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STUDY ON BACILLARIOPHYCEAE PHYLUM CHANGES IN SOUTHERN CASPIAN SEA

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ABSTRACT: In this study for maturing of Bacillariophyceae species, choose 6 line Lisar, Anzaly, Sefidrood, Nooshahr, Babolsar and Amirabad that every line have 4 stations(A, B, C, D) and water for analysis have taken from different deeps (0,5,10,20,50,100) meter in southern of Caspian sea and then transferred to laboratory of Caspian sea ecological institute. Then the samples transferred to laboratory of Ecological Academy, kept in cool and darkness in properly capped glass bottles. The phytoplankton was analyzed on a "Nikon" light microscope at ×480 magnification. Algae abundance was determined using the Hydro bios counting chamber and sampled (volume 0.1 ml). In this study, during 1995-1996 the overall average cell abundance and biomass of Bacillariophyceae in different seasons were significant different. The dominant cell abundance was recorded in winter (79%). During 2006-2007, cell abundance of Bacillariophyceae increased but Pyrrophyta show decrease of cell abundance. Since major changes in an ecosystem can affect all the tropic levels in the food chain, any ecological and environmental alteration can have a significant impact on Bacillariophyceae species specially the large-sized Bacillariophyceae community in the Caspian Sea.

***Keywords*:** Bacillariophyceae, Caspian Sea, Season, Abundance, Biomass.

INTRODUCTION

Bacillariophyceaes are microscopic plants that live in the sea waters. There are many species of Bacillariophyceae, each of which has a characteristic shape. Collectively, Bacillariophyceae grows abundantly in sea waters around the world and is the foundation of the marine food chain. According to Hossini, et al., 1996, the area of the Northern Caspian varies from 92,750 up to 126,596 km2, and its average volume makes 900 km3.The average depth is 6 meters, maximal depths do not exceed 10 m, about 20 % of the area has the depths less than 1 m.The length of coastline makes 5,580 km. The level is lower than the middle and Southern Caspian Sea, is fluctuates depending on the water balance. Bacillariophyceae are the main group of phytoplankton in Southern Caspian Sea and their abundance and biomass, will determine the quality and quantity of other aquatic animals. Phytoplankton studies and monitoring are useful for control of the physico-chemical and biological conditions of the water in any irrigation project and these interactions usually prevent equilibrium conditions (Sousa, 1984). Thus, the modern Caspian Sea is a real paradise for brackish water species originating both from marine, and from continental water bodies (Birstein et al., 1968).

Richness in this enclosed sea is lower than that in open seas. In the north, fresh and brackish water species dominate while in the middle and southern Caspian, euryhaline, marine and brackish forms are generally dominant in cell abundance. The biodiversity of the Caspian Sea is 2.5 times poorer, than that of the Black Sea, or 5 times poorer, than that of the Barents Sea (Zenkevich, 1963). The main reason of this is probably its variable salinity.

Ecological and environmental alterations are also important at the phytoplankton level as they can affect its distribution patterns and biomass. There are very few studies available on Bacillariophyceae of the Caspian SeaThe rapid change in nutrient status influences the Bacillariophyceae community structure, and thus leads to the growing frequency and magnitude of nuisance. Therefore, the purpose of this work was to study Bacillariophyceae of different seasons. The specific objectives of the study was conduct a seasonal sampling of Bacillariophyceae in the Southern Caspian Sea, in different years and analyze the structural communities of Bacillariophyceae communities in the Southern Caspian Sea during this year's and study on cell abundance and biomass of Bacillariophyceae at different regions and seasons.

MATERIALS AND METHODS

Methods

The survey of Southern Caspian Sea started with the collaboration of the Caspian Sea Research Institute in Ecology (Sari, IRAN) and Fisheries Research Center of Giulan (Anzali, IRAN), existed between the 1991-1993 periodes. From 1994 to 1996, these two institutes in collaboration with the USSR (KaspNIRKh Institute) conducted the survey (Roohi, 2009). In 1997 and 1999, the survey reverted back again to the above two institutes. Up till now, the monitoring project has been conducted on a yearly basis by the Caspian Sea Research Institute in Ecology (Sari, IRAN) for the Southern part of the Caspian Sea.

For maturing of Bacillariophyceae Factors, choose 6 line Lisar, Anzaly, Sefidrood, Nooshahr, Babolsar and Amirabad that every line have 4 stations(A, B, C, D) and water for analysis have taken from different deeps (0,5,10,20,50,100) meter in southern of Caspian sea and then transferred to laboratory of Caspian sea ecological institute.

In this study, during 1995, 1996, 2006 and 2007, Bacillariophyceae sampled of different seasons (spring, summer, fall, winter). First 500 cc of the southern Caspian sea water in different deeps (0, 5, 10, 20, 50, 100) meter took with Nansen, for preservation formaldehyde solution and added to a final concentration of 5%.After fixing with formaldehyde, transferred them to the plankton determination laboratory of Caspian Sea ecologic institute. The samples were kept standard for at least 10 days, to allow for complete settlement. The water in the upper level was siphoned off using siphon and the remainder sample was treated in a few stages by the sedimentation and centrifuge method (5 minute with 3000 rpm) (Kasimov, 1997), so that the final concentration of the samples had been chosen for quantitative measurements (Newell, 1977).

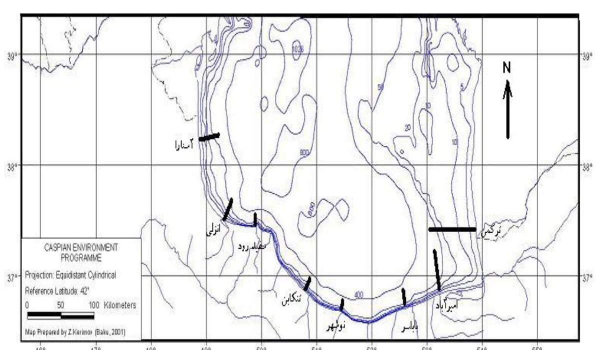

Figure 1. Map transects and station position in the Southern part of Caspian Sea

Statistical analysis significant effects of canopy structure on photo acclimation were assessed by an I-way analysis of variance (ANOVA) and Shannon-Weaver diversity were applied to compare the means of structured versus randomly mixed canopies. The significance of the instantaneous effect of canopy arrangement on photosynthetic parameters was assessed by a simple linear regression test.

RESULTS AND DISCUSSION

Results

Phytoplankton composition changed durind 1995-1996 and 2006-2007. According to this study data, pertaining to the composition of Bacillariophyceae, the Southern Caspian Sea alone recorded more than 92 species (Tables 1). Since major changes in an ecosystem can affect all the tropic levels in the food chain, any ecological and environmental alteration can have a significant impact on phytoplankton species.

Table 1. Checklist of Bacillariophyceae species during 1995-1996 and 2006-2007

During 1995-1996	During 2006-2007
BACILLARIOPHYCEAE	BACILLARIOPHYCEAE
Actinocyclus ehrenbergii	Actinocyclus ehrenbergi
A. sp.	A. parduxus
Paraduxus ehrenbergii	Amphora sp.
Amphora sp.	Chaetoceros simplex
Asterionella formosa	C. mirabilis
Chaetoceros mirabilis	C. diversicurvatus
C. socialissp	C. mulerii
C. sp.	C. rigidus
C. subtilis	C. sp.
C. wghamii	C. subtilis
Coscinodiscus gigas	C. wighamii
C. granii	Cocconeis placentula
C. jonesianus	C. sp
C. perforatus	Coscinodiscus granii
C. proximus	C. jonesianus
C. radiatus	C. perforatus
C. sp.	C. proximus
Cyclotella caspica	Cyclotella menenghiniana
C. menenghiniana	C. quadricuncta
Cymbella sp.	Cymbella sp
C. tumidae	C. tumidae
Diatoma sp.	Diatoma bombus
Diplonois interupta	D. digitale
Gomphonema salinarum	D. sp
Gyrosigma attennuatum	Dinobryon sp.
G. variabile	Diplonois interupta
Melosira granulata	Gomphonema olivacum
Navicula bombus	Gyrosigma acuminatum
N. cryptocephala	G. strigile
N. kotschyi	Melosira varians
N. simplex	Navicula bombus
N. sp.	N. cryptocephala
Nitzschia acicularis	N. simplex
N. closterium	N. sp.1
N. reversa	N. sp.2
N. seriata	Nitzschia acicularis
N. sigmoidea	N. closterium
N. sp.	N. constricta
N. sublinearis	N. reversa
N. tenirustris	N. seriata
N. distans	N. sigmoa
N. tennuis	N. sigmoidea
Pinnularia sp.	N. sp.1
Pleurosigma elongatum	N. tenirustris
Rhicosphenia sp.	N. sp.3
Rhizosolenia calcaravis	N. sp2
R. fragilissima	Pinnularia sp.
Scletonema costata	Pleurosigma delicatulum
Synedra sp.	P. elongatum
S. ulna	Rhizosolenia calcaravis
Tabellaria intermedia	R. fragilissima
Thalassionema nitzschoide	Skeletonema costata
Thalassiosira caspica	S. subsalsum
Th. variabilis	S. costatum
	S. dubius
	S. socialis
	S. sp.
	Surirella aracta
	Synedra acus
	S. ulna
	Thalassionema nitzschiodes
	Thalassiosira hustdti
	Th. sp.
	Th. aculeata
	Th. caspica
	Th. variabilis
	Tribonema sp.
	T. volgar

Before M.leidyi arrival in Southern Caspian Sea,the main species of Bacillariophyceae were Thalassionema nitzschoidea with Shannon index 1.864, then, Rhizosolenia calcaravis with Shannon index (1.058), Cyclotella menenghiniana with Shannon index 0.724 and Skletonema costatum with Shannon index 0.279 had maximum Shannon index of these groups (Table 2) but after M.leidyi arrival (during 2006 to 2007), the main species related to Bacillariophyceae with maximum Shannon index 3.132 belong to Thalassionema nitzschoide and then Chaetoceros sp.with Shannon index 1.083 (Table 2). Shannon-Weaver diversity index of some Bacillariophyceae species like Scletonema costata, Nitzschia SP increased.after M.leidyi arrival (Tables 2).

Table 2. Shannon-Weaver diversity index before and after *M.leidyi* arrival in Southern Caspian Sea

BACILLARIOPHYCEAE	Shannon Index	
Species	before M.leidyi	after M.leidyi
Actinocyclus paraduxus	0.004	0.007
Actinocyclus ehrenbergii	0.017	0.006
Amphora sp	0	0.007
Coscinodiscus perforatus	0.001	0.019
Coscinodiscus sp.	0.002	0.006
Chaetoceros sp.	0.001	1.083
Chaetoceros subtilis	0.024	0.24
Chaetoceros wighamii	0.007	0.007
Diplonois interupta	0.003	0.019
Gyrosigma attenuatum	0.003	0.004
Nitzchia acicularis	0.297	0.414
Nitzchia reversa	0.004	0.089
Nitzchia sp.	0.047	0.077
Nitzchia sp.	0.021	0.263
Navicula tenirustris	0.059	0.007
Pinnularia sp.	0.001	0.001
Rhizosolenia fragilissima	0.002	0.997
Rhizosolenia calcaravis	1.058	0.101
S. subsalsum	0.004	0.007
Synedra ulna	0.001	0.007
Thalassiosira variabilis	0.005	0.001
Thalassionema nitzschiodes	1.864	3.132

In this study, during 1995-1996 the overall average cell abundance of Bacillariophyceae in different seasons were significant different. The dominant cell abundance was recorded by Bacillariophyceae (80%) in winter while (Figure2).

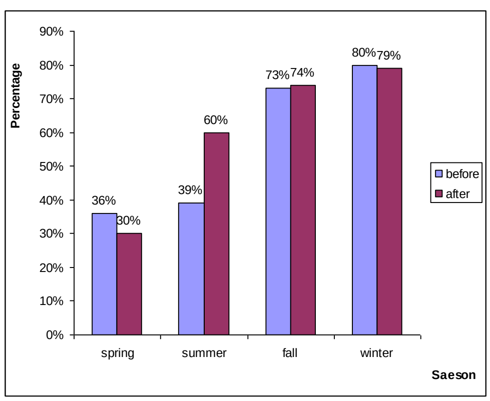

Figure 2. Compare of cell abundance percentage of Bacillariophyceae phyla during 1995-1996 and 2006-2007

The highest abundance percentage of Bacillariophyceae was spring 2006 and the minimum cell abundance percentage was at summer 2006 and abundance percentage of Bacillariophyceae in the different season had significant difference (p<.05). During spring in the years after arrival *M. leidyi*, abundance of Bacillariophyceae decreased (Figure2).

The highest diversity percentage of phytoplankton was in fall 2006 and in different seasons, Bacillariophyceae had significant change (Tables 3).

Table 3. Paired significant of Bacillariophyceae in different seasons in Southern Caspian Sea

Class	Factor	Spring	Summer	Fall	Winter
BACILLARIOPHYCEAE	Abundance	0.000	0.000	0.000	0.000
	Biomass	0.000	0.000	0.000	0.000

During spring in the years after arrival *M. leidyi*, abundance of Bacillariophyceae decreased and there is an increasing in abundance of Bacillariophyceae during winters of the same years (Hossieni et al., 1996) (Figure2).

Discussion

In Caspian Sea waters, because of different physicochemical factors as different seasons, rivers, circulation, pollution and biological factors special mnemiopsis leidyi observed changing in diversity microorganisms in different times and areas especially in southern of Caspian Sea.

During spring in the years after arrival M. leidyi, abundance of Bacillariophyceae decreased Because of increasing in zooplankton abundance during spring and summer, and also increasing of grazing zooplanktons, the result is showed decreasing in abundance of During spring in the years after arrival M. leidyi, abundance of Bacillariophyceae decreased. But in the end of summer and fall, during spring in the years after arrival M. leidyi, abundance of Bacillariophyceae decreased. Biomass increased because of increase in M. leidyi then decrease in zooplankton. There is an increasing abundance of during spring in the years after arrival M. leidyi, abundance of Bacillariophyceae decreased. During winters of the same years because of zooplankton population decreasing. In spring 1996, the variations in during spring in the years after arrival M. leidyi, abundance of Bacillariophyceae decreased and abundances inversely related with the water temperature (Hossieni et al., 1996). In totally, at the years after arrival mnemiopsis leidyi during spring in the years after arrival M. leidyi, abundance of Bacillariophyceae decreased because of increase small size cells like Thalassionema nitzschiodes. Arrival aggressor species like as N.serriata attendant M. leidyi with water balance of ships changed the Caspian Sea ecological conditions.The average annual temperature difference between regions for surface waters was high throughout the year.

Mixing also plays an important role in the limitation of primary production by nutrients. Inorganic nutrients, such as nitrate, phosphate and silica acid are necessary for phytoplankton to synthesis their cells and cellular machinery (Hutchinson, 1961).

Because of gravitational sinking of particulate material, nutrients are constantly lost from the photic zone, and are only replenished by mixing or upwelling of deeper water. Bacillariophyceae communities in hydroelectric reservoirs are highly susceptible to external forcing functions like hydrological load, external inputs of suspended solids and nutrients and human operation of the dam.

According to Salmanov, (1987), Bacillariophyceae species are the most abundant and widespread group throughout the South of Caspian Sea and in this study; it is found that cell abundance of phytoplankton decreased with decreased temperature followed by Bacillariophyceae and in this study,

Bacillariophyceae had the highest cell abundance that decreased with decreased temperature.

Zooplankton grazing, is a important factor considered in this study, is important in affecting phytoplankton distributionand that explain some of the accounted variation in our statistical relationships specially after Mnemiopsis leidyi arrival. Zooplankton body sizes and trophicgroups, feeding mainly on Bacillariophyceae (Barnett & Beisner 2007; Barnett et al., 2007). Such varietyof feeding and behavioural strategies amongst the herbivores could potentially affect the size and vertical position of the peaks of the different Bacillariophyceae. The role of the top-down effects of zooplankton in driving fine-scale vertical structure in the Bacillariophyceae remains largely unexplored. Mnemiopsis leidyi mainly lives from 0 to 15-25 m during the warm season. Then, in winter, Mnemiopsis leidyi is found throughout the isothermal layer above the pycnocline, with most of the population above 50 m and Bacillariophyceae as the main groups of phytoplankton found in the Southern Caspian Sea and Bacillariophyceae dominated the phytoplankton biomass, with the exceptions being occasional Bacillariophyceae blooms during summer and fall seasons while many species of Bacillariophyceae are photosynthetic, which lead to their initial categorization as plants. The presence of cell abundant is known to decrease grazing zooplanktons of phytoplanktons because of feeding M. leidyi of zooplanktons.

In both 1997 and 1998, like Caspian Sea after mnemiopsis arrival, in a cruise off the Washington coast and found large patches or blooms of Pseudo-nitzschia diatoms. Examination of samples taken during that cruise indicated that these blooms were composed almost entirely of P. Pseudodelicatissima. Since major changes in an ecosystem can affect all the tropic levels in the food chain, any ecological and environmental alteration can have a significant impact on phytoplankton species and the large-sized Bacillariophyceae community in the Caspian Sea (Kasymov, 1997).

Iranian lagoons and coastal regions have been steadily polluted with anthropogenic sources (fertilizers and pesticides used in agriculture and increase nutrient load of river flows due to deforestation of woodland) since the early 1980s (CEP, 2001; Salmanov, 1987). Thus, simultaneous rises in nutrient concentrations and M. leidyi abundance might also have contributed to the increases in Bacillariophyceae values while turnover of nitrogen and phosphorus by M. leidyi excretion (Kremer, 1976).

In Southern Caspian Sea waters, because of different physicochemical factors as different seasons, rivers, circulation, pollution and biological factors special mnemiopsis leidyi observed changing in cell abundance of phytoplankton in different times and areas.

M. leidyi alone would be sufficient to suppress available stocks of zooplankton within a short period (1 day in summer and 3-8 days during winter/spring) (Finenko et al., 2006) and thus would allow microorganism to increase and the reduction in herbivory due to extremely low levels of zooplankton is a possible factor determining enormous levels of Bacillariophyceae abundance.

Bacillariophyceae biomass and distribution change continuously with variations in environmental temperature, nutrient availability (Cullen and Horrigan, 1981), grazing pressure, tide and water movements (Balch, 1981; Demers et al., 1986), and seasons (Hsiao, 1980, 1988) and even with time of day. Endogenous rhythms also affect the diel distribution patterns of phytoplankton (Sournia, 1974). Diel rhythms in utrient uptake (Whalen and Alexander, 1984), cell division and photosynthetic assimilation (Legendre et al., 1988; Vandevelde et al., 1987) are well documented for natural Bacillariophyceae Populations.

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