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STUDY ON CYANOBACTERIA IN DIFFERENT YEARS AND SEASONS IN SOUTHERN CASPIAN SEA

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ABSTRACT: Since cyanobacteria are the base of life and productivity of aquatic ecosystems, sustainable ecological study of the Caspian Sea, particularly the distribution and identification of species composition, density and biomass, seasonal and regional variations in cyanobacteria before each study seems necessary.Plankton is strongly affected by numerous pesticides and herbicides. Synthetic detergents are very toxic for marine life, and water pollution with this agent affect the microbial flora. Marine life is easily affected, but the most deaths are due to lack of oxygen in the polluted water, and dumping of pesticides and toxic residue.Therefore, the purpose of this work was to study cyanobacteria of different seasons.For maturing of cyanobacteria 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. Then the samples transferred to laboratory of Ecological Academy, kept in cool and darkness in properly capped glass bottles. The cyanobacteria 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).The volume of each cell was then calculated by measuring its appropriate morph metric characteristics and geometric. Finally, the volume values were converted to biomass. In this study, cell abundance and biomass of in different seasons were significant different. The dominant cell abundance was recorded in spring while the minimum were in winter. Shannon-Weaver diversity index (Shannon et al., 1963) of species ranges from 0.00 to 0.696 that belong to Oscillatoria tenuis.Ecological and environmental alterations may trigger changes in the cyanobacteria species number, abundance and biomass. Then, since cyanobacteria depend upon certain conditions for growth, they are a good indicator of change in their environment. For these reasons, and because they also exert a global-scale influence on climate, cyanobacteria are of primary interest to oceanographers and Earth scientists around the world. Algae and produce the bulk of primary production in seas. During this study, Cyabobacteria community in the Caspian Sea changed in different years and the maximum cell abundance and biomass observed in summer and Shannon-Weaver diversity index changed in this study.

***Keywords*:** Pollution, Caspian Sea

INTRODUCTION

There are very few studies available on cyanobacteria changes after pollution of Caspian Sea. Many factors effect on in Southern Caspian Sea that, some factors act on short-medium time, while other evolves regularly on seasonal basis. The first group of factors depending on the intensity and on the frequency of disturbances is instrumental for supporting non-equilibrium dynamics and diversity or fast community reorganization events. As for the second group of factors, the annual evolution of solar elevation in the medium and high latitude regions is crucial to determine the seasonal replacement of cyanobacteria assemblages. In fact, for cyanobacteria and other organisms responding in a similar way to the same temporal scales- the time variable represents a complex environmental gradient driving annual successions.

The driving forces and mechanism of seasonal, changes are acknowledged to be related to variation in physical, chemical and biotic environment and to the many possibilities brought about by their mutual interaction which together effect differential specific growth and less rate among the algae (Reynold ,1984).

One of the most important factors governing seasonality is temperature variation. Thus with changing water temperature some species of alga begins to disappear. During 1995-1996 and 2006-2007 physic-chemical parameters of Southern Caspian Sea waters at the various monitoring stations did not change very much. The temperature averages, which are closely related to cyanobacteria biomass and composition.

Therefore, the purpose of this work was to study cyanobacteria of different seasons. The specific objectives of the study was conduct a seasonal sampling of cyanobacteria in the Southern Caspian Sea, in different years and analyze the structural communities(abundance and biomass) of cyanobacteria communities in the Southern Caspian Sea during this year's and study on cell abundance and biomass of cyanobacteria at different regions and seasons.

MATERIALS AND 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 cyanobacteria 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.

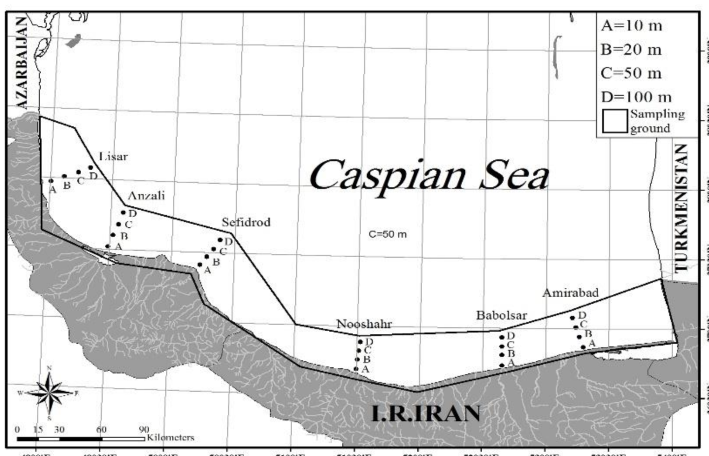

Figure.1 Map, transects and station position Southern Caspian Sea and

In this study, during 1995, 1996, 2006 and 2007, cyanobacteria 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, 1987), so that the final concentration of the samples had been chosen for quantitative measurements (Newell, 1977). A complete cyanobacteria analysis consisted of two parts. The first was identification of cyanobacteria species and to choose the final volume concentration for quantification and enumeration. If there was a few cyanobacteria species in the samples, the volume was increased from 5ml to 10ml until 25ml.the second pert was the enumeration and quantification of cyanobacteria species. The micro and nanocyanobacteria present in a sub sample of 0.1ml were taken from the original concentrated sample, and counted using a hydro bios lam. Then the samples transferred to laboratory of Ecological Academy, kept in cool and darkness in properly capped glass bottles. The cyanobacteria 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).The volume of each cell was then calculated by measuring its appropriate morph metric characteristics and geometric. Finally, the volume values were converted to biomass.

Table 1. Sampling transects, station position in southern part of Caspian Sea

Transect	Stations	Depth (m)	Longitude	Latitude
	A	10	48.58.00	37.57.5
Lisar	B	20	49.05.00	37.57.5
	C	50	49.12.30	37.57.20
	A	10	49.27.910	37.29.350
Anzaly	B	20	49.30.064	37.30.882
	C	50	49.30.414	37.34.961
	D	100	50.26.977	38.16.002
	A	10	48.54.956	37.29.379
Sefidrood	B	20	49.55.20	37.30.45
	C	50	49.54.800	37.31.370
	A	10	51.31.177	36.40.261
Nooshahr	B	20	51.32.075	36.40.976
	C	50	51.33.429	36.42.968
	A	10	52.38.646	36.43.641
Babolsar	B	20	52.38.638	36.45.172
	C	50	52.36.882	36.48.127
	D	100	52.35.987	37.25.110
	A	10	53.23.306	36.53.661
Amirabad	B	20	53.20.129	36.57.176
	C	50	53.16.350	37.00.750

Depending on the purpose of the investigation, cyanobacteria biomass can for example be expressed as cell volume (weight), plasma volume or carbon. The transformation to cell volume relies on measurements of the size of the species, and a large number of shapes have to be used for the different organism. The transformation of cell volume to plasma volume includes a stimate of the vacuole volume, and the calculation of cell carbon is in turn based on the plasma volume. The formulas recommended below are a step towards a more uniform treatment of counted organism. Volumes of species with a small size variation can be calculated as annual median values. For species present only seasonally, median values from several years can be used. Species with a large size variation are suitable divided into size groups during counting. They were analyzed by multiway factorial analyses of variance (ANOVA). For all protists, except diatoms, cell volume = plasma volume. For diatoms, plasma volume = cell volume - vacuole volume (Strathmann, 1967). Statistical analysis significant effects of canopy structure on photo acclimation were assessed by an l-way analysis of variance (ANOVA). The significance of the instantaneous effect of canopy arrangement on photosynthetic parameters was assessed by a simple linear regression test.

RESULTS AND DISCUSSION

Temperature

Temperature maxima and minima, of water column observed, were recorded in summer 2007 (29°C) and spring 1996 (5.3°C) respectively (Tables 4.1, 4.2). The seasonal distribution of temperature show significant differences among seasons (Figure 4.1) (spring, summer, and fall, winter) and the seasonal pattern of algal abundance showed a clear relationship with the water temperature due to summer had highest temperatures and winter had lowest temperatures. Then, the biomass of Chrysophyta was high in spring while, Cyanobacteria increased in summer which suggests that different groups of cyanobacteria are influenced by temperature and seasons in Southern Caspian Sea.

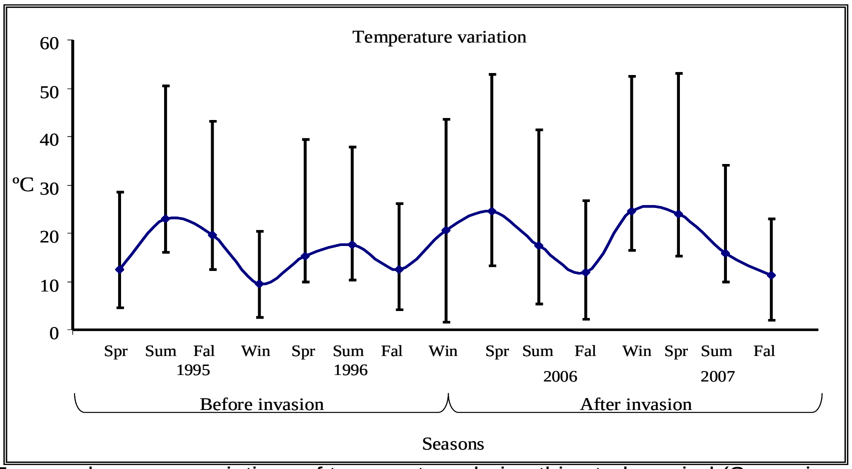

Figure.2 .Temporal average variations of temperature during this study period (Sp=spring=March-Jun Sum=summer=Jun-September Aut= autumn = September-December Win=winter=Desember-March)

Distribution of temperature was nearly homogeneous at all stations. The temperature average, which is closely related to cyanobacteria biomass and its composition, are between 29°C in summer 2007.

Cyanobacteria

In this study, in Southern Caspian Sea alone recorded 45 species of Cyanobacteria totally Cyanobacteria species increased from 16 species in 1995-1996 to 23 species in 2006-2007 (Tables.2).

Table 2. Checklist of cyanobacteria species during 1995-1996 and 2006-2007

Species	
1995-1996	2006-2007
Anabaena spiroides	Anabaena bergii
Anabaenopsis cunningtonii	A. aphanizomenoides
Aphanizominon issatschenko	A. spirodes
A. ussaczevii	Anabaenopsis cunningtonii
Aphanothece elabens	A. nodsonii
Closterum monilipherum	Aphanocapsa crassa
Lyngbya sp.	Aphanotece sp.
Microcystis aeruginosa	A. elabens
M. sp.	Aphenizominon ussaczevii
Noctoc sp.	Lyngbia limneti
Nodollaria spumginia	L. birgei
Oscillatoria chalybea	L. sp.
O. geminata	Merismopedia mimima
O. limosa	M. punctata
O. sp.	Microsystis aeruginosa
Tolypothrix distorta	M. pulverea
	M. sp.
	Nodollaria harveyana
	Nostoc sp.
	Oscillatoria limosa
	O. sp.
	O. tennuis
	Spirulina laxissma

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 cyanobacteria species due to During 1995-1996 the percentage of cell abundance and biomass of in different seasons were significant different ($p<.05$). The minimum biomass of was observed in during spring and winter 1995-1996 (6%), while both the maximum biomass and cell abundance of were observed at summer (65%) (Figurs 3, 4).

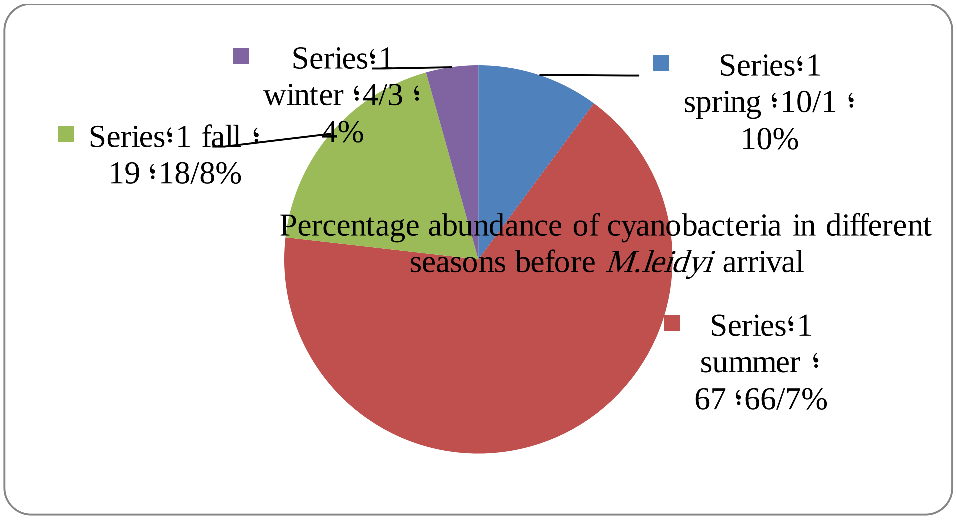

Figure3. Percentage abundance of in different seasons before *M.leidyi* arrival (1995-1996)

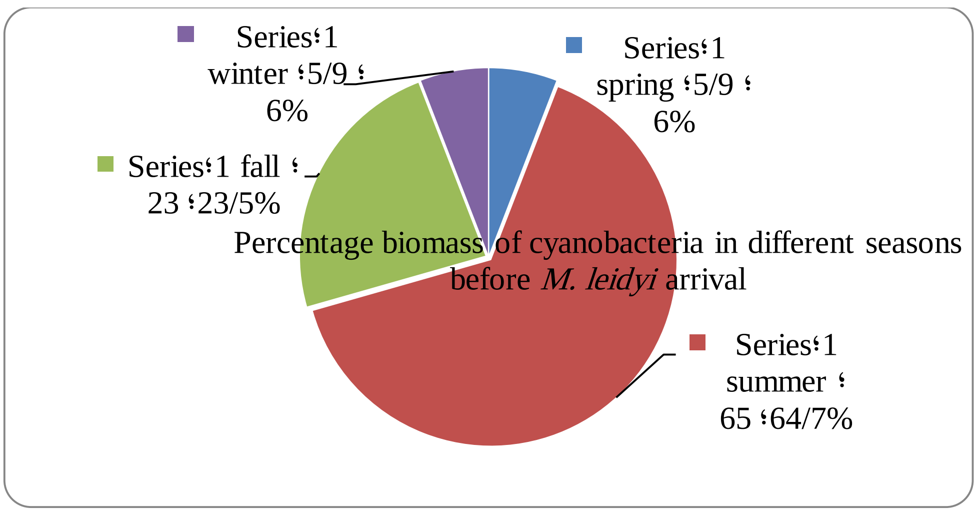

Figure4. Percentage biomass of in different seasons before *M.leidyi* arrival (1995-1996)

During 2006-2007 (after *M. leidyi* arrival), the minimum amount of abundance was observed in winter (7%) while the maximum amount of cell abundance was observed in summer (43%). The minimum and maximum biomass was observed in springs and winters (5%) and summer (61%), respectively. After *M. leidyi* arrival, as same as before *M. leidyi* arrival, the biomass and cell abundance of Cyanobacteria at different seasons showed significant difference ($P<0.05$) but in totaly, after *M.leidyi* arrival, Cyanobacteria show no significant changes (Figures5, 6).

According to statistical analyses, in addition to there being a significant, there was also a significant change in the seasonal cycle of concentration, that is, the peak occurred in summer before *M. leidyi* arrival and afterwards. cell abundance decreased in spring and continued in winter, due to minimum cell abundance show in winter during this study. But in autumn and winter during decrease of *M. leidyi* arrival, biomass show decreasing and during summers, both cell abundance and biomass of increased (Figures 5, 6).

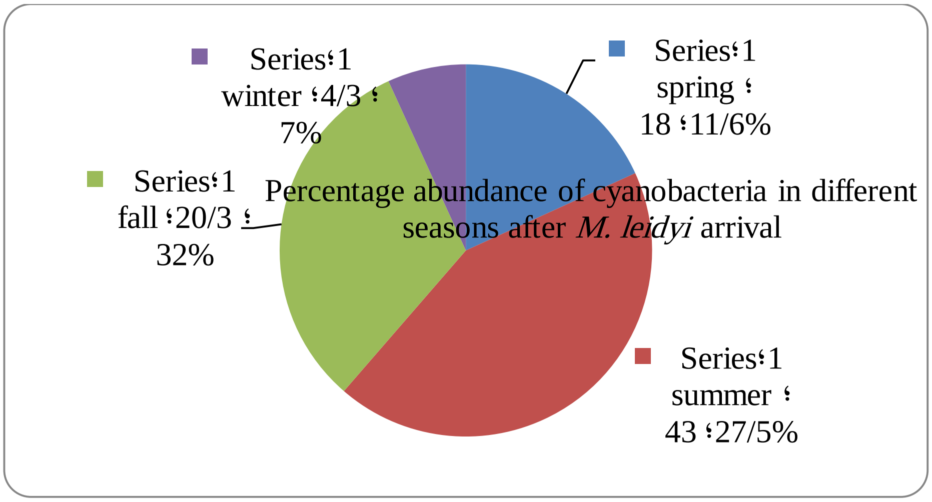

Figure5. Percentage abundance of in different seasons after *M.leidyi* arrival (2006-2007)

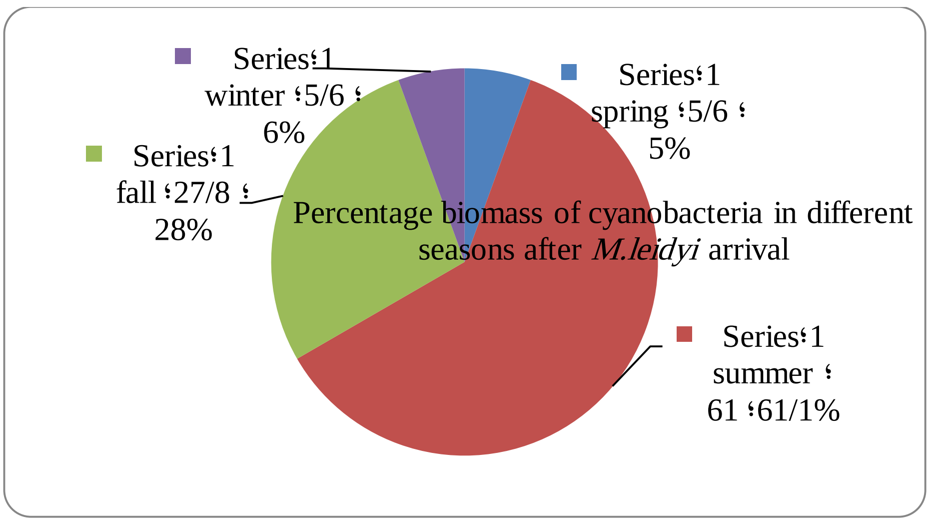

Figure6. Percentage biomass of in different seasons after *M.leidyi* arrival (2006-2007)

An effect of water pollution is the death of the aquatic waters, as a consequence of rising fertility due to the increase in nutriments, especially phosphates and nitrates which increases the quantities of plankton, plants and marine life. Little by little, the ecosystem, decrease in width and disappear.

In this study, the peak cell abundance and biomass of occurred in summer with increasing of temperature and in summer with increase air temperature, cell abundance and biomass of Cyanobacteria increased. The most characteristic of these is the seasonal cycle, although wind magnitudes additionally have strong spatial components. Consequently, primary production in temperate regions such as the Southern Caspian Sea is highly seasonal, varying with both incident light at the water's surface (reduced in winter) and the degree of mixing (Salmanov, 1987 and Kasimov, et al., 1983).

The areas of this study adjoining to river estuaries are always characterized by increased producing capacity due to organic matter brought by rivers especially in winters. Considering the high potential reproductive rates of organisms, environmental instability comprises factors characterized by very different temporal scales.

Cyanobacteria is an important group in the Southern Caspian Sea throughout the year in terms of cell abundance and many species of are photosynthetic, which lead to their initial categorization as plants. As a result, it was shown that the biomass and abundant decreased rapidly with decrease temperature in fall and winter. However, it was also noted that 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 changes in values while turn over of nitrogen and phosphorus by *M. leidyi* excretion (Kremer, 1976) would also contribute to these changes of .

In Caspian Sea waters, especially in southern of Caspian Sea, because of different physicochemical factors as different seasons, rivers, circulation, pollution and biological factors special *mnemiopsis leidyi* observed changing in cell abundance and biomass and number of species of in different seasons*. Mnemiopsis leidyi* is a highly fecund comb jelly feeding extensively on zooplankton. The main diet of this ctenophore in the southwestern Caspian Sea was found to be copepods (45%) during May 2000- march 2001 (Kasimov, 1983), as found previously in the Black Sea (Mutlu, 1999). Predation impacts of M. leidyi on zooplanktic prey organisms have been previously demonstrated in its native waters, the western Atlantic, and in introduced regions (Kideys, 2002, Kideys et al., 2005). Furthermore, a recent study based on feeding experiments in the Caspian Sea suggested that the predation pressure of 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 to change cyanobacteria cell abundance and biomass to change and the reduction in herbivory due to extremely low levels of zooplankton is a possible factor determining enormous levels of some groups of cyanobacteria abundance and limitting another groups. 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 (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 Populations.

REFERENCES

BALCH WM. 1981. An apparent lunar tidal cycle of cyanobacteria blooming and community succession in the Gulf of Maine. Journal of Experimental Marine Biology and Ecology. 55:65-77.

CEP. 2001. Caspian Environmental Program, Mnemiopsis workshop (Baku, 24-26 April 2001) final report; CEP Wb site: http://www.http://www Caspian environment. org/biodiversity/meeting. htm

CULLEN JJ and Horrigan SG. 1981. Effects of nitrate on the diurnal vertical migration, carbon to nitrogen ratio, and the photosynthetic capacity of dinoflagellate Gyrnnodiniurn splendens. Marine Biology. 6231-89.

DEMERS S, LEGENDRE L and THERRIAULT J-C. 1986. Phytodistribution of cyanobacteria. Bulletin of Marine Science. 43:710-729.

FINENKO G, Kideys A, Anensky B, Shiganova TA, Roohi A, Roushantabari M, Rostami HA & Bagheri S. 2006. Invasive Ctenophore Mnemmiopsis leidyi in the Caspian Sea: feeding, respiration, reproduction and predatory impact on the zooplankton community. *Marine Ecology Progress Series* 314:171-185.

HSIAO SIC. 1980. Quantitative composition, distribution, community structure and standing stock of sea ice microalgae in the Canadian Arctic. Marine Ecology 33:768-793.

Hsiao S.1988. Spatial and seasonal variations in primary production of sea ice microalgae and cyanobacteria in Frobisher Bay, arctic Canada. *Marine Ecology* 44:275-285.

KASIMOV AG. 1987.The Wildlife of the Caspian Sea. Baku. Azarbaijan.

KASIMOV AG and Bagirov RM. 1983.Biology of the modem Caspian Sea. Baku. 184pp.

KIDEYS AE. 2002. Mnemiopsis in Turkish waters, Caspian Environment rogramme, CEP

KIDEYS A; Roohi, A; Bagheri, S; Finenko, G & Kamburska, L. 2005. Impact of Invasive Ctenophores on the Fisheries of the Black Sea and Caspian Sea. Oceanography. Vol. 18, No.2, 32-42 p.

KREMER P. 1976. Population dynamics and ecological energetics of a pulsed zooplankton predator, the Ctenophore Mnemiopsis leidyi. Estuarine processes. Voll. Uses, Stresses and Adaptation to Estuary. p.197-215.

LEGENDRE L, DEMERS S, GARSIDE C, HAUGEN EM, PHINNEY DA, SHAPIRO LP, THERRIAULT J-C and YENTSCH CM. 1988.Circadian photosynthetic activity of natural marine cyanobacteria isolated in a tank. Journal of Plankton Research 1O:l-6.

NEWEL GE. 1977. Marine Plankton. London: Hutchinson

REYNOLD CS. 1984. The Ecology of Fresh Water Cyanobacterias, Cambridge University Press. Cambridge. 384pp.

ROOHI A. 2009. Population dinamic and effects of the invasive species ctenophore Mnemiopsis leidyi in the southern Caspian Sea. University Sains Malaysia.

SALMANOV MA. 1987. The role of Microflora and cyanobacteria in production process translated by Abolghasem shariati the science and industrial. fishery centers in Mirza Kochagkhan, Rasht, IRAN 349 p.

SALMANOV MA. 1987. The Role of Microflora and Cyanobacteria in the Production Processes of the Caspian. Moscow, Nauka, 1-214.

SOURNIA A. 1974. Circadian periodicities in natural populations of marine cyanobacteria. Advances in Marine Biology 12:325-389.

STRATHMANN RR. 1967. Estimating the organic content of cyanobacteria from cell volume or plasma volume. LimnoL Oceanogr., 12,411-418

VANDEVELDE T, LEGENDRE L, THERRIAULT J-C, DEMERS S and BAH A. 1987. Sub-surface chlorophyll maximum and hydrodynamics of the water column. Journal of Marine Research 45:377-396.

WHALEN SC and ALEXANDER V. 1984. Diel variations in inorganic carbon and nitrogen uptake by cyanobacteria in an arctic lake. Journal of Plankton Research 6571-590.