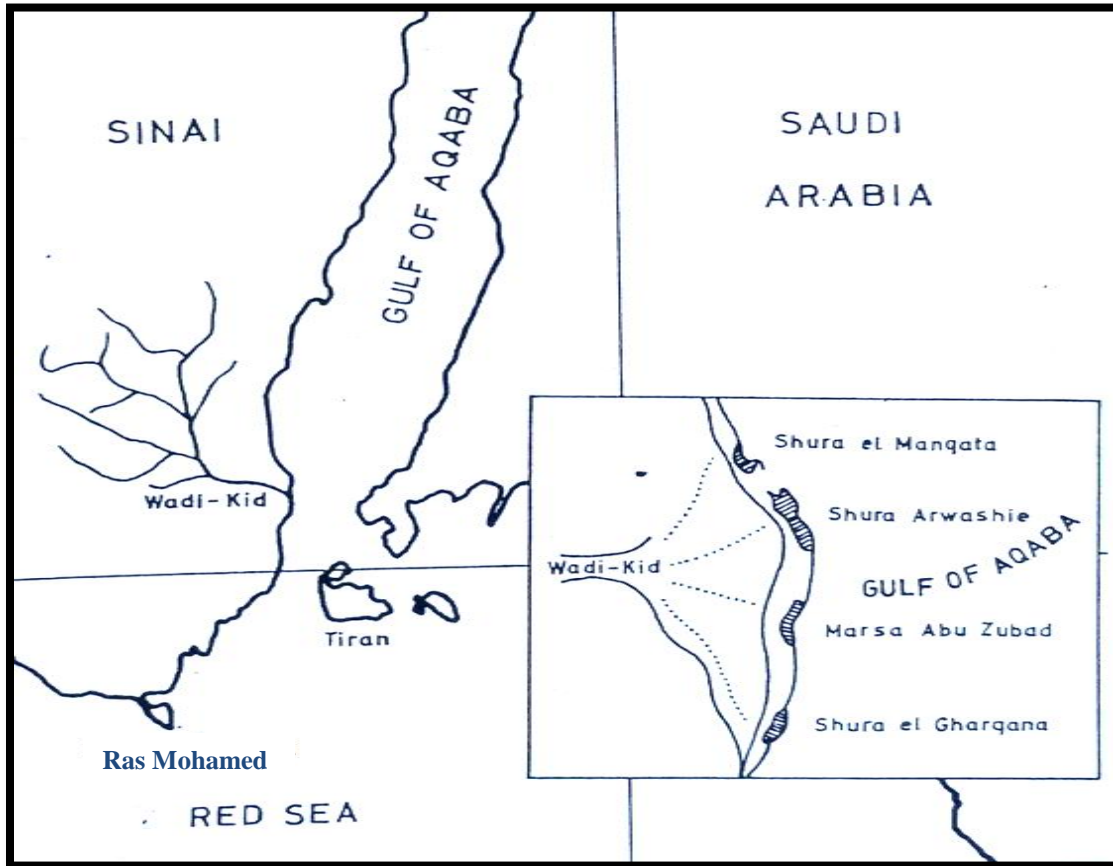


Fig. (1): Map Showing the Mangrove Locations at Nabq (Wadi – Kid) and Ras Mohamed (After Ulken, 1984).

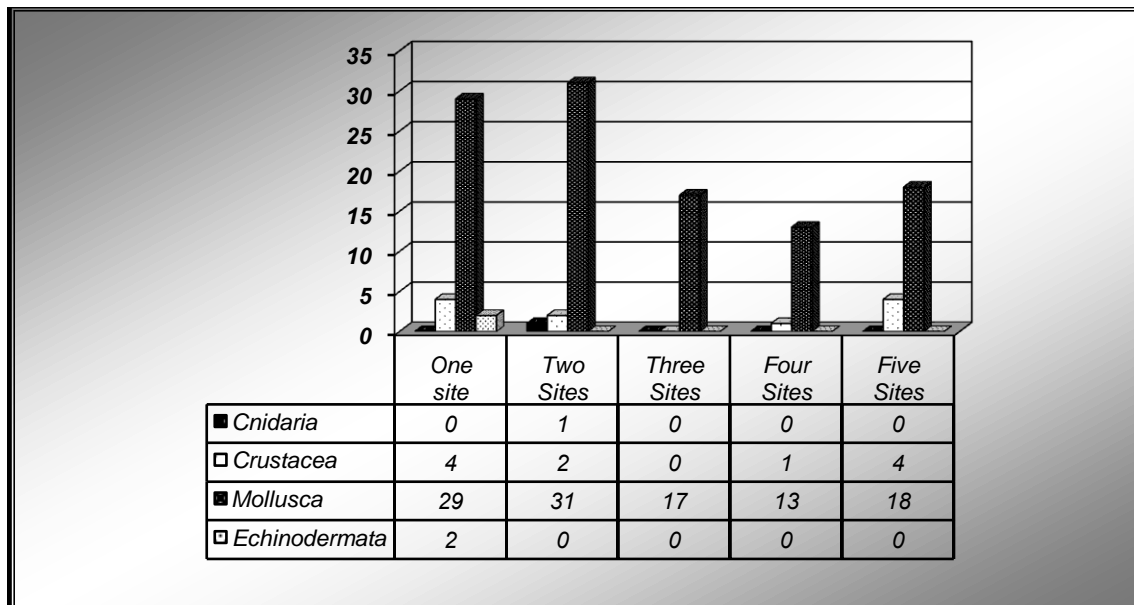


Fig. (2): Showing the Distribution of Macro-invertebrate Species in Five Sites of Mangrove at Nabq and Ras Mohamed Protectorates.

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