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CHECK LIST OF PLANKTON OF THE NORTHERN RED SEA

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ABSTRACT: Qualitative estimation of phytoplankton and zooplankton of the northern Red Sea and Gulf of Aqaba were carried out from four sites: Sharm El-Sheikh, Taba, Hurghada and Safaga. A total of 106 species and varieties of phytoplankton were identified including 41 diatoms, 53 dinoflagellates, 10 cyanophytes and 2 chlorophytes. The highest number of species was recorded at Sharm El-Sheikh (46 spp), followed by Safaga (40 spp), Taba (30 spp), and Hurghada (23 spp). About 95 of the recorded species were previously mentioned by different authors in the Red Sea and Gulf of Suez. Eleven species are considered new to the Red Sea.

About 115 species of zooplankton were recorded from the different sites. They were dominated by four main phyla namely: Arthropoda, Protozoa, Mollusca, and Urochordata. Sharm El-Sheikh contributed the highest number of species (91) followed by Safaga (47) and Taba (34). Hurghada contributed the least (26). Copepoda dominated the other groups at the four sites.

The appearances of *Spirulina platensis, Pediastrum simplex,* and *Oscillatoria* spp. of phytoplankton in addition to the rotifer species and the protozoan *Difflugia oblongata* of zooplankton impart a characteristic feature of inland freshwater discharge due to wastewater dumping at sea in these regions resulting from the expansion of cities and hotels along the coast.

KEY WORDS: Plankton, Northern Red Sea, Check list.

INTRODUCTION

The plankton of the Red Sea had been previously studied by different authors. MacDonald (1933) studied the distribution of phytoplankton and zooplankton in the Suez Canal. Ghazzawi (1936) surveyed the phytoplankton in the same area. Halim (1969) reported a preliminary review on both phytoplankton and zooplankton in the Red Sea and Gulf of Aqaba. Also, Levanon-Spanier *et al.* (1979) studied the primary production in a desert-enclosed Sea in the Gulf of Aqaba. More recently Dowidar *et al.* (1978), Dowidar (1983), Khalil *et al.* (1984) and Khalil and Ibrahim (1988) recorded the phytoplankton in the coastal water of the Red Sea near Jeddah. Dowidar (1976), Ibrahim (1988), El-Sherif and Ibrahim (1993) and Nassar (1994) studied the distribution of phytoplankton in the Red Sea and Suez Canal.

For zooplankton distribution, several studies were carried out dealing with different groups, which were reviewed by Halim (1969). Further, Bergren and Boersma (1969) estimated the planktonic Foraminifera from the Red Sea. Delalo (1966) estimated the zooplankton biomass in the Red Sea and Gulf of Aden and Ponomareva (1966) made a quantitative estimation of zooplankton in the Red Sea. Gordeyeva (1970) studied the distribution of zooplankton in the northern and central parts of the Red Sea. Kimor (1972) reported the fauna of the Suez Canal as a link and barrier in the migration of plankton organisms between the Red and Mediterranean Seas. Alvarino (1974) made comparative studies on the distribution of siphonophores in the region adjacent to both the Suez and Panama Canals. Dowidar (1974) identified 52 species of tintinnids from the Suez Bay. Al-Aidaroos (1984) studied the zooplankton communities with special reference to Copepoda

north of Jeddah. Beckmann (1988) studied the seasonal patterns of mesopelagic calanoid copepods in the central Red Sea. El-Serehy (1989) made further studies on the planktonic Protozoa (Tintinnids and Foraminifera) in Lake Temsah. Abou Zeid (1990) estimated zooplankton in the same lake with special references to Copepoda. Abd El-Rahman (1993) made ecological studies on the distribution of zooplankton communities in the northern part of the Suez Gulf (Suez Bay). In the Gulf of Aqaba, Almedia Prado-Por (1983) presented the first indications for a differential migration pattern in Calanoida. Schmidt (1973) and Almeida Prado-Por (1988) studied the vertical distribution and diurnal migration of some zooplankton components including calanoid copepods in the Bay of Eilat. Weikert (1982) described the vertical distribution of zooplankton as affected by the prevailing ecological conditions along the central part of the Red Sea (area of Atlantis), while Echelman and Fishelson (1988) studied the seasonal surface zooplankton dynamics near Eilat.

The aim of the present research is to study the species composition of both phytoplankton and zooplankton communities with a check list of recorded species in the investigation area.

MATERIAL AND METHODS

The investigated area:

Four stations were selected in the investigated area, namely: Taba, Sharm El-Sheikh, Hurghada, and Safaga (Fig. 1). The Taba Station is situated north of Aqaba Gulf at 35°E, 29°35'N. Sharm El-Sheikh Station lies between the southern part of the Gulf of Aqaba and that of Suez at 34°E, 27°45'N. Hurghada and Safaga Stations were taken along the northwestern Red Sea coast at 27°15', 26°45' W and 33°40', 33°55'N, respectively.

In all sites, samples were collected from the surface layers upper 50cm depth of the coastal zone at each station during autumn (November 1993), spring (May 1994), and summer (June, July 1994).

Phytoplankton collections:

Estimation of phytoplankton was carried out by using the sedimentation technique. One litre of seawater was collected from each site with a Ruttner water sampler and fixed with 4% neutral formalin solution. The water samples were transferred to graduated cylinders of one litre capacity and the samples left for 48 hours to sediment after adding a few drops of Lugol's solution. The supernatant water was then siphoned until the sample was concentrated to 100 ml. Subsamples were transferred into a counting cell and each plankter was identified separately under a binocular research microscope. Other qualitative studies of phytoplankton were caried out on samples hauled horizontally by fine net (pore size 50μ) with 30cm in diameter.

For identification of the different phytoplankton species the following references were referred to: Peragallo and Peragallo (1897-1908), Jorgensen (1920, 1923), Lebour (1925, 1930), Hustedt (1930), Huber-Pestaluzzi (1938), Cupp (1943), Smith (1950), Tregouboff and Rose (1957) and Kunnah (1967).

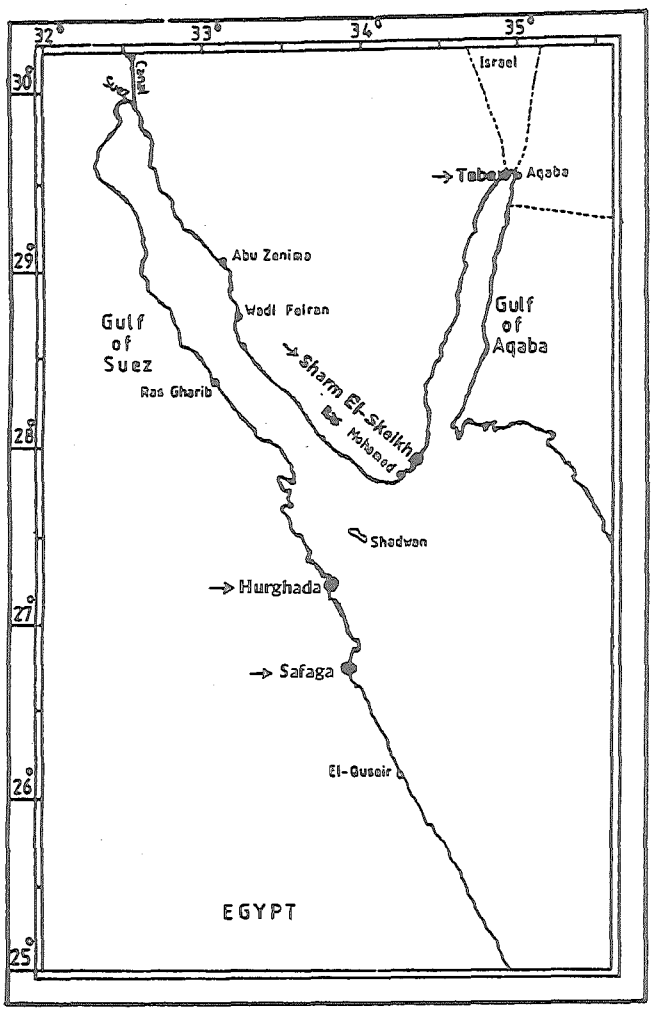

Fig. 1: Position of Stations.

Zooplankton collections:

Surface zooplankton samples were collected from each site by using a standard zooplankton net of 50μ mesh size and 30 cm in diameter. The net was towed horizontally for five minutes at a distance of 250m away from the shore. The collected samples were preserved directly with 4% formalin solution. The volume of each sample was concentrated to 200ml and subsamples were transferred into a petri dish. Each plankter was identified separately by using a research binocular microscope.

For identification of the different species of zooplankton the following references were consulted: Giesbrecht (1892), Sars (1896-1903), Jorgensen (1924), Rose (1933), Sewell (1948), Thompson (1948), Tregouboff and Rose (1957), Edmondson (1959), Newell (1963, 1979). Gonzalez and Bowman (1965), Williamson (1967), and Marshall (1969).

RESULTS

Phytoplankton community:

The phytoplankton community in the investigated area was represented by 106 species included within four main classes namely: Bacillariophyceae (41 species), Dinophyceae (53 species), Chlorophyceae (2 species), and Cyanophyceae (10 species).

Gulf of Aqaba

Sharm El-Sheikh Station - I: The phytoplankton of this site harboured the highest number of species (46 species). The site was characterized by the dominance of Cyanophyceae, which was represented by six species (Tables 1, 2) within the genera *Oscillatoria, Spirulina,* and *Phormidium*. *Spirulina platensis* predominated the other cyanophytes in this region. It was also previously recorded in the Suez Bay by El-Sherif and Ibrahim (1993).

Table 1. Distribution of Phytoplankton and Zooplankton species and genera recorded from the different sites.

Station	Sharm El-Skeikh (I)	Taba (II)	Hurgada (III)	Safaga (IV)
	Phytoplankton Species and (genera)			
Diatoms	13(10)	18(14)	15(11)	9(9)
Dinoflagellates	25(8)	10(7)	5(5)	27(11)
Chlorophytes	2(2)	---	1(1)	1(1)
Cyanophytes	6(3)	2(2)	2(2)	3(2)
Total Number of Species (genera)	46(23)	30(23)	23(19)	40(23)
	Zooplankton Species and (genera)			
Protozoa	23(13)	11(10)	9(7)	10(7)
Cnidaria	3(3)	1(1)	---	---
Annelida (larvae)	1(1)	1(1)	1(1)	2(2)
Nematoda	---	---	---	---
Rotifera	1(1)	1(1)	---	---
Arthropoda	48(26)	17(11)	14(10)	26(18)
Mollusca (larvae)	1(1)	1(1)	1(1)	1(1)
Chaetognatha	5(1)	1(1)	---	---
Echinodermata (larvae)	---	---	---	---
Urochordata	9(4)	1(1)	1(1)	8(4)
Chorodata (Fish egg)	---	---	---	---
Total	91(50)	34(27)	26(20)	47(32)

Table 2. Species list of phytoplankton recorded from Sharm El-Sheikh (I), Taba (II), Hurgada (III), and Safaga (IV).

Phytoplankton	SharmEl-Sheikh (I)	Taba (II)	Hurgada (III)	Safaga (IV)
I Bacillariophyceae:				
Amphiprora alata Kutz.			+	
Amphiprora paludosa Smith.	+	+		
Amphora coffeaformis Agardh		+		+
Amphora ovalis Kutz.	+			
Bellarochea malleus (Brightw). V. Heurck				++
Chaetoceros coarctatus Lauder	+			
Chaetoceros curvisetus Cleve		++		
Climacosphenia moniligera Ehr.			+	
Cocconeis placentula Ehr.		+		
Coscinodiscus centrales Ehr.	+			+
Cyclotella meneghiniana Kutz.	+		+	
Cyclotella striata (Kutz.) Grun.	+	+++		+
Diploneis didyma Ehr.		+		
Guinardia flaccida (Castr.) H. Peragallo	+			++
Hemiaulus hauckii Grun.		++		
Hemiaulus membranaceus Cleve				+
Licmophora gracilis (Ehr.) Grun.		++		+
Lithodesmium undulatum Ehr.				++
Mastogloia braunii Grun.		+	+	
Mastogloia smithii Thw.		+		
Melosira crucipunctata Bachm.	+			
Navicula cryptocephala Kutz.			+	
Navicula cuspidata Cleve		+		
Nitzschia punctata Grun.			+	
Nitzschia closterium (Ehr.) Smith		+		
Nitzschia delicatissima Cleve	+	+	+	
Nitzschia longissima (Bréb) Ralfs	++	+		
Nitzschia microcephala Grun.			+	
Nitzschia palea (Kutz.) W. Smith		+		
Nitzschia sigma W. Smith	+		+	
Rhizosolenia alata Brightwell			+	+
Rhizosolenia castracanei H. Peragallo	+			
Rhizosolenia delicatula Cleve		++		
Rhizosolenia stolterfothii H. Peragallo			+	
* *Rhoicosphenia curvata* Grun.		+		
Rhopalodia gibba (Ehr.) O. Muller.			+	
Rhopalodia gibberula (Ehr.) O. Muller.			+	
Striatella unipunctata (Lyngb.) Agardh.			+	

Synedra ulna (Nitzsch.) Ehr.		++		
Synedra longissima W. Smith			+	
Tropidoneis lepidopetra (Gerg.) Cleve	+			
II Dinophyceae:				
Amphisolenia bidentata Schroder.				+
Ceratium fusus (Ehr.) Dujardin	+			
Ceratium gibberum Gourret				+
Ceratium hexacanthum Gourret				+
Ceratium platycome Dad.				+
Ceratium symmetricum Pavillarel				+
Ceratium trichoceros (Ehr.) Kofoid.				+
Ceratium tripos (O.F. Muller) Nitz.	+		+	
Ceratium candelabrum (Ehr.) Stein	+			
* *Ceratium declinatum* var. *brachiatum* Jorg.	+			
Ceratium extensum (Gourret) Cleve.				+
Ceratium furca (Ehr.) Clap. and Lachm.	+			+
Ceratium furca var *berghii* (Iemm.) Jorg.				+
Ceratium karsteni Pavill.				+
Ceratium macroceros (Ehr.) Cleve				+
Ceratium macroceros var. *gallicum* (Kof.) Schiller.	+			
Ceratium massiliense (Gourret) Jorg.	+			
Ceratium massiliense var. *protuberans* (Karst.) Jorg.	+			
Ceratium pulchellum Schroder	+			+
Ceratium pullchellum var *tripodiodes* Schroder				+
Ceratium teres Kofoid.				+
Ceratium sp.	+			
Ceratocorys gourreti Paulsen		+		+
Dinophysis caudata Saville-Kent				+
Dinophysis tripos Gourret			+	+
Dinophysis dorphorum (Stein) Abe.	+			
* *Gessnerium mochimaensis* Hallm				+
Goniodoma polyedricum Pouch.	+			+
Gonyaulax polygramma Stein.				+
* *Oxytoxum frenguellii* Rampi		+		
Oxytoxum elegans Pavillard		+		
Pavillardinium biconicum Murr. and Whitt.		+		
Podolampas bipes Stein	+			
Podolampas palmipes Stein	+			
Podolampas spinifera Okamura				+
Prorocentrum aporum (Schiller) Dodge		+		
Prorocentrum marina (Cienk) Dodge	+			

Prorocentrum micans Ehr.	+	+	+	
Prorocentrum sp.		+		
Protoceratium reticulatum (Clap. and Lachm.) Butschli		+		
Protoperidinium brochii (Kof. and Swezy) Balech	+			+
Protoperidinium cerasus (paulsen) Balech	+		+	
Protoperidinium claudicans (Paulsen) Balech.	+			+
Protoperidinium conicum (Gran) Balech		+		+
Protoperidinium depressum (Bailey) Balech	+			
Protoperidinium diabolus (Cleve) Balech	+			
Protoperidinium oblongum (Aurivillius) Park and Dodge				+
Protoperidinium steinii (Jorgensen). Balech.	+			
Pyrocystis hamulus var. *semicircularis* Schroder	+			
Pyrocystis pseudonoctiluca W. Thomson	+			+
Pyrophacus horologicum Stein.			+	
Scrippsiella trochoidea (Stein) Loebl.	+	+		
Triposlenia bicornis Kofoid.				+
III Cyanophyceae:				
Chroococcus turgidus (Kg.) Naeg.			+	
* *Oscillatora chalybea* Mertens				+
* *Oscillatora curviceps* Agardh			+	
Oscillatoria tenuis Ag.	+			
* *Oscillatoria agardhii* Gom.	+			
Oscillatoria erythraeum (Ehr.) Kutz.	+			
* *Oscillatoria limnetica* Lemm.	+			+
* *Oscillatoria simplicissima* Gom.		+		
Phormidium sp.	+			
Spirulina platensis (Nordst) Geitl.	+++	++		+
IV: Chlorophyceae:				
* *Cladophora* sp.				+
* *Pediastrum simplex* Meyen	++		+++	

+++ = Abundant ++ = Common + = Frequent
* New to the Red Sea

Dinophyceae were represented by 25 species within 8 genera, while Bacillariophyceae comprised 13 species included in 10 genera as shown in Tables 1 and 2. *Nitzschia longissima, Ceratium* spp. and *Protoperidinum* spp. appeared more frequently in this sample.

Chlorophyceae were represented in Sharm El-Sheikh by two newly recorded species namely: *Pediastrum simplex* Meyen and *Cladophora* sp. *Pediastrum simplex* is a planktonic freshwater species, very rare along the Egyptian Mediterranean (Dowidar, 1974a; Gergis, 1983) and in the Eastern Harbour (Sultan, 1975; Mikhail, 1986).

Taba Station - II: Thirty species were recorded at Taba station (Tables 1, 2). They were dominated by diatoms, which were represented by 18 species included in 14 genera as shown in Table 2. Diatoms were dominated by *Chaetoceros curvisetus, Hemiaulus hauckii, Synedra ulna, Rhizosolenia delicatula, Cyclotella striata* and *Licmophora gracilis. Rhoicosphenia curvata* may be considered new to this region.

Dinophyceae were represented by 10 species (Tables 1, 2) within 7 genera from which *Oxytoxium frengullii* is newly recorded to the area.

Cyanophyceae were represented only by: *Oscillatoria simplicissima* and *Spirulina platensis*.

Chlorophyceae were not recorded from the collected sample at Taba.

Northwestern Red Sea

Hurghada Station - III: The samples collected from this site contained 23 phytoplankton species (Table 2). The community was dominated by Chlorophyceae and Bacillariophyceae. Members of the class Dinophyceae and Cyanophyceae appeared rarely.

Although, Chlorophyceae dominated the other classes it was represented only by one species, *Pediastrum simplex* Meyen, which may be considered new to this region.

Fifteen species of diatoms included in 11 genera were recorded at the Hurghada site. They were previously recorded in the Red Sea and Gulf of Suez by Halim (1969), Dowidar (1976), Dowidar *et al.* (1978), Ibrahim (1988), El-Sherif and Ibrahim (1993), and Nassar (1994). Five species of Dinophyceae were recorded (Tables 1, 2).

Cyanophyceae was represented by *Chroococcus turgidus,* which was previously recorded in Suez Bay by Nassar (1994) and *Oscillatoria curviceps,* which is considered as a new recording.

Safaga Station - IV: The phytoplankton community in this area was composed of 40 species including in 23 genera. Diatoms were represented by 9 species of which 3 species were dominated, namely: *Bellarochea malleus, Guinardia flaccida,* and *Lithodesmium undelatum.*

Dinophyceae reached its highest diversity at this station and was represented by 27 species within 11 genera. It was dominated by the genus *Ceratium* (13 species) Table 2. Chlorophyceae appeared rarely and were represented by *Cladophora* sp. Three species of Cyanophyceae were recorded at Safaga, namely: *Oscillatoria chalybea, O. limnetica* (new to the Red Sea), and *Spirulina platensis*.

Zooplankton community:

The zooplankton community recorded in the four sites is considered rich both in density and number of species. About 115 species were recorded. They were dominated by four main phyla, namely: Arthropoda (Copepoda, Cladocera, Amphipoda, Ostracoda,

Decapoda, and Crustacean eggs), Protozoa (Cilliata and Rhizopoda), Mollusca (veligers of lamellibranchs, gastropod and pteropod shells), and Urochordata, which were represented mostly by Appendicularia. Other groups such as Cnidaria, Polychaete larvae, free-living nematodes, rotifers, Chaetognatha, Echinoderm larvae, and fish eggs were rarely observed.

Gulf of Aqaba

Sharm El-Skeikh Station - I: The collected sample at Sharm El-Skeikh comprised 91 species included within 50 genera. They were dominated by copepods, appendicularians, tintinnids molluscs, cirripede larvae of *Lepas* and *Balanus,* cladocerans, and amphipods.

Copepoda was represented by 44 species dominated by *Eucalanus attenuatus, Noecalanus* spp., *Paracalanus parvus, Oithona nana, Macrosetella gracilis,* and *Corycaeus* spp.

Appendicularia comprised eight species (Table 3). They were dominated by *Oikopleura rufescens, O. dioica,* and *Fritillaria borealis. Oikopleura fusiformis, O. parva,* and *O. longicauda* were frequently recorded, while *Appendicularia sicula* and *Fritilaria haplostoma* were rare. Ascidians represented by larvae of *Ciona intestinalis* and tadpole stages.

Protozoa comprised 23 species including 3 species of Foraminifera and 20 tintinnid species (Table 3).

Larval stages of the polychaetes, such as spionid and trochophore larvae, in addition to larvae of *Nereis pelagica,* appeared frequently. One rotifer species that appeared rarely indicated the invasion of brackish water sources to this site.

Taba Station - II: Copepoda also dominated other groups. They were mostly represented by copepod larvae.This may reflect active reproduction during that time of the year (spring). Only 15 species of adult copepods were recorded from that site (Table 3).

Cirripede larvae of *Balanus* and *Lepas* were also observed. On the other hand, Protozoa was represented by 4 species of Foraminifera, while tintinnids were represented by 7 species (Table 3). Brackish rotifer species were rarely observed at this site, which illustrates the presence of inland freshwater discharge. Mollusca was represented by veligers of lamellibranchs, and gastropod and pteropod shells.

Northwestern Red Sea

Hurghada and Safaga Stations III, IV: The zooplankton at the Hurghada Station was dominated by copepods and their larvae. The adult copepods comprised 12 species and dominated by *Oithona nana.* Other crustacean groups such as Cladocera, cirripede larvae of *Lepas* and *Balanus,* decapod larvae and Crustacean eggs were rarely observed. Protozoa was dominated by tintinnids comprising 9 species (Table 3). Mollusca appeared more common and were represented by the pteropod *Limacina inflata,* veligers of lamellibranchs, and gastropod shells.

At Safaga about 47 species were recorded in addition to the meroplanktonic larvae of *Lepas, Balanus,* decapods, polychaetes, molluscs, echinoderms, tadpoles of ascidians, and fish eggs. The identified plankters comprised 10 species of Protozoa, two Cladoceran species, 23 copepods and 8 species of Appendicularia (Table 3).

Table 3. Species list of zooplankton recorded from Sharm El-Sheikh (I), Taba (II), Hurgada (III), and Safaga (IV).

Group	SharmEl-Sheikh (I)	Taba (II)	Hurgada (III)	Safaga (IV)
Protozoa				
Difflugia oblongata Ehr.	+			
Elphidium advenum Cushman		+	++	
Globigerina inflata d'Orbigny	++	++	++	+
Globoratalia truncatuloides d'Orbigny		+	+	
Quinqueloculina quadrata Norvang		++	++	
Tretomphalus bulloides d'Orbigny	+			
Codonellopsis minor Brandt			+++	
Codonellopsis silvae Silva		+		
Codonellopsis parva Kofoid and Camp.		+	++	
Codonellopsis lusitanica Jorg.	+			
Codonellopsis tessellata Brandt	+			
Eutintinnus aperatus Kof. and Camp.	+	+		
Eutintinnus fraknoi Daday	+			+
Favella panaminsis Kof and Camp.	+	+		+
Parafavella elgans Ost.		+		
Rhabdonella spiralis Fol.	+++			
Rhabdonela conica Kof. and Camp.	+			+
Rhabdonella brandti Kof. and Camp.	+			+
Rhabdonella apophysota Celve	+			
Rhabdonela elgans Jorg.	+			+
Salpingella attenuata Jorg.	+			
Salpingella secata Brandt	+			
Ascampbelliolla urceolata Ost.	+			+
Tintinnopsis beroidea Stein	+++	+	+	
Tintinnopsis tubulosa Levanden	+			
Tintinnopsis campanula Ehr.	+		+	
Epiplocylis blanda Jorg.	+			+
Epiplocylis undella Ost. and Schem.	+			+
Tintinnus vitreus Brandt	+	++	+	
Proplectella claparedei Entz				+
Petalotricha major Jorg.	+			
Porifera				
Spicules of sponges				
Cnidaria				
1-Hydroida				
Planula larvae	+	+		

Medusae: *Phialidium* sp.	+	+		
Aglaura hemistoma Peron and Lesueur	+			
2-Siphonophores				
Lensia conoidea Kerfstein and Ehlers	+			
Annelida				
Spionid larvae	++		+	+
Larvae of *Nereis pelagica*	++	+	+	+
Larvae of *Polydora ciliata*				+
Trochophore larvae	++		+	+
Nematoda		+		
Rotifera	+	+		
Arthropoda				
1-Cladocera				
Evadne tergestina Claus	+	+		+
Evadne spinifera Mull.	+		+	
Evadne nordmanni lovén.				+
2-Ostracoda				
Cypridina sp.	++	+	+	+
3-Cirripedia				
Nauplii of barnacles	+	+	++	+
Cypris larvae of barnacles	+	++	++	+
Nauplii of *Lepas*	++	+	++	+
Cypris larvae of *Lepas*	+	+	++	+
4-Copepoda				
Acartia centrura Giesb.			+	++
Acartia negligens Dana	+			+
Acartia longiremis Lill.	+			++
Acartia danae Giesb.	+			+++
Acartia clausi Giesb.			++	
Acartia discaudata Giesb.			++	
Calocalanus contractus Farran	+			
Calocalanus pavo Dana	+	+		
Candacia aethiopica Dana	+			
Candacia bispinosa Claus	+			
Candacia longimana Claus	+			++
Centropages violaceus Claus	+			++
Centropages typicus Kroyer				+++
Centropages kroyeri Giesb.	+			
Clausocalanus furcatus Brady				++
Clausocalanus arcuicornis Dana	+			
Ctenocalanus vanus Giesb.				+++
Neocalanus gracilis Dana	++			
Neocalanus teunicornis Dana	++			

Neocalanus sp.	+			
Clytemnestra scutellata Dana	+			
Copilia mirabilis Dana	+	+		
Corycella carinata Giesb.	+			
Corycaeus flaccus Giesb.	++	+		
Corycaeus lautus Dana	+++			
Corycaeus speciosus Dana	++			
Corycaeus typicus Kroyer	++	+	+	++
Corycaeus anglicus Lubbok	++			+
Eucalanus attenuatus Dana	+++	+		
Eucalanus elongatus Dana	+			
Eucalanus spinosa Giesb.			+	
Paracalanus pygmaeus Claus	+			
Paracalanus parvus Claus	+++	+	++	+++
Paracalanus aculoatus Giesb.		+		
Megacalanus longicornis Sars	+			
Mormonilla phasma Giesb.	+			
Pachos punctatum Claus				+
Phaenna spinifera Claus				+
Lucicutia flavicornis Claus	+			
Temora turbinata Dana	+			
Temora stylifera Dana	++			++
Lubbockia squillimana Claus	+			+
Lubbockia minuta Giesb.	++			
Oncaea minuta Giesb.	++			
Oncaea borealis Sars	++			
Oncaea venusta Claus	++	+	+	+
Oncaea conifera Giesb.	++	++		
Oithona nana Giesb.	+++	++	+++	+++
Oithona plumifera Baird	+	+	++	
Oithona setigera Dana	+	+	+	+
Oithona robusta Giesb.		+		
Euterpina acutifrons Dana	++	++	++	++
Macrosetella gracilis Dana	+++	++		++
Microsetella norvegica Boeck	+		+	+
Microsetella rosea Giesb.	+			+
Nauplii of Copepoda	++	++	+++	+++
Copepodite stages	++	++	++	+++
Crustacean eggs.	++	++	+++	+++
5-Decapoda				
Zoea larvae of crabs	+	+		+
Nauplii larvae of decapods			++	+
6-Amphipoda				
Hyperia spp	+			

Mollusca				
Pteropod *Limacina inflata* Giesb.	+++	+++	+++	++
Gastropod veligers	++	++	++	++
Lamelibranch veligers	++	++	+++	++
Chaetognatha				
Sagitta neglecta Grassi	+			
Sagitta decipiens Fowler	++			
Sagitta hexaptera d'Orloigny	+	+		
Sagitta fredrici R.Z.	++			
Sagitta pacifica Tokioka	+			
Echinodermata (larvae of Echinid)				
Urochordata				
Oikopleura longicuada Vogt	++	+	+	++
Oikopleura fusiformis Fol.	++			
Oikopleura rufescens Fol.	+++			
Oikopleura dioica Fol.	+++			+
Oikopleura intermedia Lohm.				+
Oikopleura parva Lohm.	++			+
Appendicularia sicula Fol.	+			++
Fritillaria pellucida Busch				+
Fritillaria borealis Lohm.	+++			+++
Fritillaria haplostoma Fol.	+			
Folia gracilis Lohm.				+
Larvae of *Ciona intestinalis* Fleming	+			
Tadpole of Acidians	+			+
-Fish eggs	+		++	+
-Fish larvae	+			

+++ = Abundant ++ = Common + = Frequent

DISCUSSION AND CONCLUSIONS

In the present study, 106 species of phytoplankton were recorded including 41 diatoms, 53 dinoflagellates, 10 cyanophytes, while Halim (1969) in his review collected references of 209 phytoplankton species (84 diatoms and 125 dinoflagellates) occurring in different regions of the Red Sea. Most of them were, however, recorded from oceanic regions as the neritic waters of the Red Sea were rarely sampled. About 220 phytoplankton species were recorded in the neritic water of Jeddah by Dowidar *et al.* (1978). Khalil *et al* (1984) recorded 100 species including 73 diatoms and 27 dinoflagellate species in the region of south Jeddah. Khalil and Ibrahim (1988) listed 124 species of phytoplankton (73 diatoms and 51 dinoflagellates) near Jeddah and Ibrahim (1988), reported 111 species (63 diatoms, 42 dinoflagellates, and 6 cyanophytes) in the Foul Bay

of the Red Sea. Also, Dowidar (1976) and El-Sherif, and Ibrahim 1993 studied the phytoplankton in the Suez Canal and recorded 273 species (182 diatoms, 88 dinoflagellates, 1 silicoflagellate, and 2 Ibriidae) and 139 species (94 diatoms, 36 dinoflagellates, 1 silicoflagellate, 3 chlorophytes, and 5 cyanophytes), respectively. Nassar (1994) studied the quantitative and qualitative distributions of phytoplankton in the Suez Gulf of the Red Sea and recorded 76 species including 50 diatoms, 18 Dinophyceae, 5 Cyanophyceae, and 3 green algae.

Judging from all the previous records, about 95 of our recorded species were previously mentioned. About 11 species may be regarded as new records to the region (Table 2). Some of them are littoral species with tropical and/or subtropical affinities and are widely distributed in the neritic waters of the Mediterranean Sea and Indian Ocean (Dowidar, 1974; Soumia, 1967, 1968). A few are freshwater forms.

Spirulina platensis occurred in massive amounts in Sharm El-Skeikh and Taba, *Pediastrum simplex* was abundant in Hurghada and less so in Sharm El-Sheikh. While, *Oscillatoria* species appeared frequently in Sharm El-Sheikh. All of them are freshwater forms from inland origins related to wastewater dumping at sea in these regions due to the expansion of cities and hotels along the coast.

The community composition at Sharm El-Sheikh in November (≅ 23°C) was diversified. At the same time Cyanophyceae, which represented only by few species contributed the most abundant class as it prefers warm water (Carr and Whitton, 1982) and sewage polution (James, 1975). For diatoms, they appeared in high counts during May (≅ 25°C) in Taba, beside their high species composition. Several previous works also illustrated great increases in the number of diatoms during the same period (spring) in natural habitats (Hutchinson, 1967). Further, the green alga *Pediastrum simplex* was the most dominant species at Hurghada in summer (June ≅ 29.5°C) due to the large quantities of fresh inland water discharge from many hotels. This agrees with the observations of Singh (1960) that this species favours high temperature and usually predominates in tropical waters. Also, it is a planktonic freshwater species, very rarely recorded along the Egyptian Mediterranean (Dowidar, 1974, Gergis, 1983) and in the Eastern Harbour (Sultan, 1975; Mikhail, 1986) as mentioned before.

Generally, the effect of temperature variations on phytoplankton is mostly manifested on the periodicity of the different groups of algal communities and algal succession (Behrendt, 1990; Sommer *et al.*, 1986).

For the zooplankton community, most of the recorded species were included in the review of Halim (1969). Most of the 23 tintinnid species recorded in the present work are encountered in the Mediterranean Sea. Few are typically Red Sea dwellers, namely, *Rhabdonella brandt, Codonellopsis silvae, C. parva, Tintinnopsis tubulosa, Petalotricha major,* and *Salpingella secata*. Rhizopoda was represented by 6 species, mostly of Foraminifera. They appeared more frequently at Taba Station and were dominated by *Quinqueloculina quadrata* and *Globigerina inflata*. The brackish rhizopod species *Difflugia oblongata* was rarely recorded at Sharm El-Shiekh. Two rotifer species proved the exsistence of fresh inland water discharge from land based sources of new buildings and hotels, as mentioned previously.

Copepoda represents the most important component of zooplankton in the entire investigated area. About 55 species were recorded. Calanoids out ranked the other

copepod groups (43 spp) compared to cyclopoids (8 spp) and harpacticoids (4 spp) (Table 3). This agrees with the estimations in other regions: Abd El-Rahman (1993) reported 27 species in the Suez Bay of which 12 were calanoids. Also, Hussein (1992) in Qatari waters of the Arabian Gulf mentioned calanoids as the most dominant group. Halim (1969) gave a list of 155 copepod species that were previously recorded in the Red Sea. Almedia Prado-Por (1988) recorded 29 calanoid copepods in the Gulf of Aqaba (Eilat). The majority of them are herbivores.

The majority of the recorded copepods are neritic perennial forms that appeared all year round and were previously recorded in the Mediterranean Sea and Gulf of Suez. Few species such as *Paracalanus aculeatus, Oncaea conifera, Oithona robusta, O. setigera,* and *Microsetella rosea* appeared only at the northern part of the Gulf of Aqaba (Taba) and less so at the southern part (Sharm El-Sheikh).

Cladocera was represented in the present investigation by three species (Table 3). *Evadne tergestina* was previously recorded from the main basin of the Red Sea and occurred abundantly in the summer plankton of the Gulf of Aqaba (Komarowsky, 1958). Three cladocerans including *Evadne tergestina* were previously recorded in Gulf of Suez (Gurney, 1926). More recently, 5 species from which *Evadne tergestna, E. normandi,* and *E. spinifera* were reported in the Suez Bay (Abd El-Rahman, 1993). In Lake Temsah, only three species including *E. tergestina* were recorded (Abou Zeid, 1990). Our recorded cladoceran species were previously mentioned by Dowidar and El-Maghraby (1970) in the Mediterranean Sea. Ostracod *Cypridina* sp. and Amphipod *Hyperia* sp. were rarely reported at Taba and Sharm El-Sheikh, respectively. Due to the shallowness of the investigation area, cirripede larvae of both *Lepas* spp, *Balanus* spp, decapod larvae and lamellibranch veligers, gastropod shells and the pteropod *Lemacina inflata* were frequently recorded at the four sites. The genus *Sagitta* was represented by 5 species mostly at Sharm El-Sheikh. Pelagic tunicates were represented by 11 species, which more frequent at Sharm El-Sheikh and Safaga. Fenaux (1966) recorded 14 appendicularian species in the Red Sea from which only 6 are known from 15°43'N.

The species composition of the zooplankton community plays an important role in determining the phyto-zooplankton relationship. Thus the production of copepods in any natural water mass is often considered equivalent to the secondary producers as most of them, particularly their larval stages, consequently feed directly on the phytoplankton. At the Taba Station, inspite of the highest density of phytoplankton accompanied with the lowest zooplankton, its species composition was dominated by copepod larvae. This may explain the disappearance of chlorophytes as the result of the grazing effect of these copepods on the green algae (Carr and Whitton, 1982).

In conclusion, the appearance of *Spirulina platensis, Pediastrum simplex,* and *Oscillatoria* species of phytoplankton in massive counts in addition to rotifer species and protozoan species of zooplankton at the same time in the same region points to the presence of fresh water sources in these areas of investigation coming from new buildings.

REFERENCES

Abd El-Rahman, N.S. 1993. Ecological Studies on the Distribution of Zooplankton communities in the Northern Part of the Suez Gulf (Suez Bay). M.Sc. Thesis, Faculty of Science, Suez Canal University, Egypt. 316p.

Abou Zeid, G.M. 1990. Distribution of Zooplankton in Lake Timsah with Special Reference to Copepoda. M.Sc. Thesis, Faculty of Science, Suez Canal University, Egypt. 96 p.

Al-Aidaroos, A.M. 1984. Studies on the Zooplankton Community with Special Reference to Copepoda, NOrth of Jeddah, Saudia Arabia. M.Sc. Thesis, Faculty of Marine Science, King Abdel-Aziz University, Jeddah, Saudia Arabia. 238 p.

Almeida Prado-Por, M.S. 1983. Diversity and dynamics of *Copepoda calanoida* in the northern Gulf of Aqaba (Eilat) Red Sea. *Oceanologica Acta.* 6: 139-145.

Almeida Prado-Por, M.S. 1988. Vertical migration of calanoid copepods in the Gulf of Aqaba (Eilat). *Rapport Committee International de la Mer Mediterranee.* 31(2): 302 p.

Alvarino, A. 1974. Distribution of siphonophores in the regions adjacent to the Suez and Panama Canals. *Fishery Bulletin.* 72: 527-546.

Beckmann, W. 1988. Seasonal patterns of mesopelagic calanoid copepods in the central Red Sea. *Rapport Committee International de la Mer Mediterranee.* 31(2): 302 p.

Behrendt, H. 1990. The chemical composition of phytoplankton and zooplankton in an eutrophic shallow lake. *Arch. Hydrobiol.* 118(2): 129-145.

Bergren, W.A. and A. Boersma, 1969. Late Pleistocene and Holiocene planktonic foraminifera from the Red Sea. In: *Hot Brines and Recent Heavy Metal Deposits in the Red Sea.* (Eds. E.T. Degens, and D.A. Ross), Berlin-Hedel beerg-New York. Pp. 282-291.

Carr, N.G. and B.A. Whitton, 1982. The biology of cyanobacteria. *Botanical Monograph.* 19: 491-513.

Cupp, E.E. 1943. Marine plankton diatoms of the west coast of North America. University of California Press, Berkley and Los Angelos, California. 238 p.

Delalo, E.P. 1966. Distribution of zooplankton biomass in the Red Sea and Gulf of Aden in winter 1961-1962. *Okeanol. Issled* 15: 131-139.

Dowidar, N.M. 1974. Tintinnids from the Suez Canal. *Rapport Committee International de la Mer Mediterranee.* 22(9): 123-124.

Dowidar, N.M. 1974a. The phytoplankton of the Mediterranean waters of Egypt. I. A check list of the species recorded. *Bulletin Institute of Oceanography and Fisheries.* A.R.E. 4: 319-344.

Dowidar, N.M. 1976. The phytoplankton of the Suez Canal. *Symposium Eastern Mediterranean Sea. IBP/PM UNESCO. Acta Adriatica* 18(14): 241-255.

Dowidar, N.M. 1983. The genus *Ceratium* from the Red Sea. *Journal of Faculty of Marine Science.* King Abdel-Aziz University, *Jeddah.* 3: 5-37.

Dowidar, N.M. and A.M. El-Maghrahy, 1970. The neritic zooplankton of south Mediterranean at Alexandria. Distribution and ecology of the zooplankton organisms with special reference to Copepoda. *Bulletin of Institute of Oceanogr. Fisheries.* A.R.E. I: 225-273.

Dowidar, N.M., S.A. Raheem Eldin and A.A. Aleem, 1978. Phytoplankton population in the region of obhor (Jeddah. Saudi Arabia). *Bulletin Faculty of Science.* King Abdel-Aziz University, Jeddah 2: 271-292.

Echelman, T. and L. Fishelson, 1988. The seasonal surface zooplankton dynamics near Eilat (Gulf of Aqaba), Red Sea. *Rapport Committee International de la Mer Mediterranee.* 3(2): 304 p.

Edmondson, W.T. 1959. *Fresh Water Biology.* 2nd edition John Wiley and Sons Inc; New York and London. 1248 p.

El-Serehy, H.A. 1989. Distributional and Biological Studies on Marine Protozoa of Lake Timsah. Ph.D. Thesis, Faculty Science, Suez Canal University, Egypt. 152 p.

El-Sherif, Z.M. and A.M. Ibrahim, 1993. Phytoplankton production, Diversity and chlorophyll-a in the Suez Canal, Egypt. *Bulletin of Institute of Oceanography and Fisheries.* A.R.E. (19): 191-212.

Fenaux, R. 1966. Appendicularia of the Red Sea. *Bulletin Museum of Natural History Paris.* Ser. 2, 38(6): 784-785.

Gergis, W.L. 1983. Distribution of the Phytoplankton along the Egyptian Mediterranean Coast west

of Alexandria. M.Sc. Thesis, Faculty of Science, Alexandrea University, Egypt. 103 p.
Ghazzawi, F.M. 1936. Plankton of the Egyptian water. A study of Suez Canal plankton. (A) The phytoplankton. *Notes Memoirs Fisheries Research Directorate.* Cairo. 24: 1-83.
Giesbrecht, W. 1892. Systematik und faunistik der pelagischen copepoden des Golfes Von Neapel. (*Fauna Flora Golfes von Neaple*) 19: 1-831.
Gonzalez, J.G. and T.E. Bowman, 1965. Planktonic Copepods from Bahia Fosfore Scente, Puerto Rico and Adjacent waters. *Proceedings of the United States National Museum*, Smithsonian Institution. Washington, D.C. 117(3531).
Gordeyeva, K.T. 1970. Quantitative distribution of zooplankton in the Red Sea. *A.O. Kovalevsiky Institute of Biology Southern seas, Ukrainian Academy Science,* USSR, Okenologiya. 10: 867-871.
Gurney R.M. 1926. Report on the crustacea (Copepoda and Cladocera) of the plankton. *Transactions of Zoological Society of London.* 22: 139-172.
Halim, Y. 1969. Plankton of the Red Sea. *Oceanography and Marine Biology,* Annual Review. 7:231-275.
Huber-Pestaluzzi, G. 1938. *Das Phytoplankton des Succwassers.* I *Teile, Die Binnergewasser.* Stuttgart. 342 p.
Hussein, M.M. 1992. A preliminary study on the zooplankton community of Qatari waters. *Comm. Int. Sci. Dev. Res.* 37(561): 123-141.
Hutchinson, C.E. 1967. *A treatise on Limnology. II: Introduction to Lake Biology and the Limnoplankton.* John Wiley, New York. 1115 p.
Hustedt, F. 1930. Die Kieselagen Deutschlands Osterreichs und Schweiz. *Rabenhorst Kryptogamen Flora.* 7: 920 p.
Ibrahim, E.A. 1988. Observations on the distribution of phytoplankton in Foul Bay, Red Sea. *Bulletin of Institute of Oceanography and Fisheries.* A.R.E. 14(1): 91-103.
James, D.E. 1975. Blue green algae, pollution indicators. *Carolina Tips.* 38: 57-58.
Jorgensen, E. 1920. Mediterranean Ceratia. *Report Danish Oceanographic Expedition. 1908-1910, Biology 2, Journal.* 1: 1-110.
Jorgensen, E. 1923. Mediterranean Dinophysiaceae. *Report Danish Oceanographic Expedition. 1908-1910, Biology 2, Journal.* 2: 1-80.
Jorgensen, E. 1924. Mediterranean Tintinnidae. *Report Danish Oceanographic Expedition. 1908-1910, Biology 2, Jouranl.* 3: 1-110.
Khalil, A.N., A.K. Khafagi and A.M. Ibrahim, 1984. Preliminary survey of micro and macrophytes south of Jeddah. Red Sea. *Proceedings of Symposium Coral Reef Environment Red Sea.* Jeddah. Pp. 555-576.
Khalil, A.N. and A.M. Ibrahim, 1988. Seasonal study of the surface phytoplankton of the Red Sea North of Jeddah. *Arabian Gulf Journal Scientific Research Agriculture and Biological Sciences, B* 6(2): 189-204.
Kimor, B. 1972. The Suez Canal as a link and a barrier in the migration of planktonic organisms. *Israel-Journal of Zoology.* 21: 391-403.
Komarowsky, B. 1958. The occurrance of *Evadne tergestina* Claus in summer plankton of the Gulf of Aqaba (Eilat). *Bulletin Sea Fisheries Research Station.* Israel (Haifa). 16: 1-2.
Kunnah, M.C. 1967. *Chlorococcales.* The Indian Council of Agricultural Research, New Delhi. Job Press Private Ltd. Kanpur, India. 363 p.
Lebour, M.V. 1925. *The Dinoflagellates of the Northern Sea.* M.B.A., Plymouth. U.K. 172 p.
Lebour, M.V. 1930. *The Planktonic Diatoms of the Northern Sea.* London, printed for the Ray Society. 244 p.
Levanon-Spanier, I., E. Padan and R. Resis, 1979. Primary production in a desert enclosed sea-the Gulf of Aqaba (Eilat), Red Sea. *Deep Sea Research.* 26: 673-685.
MacDonald, R. 1933. An examination of plankton hauls made in the Suez Canal, during the year

1928. *Notes Memoirs Fisheries Research Directorate.* Cairo. 3: 1-11.

Marshall, S.M. 1969. Protozoa. In: *Fiches d'Identification du Zooplankton.* J.H. I'Exploration de la Mer Charlotten I und Slot. Danemark. Sheets 117-127.

Mikhail, S.K. 1986. Preliminary Investigation of Epiphytes Growing on Some Marine Algae and Artificial Substratum in the Eastern Harbour. M.Sc. Thesis. Faculty of Science Alexandria University, Egypt. 178 p.

Nassar, M.Z. 1994. Effect of Oil Pollution on the Quantity and Quality of the Phytoplankton in Suez Bay of the Red Sea. M.Sc. Thesis. Faculty of Science, Tanta University, Egypt. 93 p.

Newell, G.E. and R.C. Newell, 1963. *Marine Plankton: A Practical Guide 5th Edition,* Hutchinson Educational Ltd., London. 221 p.

Newell, G.E. 1979. *Marine Plankton: A Practical Guide* Hutchinson and Co. Ltd., London. 237 p.

Peragallo, H. and M. Peragallo, 1897-1907. *Diatomees Marines de France et des Districts Maritimes Voisions.* I-III (text and plates). 1-491, Tempere. Grez. Sur-Loing.

Ponomareva L.A. 1966. Quantitative distribution of zooplankton in the Red Sea as observed in the period May-June, 1966. *Institute of Oceanoogy USSR, Academy of Science USSR Oceanology.* 8: 240-242.

Rose, M. 1933. Copepoda pelagiques. *Faune de France.* 26: 1-374.

Sars, G.O. 1896, 1903. *An Account of the Crustacea of Norway.* Vol. 2 and 4.

Schmidt, H. E. 1973. The vertical distribution and diurnal migration of some zooplankton in the Bay Eilat (Red Sea), *Helgoländer Wissenschaft Meeresunters.* 24: 333-340.

Sewell, R.B.S. 1948. The free swimming planktonic copepoda, Geographical distribution. John Murray Exped. 933-934, *Scientific Reports British Museum (N.).* 8: 321-592.

Singh, V.L. 1960. Phytoplankton ecology of the inland waters of Uttar Pradesh. *Proceedings of Symposium Algology,* ICAR. New Delhi. Pp. 243-271.

Smith, G.M. 1950. *Freshwater Algae of the United States Second Edition,* Mc. Graw-Hill Book Co. Inc. New York. 719 p.

Sommer, U.Z.M., G.W. Lampert and A. Duncan, 1986. The PEG-model of seasonal succession of planktonic events in freshwater. *Arch. Hydrobiol.* 106(4): 433-471.

Sounia, A. 1967. Contribution a la connaissance des peridiniens microplanctoniques der canal de Mozambique. *Bulletin du Museum d' Histoire naturelle.* Paris. 39(2): 417-438.

Sounia, A. 1968. Diatomees planctoniques du canal de Mozambique et de Liile Maurice, *ORSTOM Meim.* 31: 120 p.

Sultan, H.A. 1975. Preliminary Investigation on the Primary Production of Marine Phytoplankton of the Mediterranean Coast around Alexandria. M.Sc. Thesis, Faculty of Science Alexandria University, Egypt. 237 p.

Thompson H. 1948. *Pelagic Tunicates of Australia.* Commonwealth Council of Scientific and Industrial, Research, Australia. 196p.

Tregouboff, G. and M. Rose, 1957. Manuel de Planctologie Mediterraneenne. 2 vols: C.N.R.S., Paris. 587 p.

Weikert, H. 1982. The vertical distribution of zooplankton in relation to habitat zones in the area of the Atlantis II Deep Sea central Red Sea. *Marine Ecology Progressive Series.* B. Pp. 129-143.

Williamson, D.I. 1967. On a collection of planktonic Decapoda and Stomatopoda (Crustacea) from the Mediterranean Coast of Israel. *Bulletin Sea Fisheries Research Station.* Haifa. 45: 1-32.

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