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Epiphytic Microalgal Dynamics and Species Composition on Brown Seaweeds (*Phaeophyceae*) on the Northern Coast of Jeddah, Saudi Arabia

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Abstract

Epiphytic microalgae grow on host seaweeds. Seaweeds are multicellular macro-algae, which are abundant in intertidal zones of coastal environments. The report on epiphytic microalgae is rare in the Red Sea. Thus, an investigation on epiphytic microalgae was carried on northern coast of Jeddah, the Red Sea, Saudi Arabia. The Red Sea is narrow oceanic basin which is lying between the African and the Asian continental shelves. During the study, 4 species of seaweeds were recorded in Phaeophyceae which were Laminaria sp., Padina fraseri, Sargassum muticum and Turbinaria ornata. A total of 83 epiphytic microalgae were identified, including 76 belong to Bacillariophyceae, 5 belong to Cyanophyceae, 1 belongs to Chlorophyceae and 1 belongs to Dinophyceae. On seaweeds of Laminaria sp., the dominant epiphytes were Leptocylindrus danicus, Licmophora flabellata and Navicula ramosissma. On seaweeds Padina fraseri, the dominant epiphytes were Cylindrotheca closterium, Navicula sp., Nitzschia sp. and Prorocentrum lima and Cocconeis lineatus. On seaweeds of Sargassum muticum, the dominant epiphytes were Navicula distans, Nitzschia socialis and Navicula vanhoeffeni. On seaweeds Turbinaria ornata, the dominant epiphytes were Leptocylindrus minimus, Bacillaria paxillifer, Leptocylindrus danicus, Nitzschia hungarica and Thalassionema frauenfeldii. The host seaweeds influenced the associated diatoms mainly through its morphology and surface texture and roughness to provide a point of attachment and shelter for host-adapted species. Most of the dominant epiphytes were in smaller cell size diatoms, except Cylindrotheca closterium. The findings of the study focused on individual species of benthic marine diatoms associated with specific seaweeds species even in different regions of the Red Sea in different seasons of Saudi Arabia. These findings could be the important source for future explanation of marine eco-biogeographical phenomena in the Red Sea.

Keywords: Epiphytic microalgae; Species compositon; Benthic species; Brown seaweeds; Seaweeds host; Dynamic; Jeddah Coast; The Red Sea

Introduction

Epiphytic microalgae on seaweeds are sessile plants grown with attached or associated to seaweeds hosts. Seaweeds are multicellular and macroscopic macro-algae, which are abundant in intertidal zones of coastal environments. Primarily they grow in near-shore coastal waters with suitable substrates for attachment [1]. Seaweed is one of the best growing plants worldwide. Different species occupy different habitats based on depth, degree of exposure to wave action, shore beds and other environmental factors [2,3]. Seaweeds provide more space availability for settlement and colonization of epiphytes [4], and increase the probability of more individuals and species being present. They also facilitate additional habitats which sanction the coexistence of more species in a given area. Thus, increasing of the habitat complexity provides an intensifier of the density and diversity of organisms in marine systems [5,6]. The leaves of seaweeds provide substrates suitable for the attachment and growth of various numbers of microalgae [7]. Epiphytic flora attach on host tissue such as leaves of seaweeds with loosely attached and tightly attached or adnate component [8,9]. Epiphytic microalgal community on seaweeds is composed of variety species of diatoms, red, brown, green algae and Cyanophyta [10]. They are the common and important flora in terms of aquatic productivity [11], and a suitable food source for higher trophic levels [12,13]. Therefore, epiphytes and their host seaweeds assemblages serve as nursery habitats for many littoral fishes [14,15]. The dynamics, abundance and community structure of epiphytic microalgae are influenced by biotic factors such as leaf age, seasonal cycle of the host, and grazing pressure by herbivores, and also by the light, temperature, nutrients and water motion [7,16,17]. The abundant and diverse epiphytic microalgae include diatoms, dinoflagellates and cyanobacteria which make a significant contribution to food webs.

An investigation on epiphytic microalgae was carried out on northern coast of Jeddah, the Red Sea, Saudi Arabia. The Red Sea is narrow oceanic basin which is lying between the African and the Asian continental shelves. The northern end of the Red Sea connects with the Mediterranean Sea through the Suez Canal, and the southern region exchanges its waters with the open ocean (Gulf of Aden and the Arabian Sea) through Bab-el-Mandeb strait [18]. The Red Sea is a unique area in the tropics for several reasons which having the highest saline water body in the world's seas with the deep water salinity of 40.06 psu while the surface water salinity ranged from 40.10-40.65 psu [19,20]. The high salinity phenomenon occurs due to its location in an arid and hot climatic zone, isolation from open ocean, without riverine inputs, the high evaporation rate (>210 cm yr⁻¹), and scant rainfall restricted from October to May, resulting in a negative hydrological budget. The Red Sea is also considered as an oligotrophic water body due to deficient of several major nutrients such as nitrate, ammonium, phosphate, and silicate [21]. The required nutrients for photosynthetic activity have to come through water intrusion (from the Gulf of Aden), the subsurface (below the nutricline), or via aerial deposition. Higher nutrient

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concentrations occur in the southern areas, and gradually decline towards the north [22]. The reservoirs of nutrients in the Red Sea are trapped below the stratified zone due to the persistent pycnocline. The deep water renewal is generally prevented by high stratification levels and the resulting homogeneity of the northern Red Sea deep waters which limits nutrient availability and biological productivity in the euphotic zone. The nutrients supply occurred through the convergence zone formed by the Eastern and Western coastal currents collision. These two currents (one heading northwards and the other southwards) collision brings cold nutrients rich water from deeper parts of the water column to rise to the surface [21]. Moreover, Jeddah Coast is receiving huge waste water from fish farms, industries and domestic use as it is the second biggest city of Saudi Arabia, located on the Coast off the Red Sea and is extending rapidly.

There are few reports on the study of microalgae ecology, community and primary productivity on the Jeddah Coast of the Red Sea. Aleem [23] studied on community composition of microalgae at Obhur, Jeddah Coast of the Red Sea and he recorded 16 species of Cyanophyta and 27 species of Chlorophyta. Khomayis [24] studied on phytoplankton abundance with annual nutrients recycle was conducted in tourist resort area from South Corniche to North Obhur of Jeddah Coastal water. Diatom composition in marine fouling area of Obhur was studied by Khomayis and Haibi [25] in which they recorded 22 species of diatoms. Recently, Harbi and Affan [26] studied on seasonal dynamics of epiphytic microalgae and their host seaweeds Florideophyceae at Jeddah Coast, the Red Sea, and Saudi Arabia. In this study, brown seaweeds (Phaeophycease) and their epiphytic microalgal association was studied in relation with environmental factors at the

northern part of Jeddah Coast. The aim of this study was to investigate the community composition and seasonal dynamics of leaf epiphytic microalgal abundance of host seaweeds species of *Phaeophyceae* at the northern coast of Jeddah, the Red Sea.

Materials and Methods

Study area, sampling and sample analysis

The sampling was done seasonally at the peak of season which was in March (spring), June (summer), September (autumn) and December (winter) in 2015. The sampling was conducted at the northwest coast of Jeddah, Saudi Arabia, the Red Sea. The sampling sites were; (i) Yambu (23°59′45″N and 38°10′35″ E) am one of major sea port of the Red Sea in the Al Madinah province of western Saudi Arabia. It is approximately 300 kilometers northwest of Jeddah. There are oil refineries and petrochemical industry. (ii) Ar-Riyas (23°33′55″N and 38°36′17″E) is an industrial city of Madinah province, (iii) Mastura (23°08′80″N and 38°47′14″E) is famous for fishing, (iv) Rabigh (22°41′35″N and 39°00′34″E) has several industries such as cement factory, electricity station, large refinery, Petro Rabigh and (v) Thuwal (22°16′44″N and 39°05′21″E) had long been a fishing center. The town is experiencing an increase in industries due to its proximity to the King Abdullah Economic City (Figure 1).

Seaweeds samples were collected randomly from the above mentioned sites. The wet seaweeds leaves (except stalk and rhizoids) were kept in polyethylene bags and transferred to laboratory. Hundred grams wet sea weeds were put in plastic bottle with filtered seawater, and separation of epiphytic algae from their host was performed by manual



Page 3 of 9

shaking method. Then, the epiphytic microalgal samples were preserved with 2% of logul's solution for further study. For taxonomical study, the sample was observed under the phase-contrast microscope (Zeiss Axioplan, Germany) at 400X magnification. Taxonomic identifications were made with reference to Prescott [27], Tomas [28,29], Shim [30], Kobayasi [31] and Round et al. [32]. For quantitative study, a 1 mL sample was taken after mixing of the preserved sample and counted in a Sedgewick-Rafter (S-R) counter chamber with same microscope as mentioned above. Counted results were summarized as cells per 100 grams of seaweeds, and used for graphical presentation (Figure 2). The water temperature, salinity and pH were measured on spot with portable meter HACH (Model HQ14d).

Results

The water temperature was found to be highest in summer-autumn, followed by spring and winter. Temperature varied from 22.10-32.02°C with an average of 28.48°C, showing minimum and maximum in winter and summer at Yambu and Rabigh, respectively. Salinity fluctuated from 38.72-39.35 psu with an average of 38.92 psu. The salinity was lowest in spring at Ar-Rayis and the highest was in summer at Yambu (Figure 3). The pH varied from 8.40 to 8.63 throughout the study with an average of 8.52. The highest and the lowest pH was recorded at Rabigh and Mastorah in spring and summer, respectively. The high pH was in spring, followed by winter among all the stations (Figure 4).

Seaweeds and epiphytic microalgal species composition

Total 4 species seaweeds of *Phaeophyceae* were found throughout the year among different sites. *Padina fraseri* was found in four seasons at stations Thuwal, Masturah, Rabigh and Yambu. *Laminaria* sp. was found in spring and summer at Ar-Riyas and Rabigh. *Sargassum muticum* was found spring and autumn at Ar-Riyas, Masturah and

Rabigh. Turbinaria ornata was found in winter, spring and autumn at Rabigh and Thuwal (Table 1). A total of 83 epiphytic microalgae were identified, including 76 belong to Bacillariophyceae, 5 belong to Cyanophyceae, 1 belongs to Chlorophyceae and 1 belongs to Dinophyceae which were grown on different species of seaweeds of Phaeophyceae. Among the identified epiphytic microalgae of the host seaweeds of Phaophyceae, the percent contribution of epiphytic Bacillariophyceae, Cyanophyceae, Chlorophyceae and Dinophyceae were 91.57, 6.02, 1.20 and 1.20%, respectively. Within Diatoms, the pennate and centric diatoms were 72.37% and 27.63%, respectively (Table 2). The cell abundance of epiphytes on host Laminaria sp. of seaweeds varied from 16.00×10^5 to 73.00×10^5 cells/100 g Laminaria sp. with an average of 45.00×10^5 cells/100 g Laminaria sp. The highest and lowest cell abundance of epiphytes was found in summer and spring, respectively (Figure 5). Three species of epiphytes were found to occur in high frequently during the study. Cylindrotheca closterium was found to be occurred in high frequently in spring, Licmophora flabellata was in spring and summer, and Navicula transitans was in winter (Table 2).

Seasonal dynamics of epiphytes on host seaweeds

On seaweeds of *Laminaria* sp., the dominant epiphytes were *Leptocylindrus danicus*, *Licmophora flabellata* and *Navicula ramosissma* in winter. The abundance of *Leptocylindrus danicus*, *Licomophora flabellata* and *Navicula ramosissma* were 16.01×10^5 , 16.01×10^5 and 14.11×10^5 cells/100 g of *Laminaria* sp. and their percent contribution (21.93, 21.93, 19.33)% to the total epiphytic microalgae. Similarly, in spring, the dominant species of epiphytes were *Cylindrotheca clostridium* and *Leptocylindrus danicus* which contributed 12.18% and 51.11%, respectively to the total epiphytic microalgae (Table 3). On seaweeds of *Padina fraseri*, a total five dominant epiphytic microalgae were found and among them *Cylindrotheca closterium*, *Navicula* sp.,



Figure 2: Seasonal variation of water temperature (°C) at the Northwest coast of Jeddah, namely Yambu, Ar-Riyas, Mastorah, Rabigh and Thuwal, the Red Sea, Saudi Arabia from spring to winter 2015.







Figure 4: Seasonal variation of pH at the at the Northwest coast of Jeddah, namely Yambu, Ar-Riyas, Mastorah, Rabigh and Thuwal, the Red Sea, Saudi Arabia from spring to winter 2015.

Page 5 of 9

Phaeophyceae	Winter	Spring	Summer	Autumn
Species name				
Laminaria sp.	-	R, A	R	-
Padina fraseri (Greville, 1830)	M, R, T	M, R, T	R, M	M, R, T, Y
Sargassum muticum (Fensholt, 1955)	-	R, M, A	М	M, R, A
Turbinaria ornata (Agardh, 1848)	R, T	R	-	R, T

'Legend of location; M, Masturah; R, Rabigh; T, Thuwal; Ar-Riyas; and Y, Yanbu.

Table 1: List of seaweeds found at different sites of Northwest coast of Jeddah,	Saudi Arabia, namely Ya	anbu, Ar-Riyas, Mastorah,	Rabigh and Thuwal, the Red Sea from
spring to winter 2015.			

	Spring	Summer	Autumn	Winter	%
Bacillariophyceae					91.57
Pennate diatoms					72.37
Amphiprora alata Kützing				X	
A. angustata Hendey				X	
A. paludosa Smith	Х	Х		X	
A. paludosa Smith	R				
Amphora arcus Gregory 1855				X	
A. coffeaeformis Kützing	Х	Х			
A. commutata Grunow		Х			
A. exigua Levkov			Х		
Bacillaria paradoxa Gmelin	Х		Х		
<i>B. paxillifer</i> Müller		Х	R	Х	
Closterium jenneri Ralfs			R		
C. moniliferum Ehrenberg				R	
C. pronum Brébisson				Х	
Cocconeis heteroidea Hantzsch		Х	Х		
C. heteroieda Hantzsch				Х	
C. pediculus Ehrenberg	Х				
C. pellucida var. minor Grunow	R				
Cylindrotheca closterium Ehrenberg	Н	F	Х	F	
Entomoneis paludosa var. subsalina Cleve			Х		
Fragilaria crotonensis Kitton		Х			
Gyrosigma acuminatum Kützing				R	
G. balticum Ehrenberg				Х	
Licmophora paradoxa Lyngbye				X	
<i>L. abbreviata</i> Agardh		F	F	С	
L. flabellata Greville	Н	R	Н		
L. gracilis Ehrenberg		Х		R	
L. paradoxa Agardh				R	
Navicula delicatula Cleve	F	Х			
N. didyma Ehrenberg		Х			
N. distans Smith	С	F	С	Х	
<i>N. granii</i> Gran				Х	
<i>N. incerta</i> Grunow	С		Х		
N. jejunoides f. longissima Van	F	R			
N. peregrine Ehrenberg			R		
N. ramosissma Agardh	Х			Х	
N. transitans Cleve		F	F	Н	
Navicula vanhoeffeni Smayda		Х		С	
Nitzschia closterium Ehrenberg				Х	
<i>N. hungarica</i> Grunow	Х	R			
N. longissima Brébisson			F	С	
N. longissima Brébisson	Х				
<i>N. reversa</i> Smith.			R	R	
N. seriata Cleve		Х	R		
<i>N. sigma</i> Kützin				R	
N. socialis Gregory		R			
Pinnularia brebissonii Kützing				X	
P. viridis Nitzsch		X	R	R	

P. viridis Nitzsch	X				
Pleurosigma angulatum Smith	X	С		Х	
P. directum Grunow				Х	
P. normanii Ralfs	R	R	F	R	
Synedra ulna Nitzsch			Х		
Tabellaria fenestrata Nitzsch	X	R		Х	
Thalassionema frauenfeldii Grunow		Х	R		
T. nitzschioides Grunow		Х		X	
Centric diatoms					27.63
Biddulphia sp. Gray	X				
Chaetoceros affinis Lauder				Х	
C. curvisetus Cleve	R				
C. socialis Lauder		R			
C. turgidus Kützing			Х	Х	
Coscinodiscus sp.	X				
C. lineatus Ehrenberg		Х			
C. wailesii Gran & Angst		Х			
Cyclotella meneghiniana Kützing			Х		
Guinardia delicatula Cleve		Х			
Hyalosynedra laevigata Grunow			Х		
Leptocylindrus minimus Gran	X	R	F	С	
L. adriaticus Schroder	R				
L. danicus Cleve	F	F	С	С	
Melosira nummuloides Agardh	X				
Rhizosolenia delicatula Cleve	X	Х		Х	
R. lineola Cleve			Х		
R. pungens Clev		Х			
R. setigera Cleve		Х	Х	Х	
R. stolterfothii Peragallo		Х	Х		
Striatella delicatula Kützing		Х	R		
Chlorophyceae					1.20
Tetraselmis cordiformis Carter				Х	
Cyanophyceae					6.02
Anabaena collarcito Thomas		Х	R		
Merismopedia sp.			Х		
Oscillatoria sp.	X	С			
O. formosa Gomont			Х	С	
Trichodesmium sp.	R	F	F	R	
Dinophyceae					
Prorocentrum lima Ehrenberg	С	R	R	R	1.02

"Legend of occurrence frequency: Sporadically (X=1-20%), Rarely (R=21-40%), Commonly (C=41-60%), Frequently (F=61-80%) and High Frequently (H=81-100%). **Table 2:** List of epiphytic microalgal taxa, frequency of occurrence and percent (%) contribution of each class on the seaweeds Phaeophyceae at the northern coast of Jeddah from spring to winter, 2015.

Nitzschia sp. and Prorocentrum lima were dominant in spring, and in summer the dominant epiphytic microalgae was Cocconeis lineatus. In winter, the highest percent contribution was 19% by Cylindrotheca closterium, followed by Navicula sp. (17%) and Nitzschia sp. (13%). Similarly, in summer the percent composition of Cocconeis lineatus and Trichodesmium sp., 10 and 10% to the total epiphytes (Table 3). On seaweeds of Sargassum muticum, four epiphytes were found to be dominated in spring, and another two epiphytes were found to be dominant autumn. In spring, Navicula distans and Nitzschia sociales contributed 23.00 and 23.00%, followed by Navicula vanhoeffeni (11.04%) and Leptocylindrus minimus (10.00%) in epiphytic microalgae. In autumn, Leptocylindrus minimus and Navicula transitans were the dominant species which contributed 37.00 and 10.00%, respectively to the total epiphytes (Table 3). On seaweeds of Turbinaria ornata, six species of epiphytes were found to be dominant from winter to autumn. In winter the highest percent contribution was 59.00% by *Leptocylindrus minimus*, followed by *Bacillaria paxillifer* (15.00%). *Leptocylindrus danicus* contributed 20.65 and 10.32% to the total epiphytes in spring and summer, respectively. In autumn, the highest contribution was 17.00% by *Nitzschia hungarica*, followed by *Leptocylindrus danicus* (14.00%) and *Thalassionema frauenfeldii* (12.00%) to the total epiphytes (Table 3).

Discussion

Four species seaweed of *Phaeophyceae* were identified at the study area in different seasons in different stations. Different types of epiphytic microalgae were also found on same seaweeds of *Phaeophyceae* which might be occurred depending on local environmental conditions (nutrient, substratum, current, etc.). The epiphytes abundance and composition are the results of the interaction between the lifespan of the host and the reproductive lifespan of the epiphytes although

Page 6 of 9

Page 7 of 9

	Winter		Spring		Summer		Autumn	
	10⁵ cell	%	10⁵ cell	%	10⁵ cell	%	10⁵ cell	%
	1	1	Laminaria sp.	1	1	1	1	
Cylindrotheca closterium	-	-	1.95	12.18	-	-	-	-
Leptocylindrus danicus	16.01	21.93	8.18	51.11	-	-	-	-
Licomophora flabellata	16.01	21.93	-		-	-	-	-
Navicula ramosissma	14.11	19.33	-		-	-	-	-
Navicula sp.	-	-	3.22	20.11	-	-	-	-
			Padina fraseri			· · · ·		
Cocconeis lineatus	-	-	-	-	3.90	10	-	-
Cylindrotheca closterium	-	-	1.93	19	-	-	-	-
Navicula sp.	-	-	1.73	17	-	-	-	-
Nitzschia sp.	-	-	1.33	13	-	-	-	-
Prorocentrum lima	-	-	1.00	10	-	-	-	-
Trichodesmium sp.	-	-	-	-	3.90	10	-	-
		Sai	rgassum mutic	um				
Leptocylindrus minimus	-	-	9.20	10	-	-	-	-
Leptocylindrus minimus	-	-	-	-	-	-	6.36	37
Navicula distans	-	-	23.00	25	-	-	-	-
Navicula transitans	-	-			-	-	1.69	10
Navicula vanhoeffeni	-	-	11.04	12	-	-	-	-
Nitzschia socialis	-	-	23.00	25	-	-	-	-
		T	urbinaria ornat	a			·	
Bacillaria paxillifer	0.74	15	-	-	-	-	-	-
Leptocylindrus minimus	2.94	59	-	-	-	-	-	-
Leptocylindrus danicus	-	-	39	20.65	10.32	10.32	-	-
Leptocylindrus minimus	-	-	-	-	-	-	4.53	14
Nitzschia hungarica	-	-	-	-	-	-	5.36	17
Thalassionema frauenfeldii	-	-	-	-	-	-	3.71	12

Table 3: List of dominant (10% or above) epiphytes cell abundance (10⁵ cell/100 g of seaweeds) and host seaweeds found from winter to autumn 2015 at northwest coast of Jeddah, the Red Sea.



Page 8 of 9

environmental factors and predators control the abundance of epiphytic microalgae [33]. In this study, some of the species diatoms among 78 species of diatoms might be obligatory to be epiphytic in habitat. It is reported that the genera Cocconeis, Achnanthes, and Tabularia are obligate diatoms [32,34]. Among the epiphytic smaller diatoms, the genera of Leptocylindrus sp., Licmophora sp., Cocconeis sp., and some species Navicula ramossima, Navicula distans, Navicula transitans, Navicula vanhoeffeni and Nitzschia socialis were found to be obligate epiphytes at different seasons on different type of seaweed of Phaeophyceae. There is evidence that tube forming species of Navicula, Nitzschia and Amphora which create cells masses within a gelatinous matrix are epiphytes [32]. Thus, the species which showed 10% or more abundance among the microalgae found on the leaves of seaweeds of Phaeophyceae can be consider as real epiphytic microalgae though they occurred in different seasons on same or different genus of seaweeds of Phaeophyceae.

Diatoms were the most dominant epiphyte though some also from Dinophyta, Chlorophyta and Cyanophyta. Diatoms have advantage over other group of epiphytes because of their high fucoxanthin content. Fucoxanthin is known as the most efficient photosynthetic carotenoid absorbing light in the green waveband [35]. Thus, diatoms become dominant on the seaweeds in coastal waters with effect of available of particulate and dissolved organic matter and blue light. The blue light can rapidly attenuated with preferential transmission of the green-to- yellow wavelengths for photosynthesis [36]. Additionally, it is well know that vegetative ecosystems are ideal habitats for benthic diatoms and other epiphytes since seaweeds leaves provide greater surface area for the colonization and growth of diatoms [37,38] found that diatoms and bacteria are the first organisms which make colony on the submerged objects. Therefore, dominancy of diatoms on submerged seaweeds of Phaeophyceae from spring to autumn might be occurred due to suitable circumstance with favorable temperature and light as those seasons day length is longer in Saudi Arabia than that of winter.

However, Ramm [39] reported that the reasons for a specific dependency of epiphytic microalgae on the substratum might be related with the shape of the thalli surface. The diatoms with small attaching area like Licmophora sp., is predominant on fine branched thalli while think branched thalli are preferred by diatoms with a large attaching area like Cocconeis sp., and tube living diatoms like Navicula sp., [39]. In this study, the seaweeds of Phaeophyceae having larger and branched thalli which provided suitable substratum for small and large attaching diatoms. In all seasons, almost same species (Leptocylindrus sp., Licmophora sp., Navicula sp. and Nitzschia sp.) of epiphytic microalgae were found to be dominant on the four species of seaweeds of Phaeophyceae. Thus, it can be said that these epiphytes are obligate on the seaweeds (Laminaria sp., P. fraseri, S. muticum and T. ornata) of Phaeophyceae. Except diatoms, a species of dinoflagellates (Prorocentrum lima) was found to be epiphytic on Padina fraseri seaweed and it was found to be dominant above 10% to the total epiphytic microalgae. It is well known that dinoflagellates are planktonic species, thus its presence as a dominant species might be related with the occurrence of its bloom and it attached with seaweeds temporarily during spring.

Conclusion

The host seaweeds influenced the associated diatoms mainly through its morphology and surface texture and roughness, providing a point of attachment and shelter for host-adapted species. Depth affected diatom community growth form structure. The seaweeds were collected from intertidal zone where the water depth was around half meter. Four species seaweeds of *Phaeophyceae* were found at the study area throughout the year. Most of the dominant epiphytes were in smaller cell size diatoms, except *Cylindrotheca closterium*. The findings of the study focused on the need for further, long-term and spatially extensive investigations to gather the necessary information about individual species of benthic marine diatoms associated with specific seaweeds species even in different regions of the Red Sea in different source for future explanation of marine eco-biogeographical phenomena in the Red Sea.

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Page 9 of 9