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An ecologic study on Bacillaphyta and Cyanophyta and compare before and after Mnemiopsis leidyi arrival in the Southern Caspian Sea

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ABSTRACT: Phytoplankton are primarily structured by the water elements, influenced by light intensity, the diversity is different with north and middle of Caspian Sea. It is important to know about diversity, abundance and biomass of phytoplankton in this area, then for this study was done in southern par of Caspian Sea. All samples were taken during 1995-96 and 2006-2007 in 6 transects such as Lisar, Anzali, Sefidroud, Noushahr, Babolsar and Amirabad, respectively. The phytoplankton compositions were changed significantly with seasons ($P<0.05$). In comparison after *Mnemiopsis leidyi* arrival, phytoplankton species were increased. Totally 124 species were identified from 2 phylums such as Bacillariophyta and Cyanophyta were 91 and 33 species, respectively. At the present research, the most dominant group was Bacillariophyta and between all species and majority related to *Thalassionema nitzchoide* specie. Also, 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. During 2006- 2007 (after *M. leidyi* arrival), the phytoplankton are shown significant changes in diversity at different seasons ($P<0.05$. The highest amounts of phytoplankton in southern part of Caspian Sea were Cyanophyta and Bacillariophyta phyla, respectively and According to statistical analysis, there was a significant change in seasonal cycle of Cyanophyta concentration. Because decreasing siliconate phytoplankton in the summer, Nodularia spumigena, of Cyanophytes, bloomed in 2005

***Keywords*:** Phytoplankton, Caspian Sea, Species, Mnemiopsis leidyi

INTRODUCTION

The Caspian Sea is unique not only because of its size and as distinct from other lakes, the water of the Caspian is not fresh, but brackish then it is an important lake that has been studied intermittently hydrologically and biologically by researchers of the countries around that and is the largest lake on our planet. It is bigger than the Great American lakes and Lake Victoria in Africa by surface area. It is a remnant of the Tethys Ocean, along with Black and Mediterranean seas. It became landlocked about 5.5 million years ago due to continental drift. Some 50-60 milion years ago, Thetis Ocean connected the Atlantic and the Pacific Oceans. Gradually, due to movement of continental platforms, it lost its connection, initially, with the Pacific Ocean, and later with the Atlantic, turning it into an isolated water body. Thus, the salinity of the Caspian can be accounted for its genesis and the Caspian Sea in classical antiquity among Greeks and Persians it was called the Hyrcanian Ocean (Salmanov, 1987).

Phytoplankton are primarily structured by the water elements, influenced by light intensity, the diversity is different with north and middle of Caspian Sea. It is important to know about diversity, abundance and biomass of phytoplankton in this area (Battish, 1992).

The study done by (Salmanov, 1987) across large regions of the World Ocean such as the Southern Ocean, phytoplankton is also limited by the lack of the micronutrient iron. This has led to some scientists advocating iron fertilization as a means to counteract the accumulation of human-produced carbon dioxide (CO_2) in the atmosphere.

Large scale experiments have added iron (usually as salts such as iron sulphate) to the oceans to promote phytoplankton growth and draw atmospheric CO_2 into the ocean.

Phytoplankton obtain energy through the process of photosynthesis and must therefore live in the well-lit surface layer (termed the euphotic zone) of an ocean, sea, lake, or other body of water. Phytoplankton account for half of all photosynthetic activity on Earth. Thus phytoplankton is responsible for much of the oxygen present in the Earth's atmosphere half of the total amount produced by all plant life. Their cumulative energy fixation in carbon compounds (primary production) is the basis for the vast majority of oceanic and also many freshwater food webs (Boyd and Tucker, 1998). Thus algal growth is regulated by basic growth parameters such as inorganic nutrients (Hart and Robinson, 1990). A study shown that the Bacillariophyta and Euglenophyta phylum had maximum and minimum diversity respectively in southern part of Caspian Sea (Ganjian et al., 2004).

Many studies done by authors (Cullen and Horrigan, 1981) about phytoplankton diversity in different ecosystems and the effects of different biotic and abiotic on their population due to phytoplankton biomass, distribution and species composition change continuously with variations in environmental temperature and nutrient availability. A research shown (Balch, 1981 and Demers et al., 1986) that the species composition of phytoplankton are changed on grazing pressure, tide, water movements. A rhythm of water movement in different season and depth make nutrient uptake, cell division and photosynthetic assimilation that phytoplanktons population increment (Legendre et al., 1988 and Vandevelde et al., 1987). Also a research (Sournia, 1974) shown that the even with time of day. Seasonal diversity of plankton life was used as a measure of water quality of a brackish water aquaculture (Ganjian Khenari et al., 2010).

MATERIALS AND METHODS

All seasonal samples were collected from six horizontal transects. Along each transect four stations (A, B, C, D) were located at depths of 10, 20, 50 and 100 meters (Figure 1). The longitude and latitude of six transect were 48° 58' 00″ to 53° 12' 92″ E and 37° 57' 50″ to 37° 02' 66″ N (Table 1). Sampling was done at various depths such as A=10m (0, 10) m, B=20m (0, 10, 20) m, C=50m (0, 10, 20, 50) m, D=100m (0, 10, 20, 50, 100) m (Table 1). This study was done in years 1995, 1996, 2006 and 2007.

Table1. Sampling transects, station position in southern part of Caspian Sea

Transect	Stations	Depth (m)	Latitude	Longitude
Lisar	A	10	37° 57′ 50″	48° 58′ 00″
	B	20	37° 57′ 50″	49° 05′ 00″
	C	50	37° 57′ 20″	49° 12′ 30″
	D	100	37° 52′ 48″	49° 26′ 97″
Anzaly	A	10	37° 29′ 508″	49° 28′ 984″
	B	20	37° 30′ 947″	49° 30′ 240″
	C	50	37° 35′ 090″	49° 30′ 199″
	D	100	37° 39′ 957″	49° 30′ 186″
Sefidrood	A	10	37° 29′ 373″	49° 55′ 898″
	B	20	37° 30′ 545″	49° 55′ 417″
	C	50	37° 31′ 374″	49° 55′ 067″
	D	100	37° 31′ 515″	49° 55′ 650″
Nooshahr	A	10	36° 40′ 255″	51° 31′ 249″
	B	20	36° 40′ 812″	51° 32′ 297″
	C	50	36° 43′ 249″	51° 31′ 101″
	D	100	36° 45′ 071″	51° 32′ 695″
Babolsar	A	10	36° 43′ 567″	52° 38′ 961″
	B	20	36° 45′ 216″	52° 38′ 562″
	C	50	36° 48′ 159″	52° 36′ 940″
	D	100	36° 48′ 845″	52° 36′ 872″
Amirabad	A	10	36° 53′ 778″	53° 22′ 721″
	B	20	36° 57′ 287″	53° 20′ 485″
	C	50	37° 00′ 680″	53° 15′ 686″
	D	100	37° 03′ 269″	53° 13′ 058″

All phytoplankton samples were collected by using a Van Dorn water bottle sampler as well as tubes membrane pump. Totally 500 ml of water were taken and added to the glass bottles and then fixed with neutralized formaldehyde solution as 4% (APHA, 2005) then the samples transferred to laboratory of main biological laboratory, kept in cool and darkness in properly capped glass bottles. The composition and abundance of each phytoplankton sample was determined under a photo microscope “Nikon” light at ×480 magnification and identified by keys. Algae abundance was determined using the Hydro bios counting chamber and sampled (volume 0.1 ml). Depending on the purpose of the investigation, phytoplankton 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 (e.g.diatoms and monads). For all protists, except diatoms, cell volume = plasma volume. For diatoms, plasma volume = cell volume - vacuole volume (25).Obtained data are in two parts; before and after of invasion by Mnemiopsis leidyi. (Salmanov, 1987 and Strathmann, 1967). All data were analyzed by Multi way factorial analyses of variance (ANOVA).

Figure 1. Map transects and stations in the Caspian Sea

RESULTS AND DISCUSSION

Result

In this study, bith Bacillaphyta and Cyanophyta species composition changed considerably with seasons. This study data are pertaining to the composition of Bacillaphyta and Cyanophyta microalgae in southern part of Caspian Sea. In accordance with the survey carried out in southern part of Caspian Sea, during this study, two phylums Bacillaphyta and Cyanophyta

During 1995-96, about 35% of total species of Bacillaphyta and Cyanophyta were reduced (51 species) respect to spring with Bacillariophyta domination. In all seasons, Bacillariophyta was domination. In winter, Bacillariophyta (46 species) were increased respect to spring, summer and autumn (Figure 2).

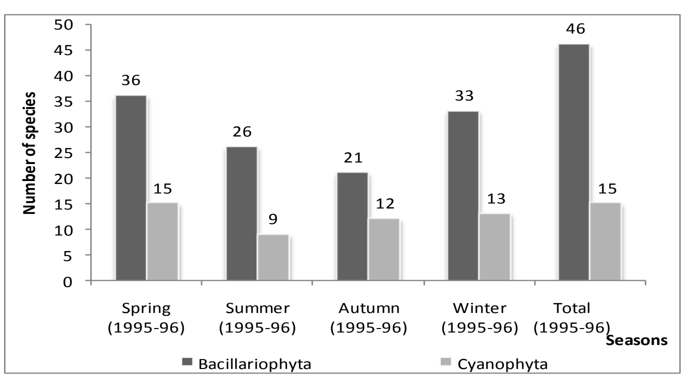

Figure 2. Number of Bacillaphyta and Cyanophyta species in different years and seasons during(1995-1996)

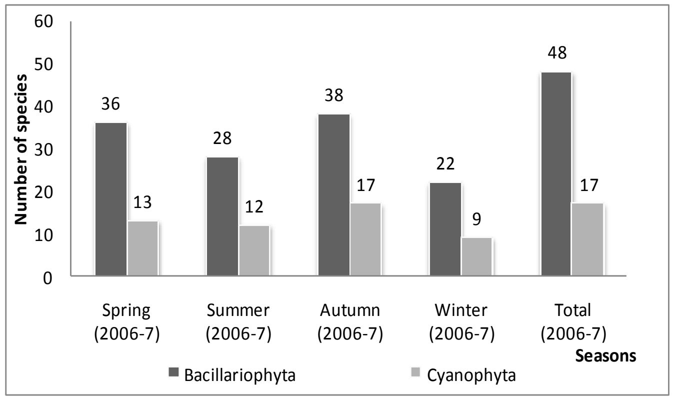

Figure 3. Number of Bacillaphyta and Cyanophyta species in different years and seasons(during 2006-2007)

During 2006-2007, the domination phyla were related to Bacillariophyta (Figure 3). In spring season, totally 49 species identified with two phylums such as Bacillariophyta and Cyanophyta. In summer, total species of Bacillaphyta and Cyanophyta increased (40 species) with Bacillariophyta domination. The maximum species of both Bacillaphyta and Cyanophyta observed in autumn (Figure 3).

During 2006-2007, significant changes were acquired in diversity of phytoplankton in different seasons and Bacillariophyta was significantly decreased (P<0.05). But Cyanophyta was significantly increased (P<0.05).

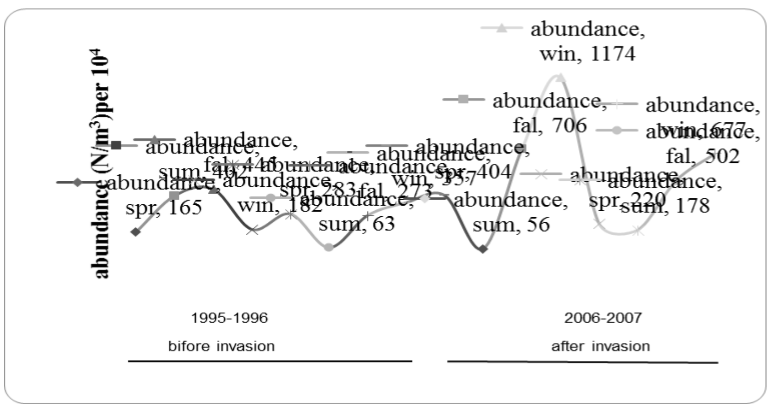

Figure .4 .The abundance of Bacyllariophyta at different seasons(spring=March-Jun Summer=Jun-September,Autumn=September-December, Winter= December-March)

In Southern Caspian Sea, during summer 1995, Bacyllariophyta abundance increased and continued to fall and then in winter, decreased and then in summer and fall to spring 1996 increased. The maximum abundance of Bacyllariophyta occurred inwinter 2006 (Figure 4).

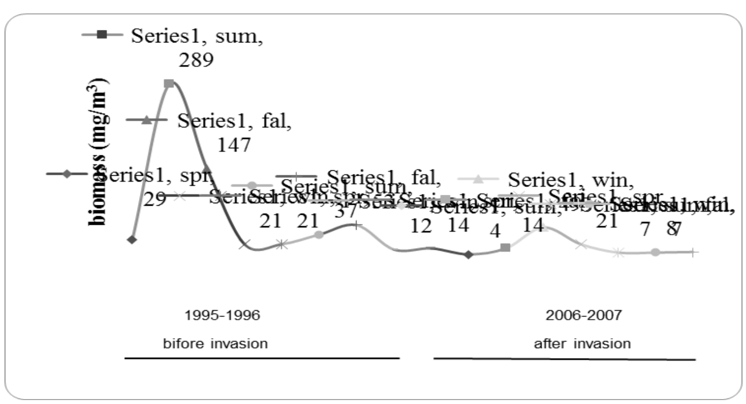

Figure. 5 .The biomass of Bacyllariophyta at different seasons (spring=March-Jun, Summer=Jun-September, Autumn=September-December , Winter= December - March)

During this study, the maximum biomass of Bacyllariophyta observed in summer of 1995. In spring 1996, Bacyllariophyta started to increasing in cell abundance but not biomass and accurding to statistical analysis, there was a significant change in the seasonal cycle of Bacyllariophyta concentration, that is, the peak occurred in spring-summer 1995 and winter – spring 1995-1996, before M.leidyi invaded (Figure 5).

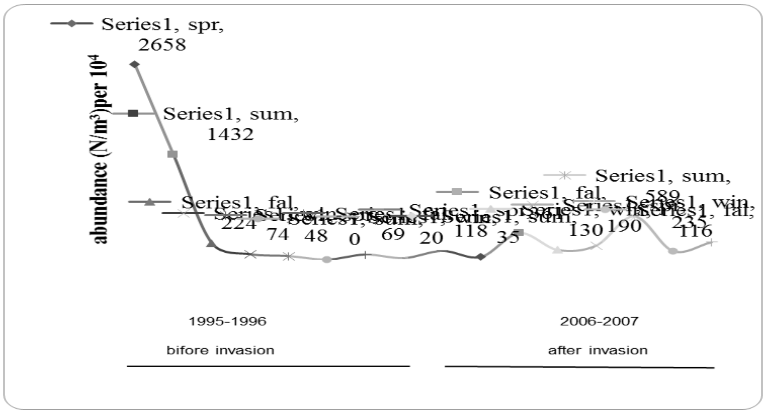

Figure .6.The abundance of Cyanophyta at different seasons (spring=March- Jun, Summer=Jun-September, Autumn=September-December, Winter=December-March)

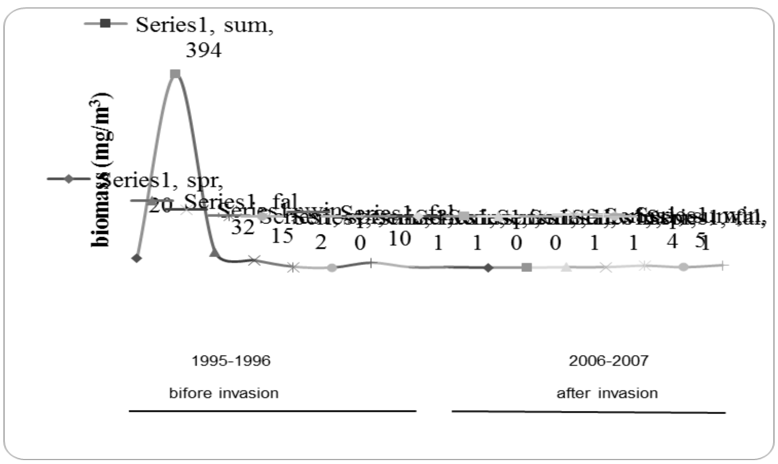

Figure .7 .The biomass of Cyanophyta at different seasons (spring=March-Jun, Summer=Jun-September, Autumn=September-December, Winter=December-March)

In the present study, Cyanophyta was observed in high abundance in summer with the dominant species being Oscillatoria limosa and the peak of Cyanophyta cell abundance occurred in spring1995, but, the peak of Cyanophyta biomass occurred in summer of the year

The high increase in Cyanobacteria cell abundance in summer progressed, suggests that the strong relationship between Cyanobacteria abundance and water temperature, as observed in the Southern Caspian Sea. In fall 1995, cell abundance and biomass of Cyanophyta decreased. (Figures 6,7). The seasonal diversity of phytoplankton in this study had significant difference in different seasons ($P<0.05$). Shannon-Weaver diversity index (Tahami et al., 2011) of phytoplankton species ranges from 0.00 to 4.46.during 1995 to 1996 and 2006 to 2007.

dicussion

Bacillaphyta and Cyanophyta community is a heterogeneous group of tiny plants (phytoplankton) adapted to suspension in the sea and fresh water (Battish, 1992) that the dynamic of rapid increase or decrease of plankton populations is an important issue in marine ecology (Cullen and Horrigan, 1981; Tahami et al., 2012), grazing pressure, tide and water movements (Balch, 1981 and Demers et al., 1986), seasons (Hsiao, 1980 and Hsiao, 1988) and even with time of day. Endogenous rhythms also affect the dial distribution patterns of Bacillaphyta and Cyanophyta (Sournia, 1974 and Tahami, 2012).

As well as in case of varying location, the diversity of temperature conditions of the Caspian change abundance and biomass. In Southern Caspian Sea many Bacillaphyta are photosynthetic and generally have rapid growth rates, which led to their initial categorization as plants and ecological significance includes playing a major role at the base of the food chain. Production characteristics of various areas of the Caspian are also quite different and, as well in the cases of locationand temperature, which results in the magnification of abundance and biomass of this lake. Phytoplankton can undergo rapid population growth when water temperatures rises in the presence of excess nutrients.mineral elements arriving with river runoffs serve as a basis for biological production. Dial rhythms in nutrient uptake, cell division and photosynthetic assimilation are well documented for natural phytoplankton populations (Legendre et al., 1988 and Vandevelde et al., 1987). Competitive dominance of the best adapted species is a process requiring a homogeneous habitat, environmental stability and equilibrium conditions (Hutchinson, 1961). Therefore, phytoplankton may be viewed as a non-equilibrium community of competing species and thus are not an exception to the principle of competitive exclusion. the loss of ecosystem stability, will be indicated by an inflection point in the scatter plot of diversity and related key variable.

According to statistical analysis, there was a significant change in seasonal cycle of Cyanophyta concentration. Because decreasing siliconate phytoplankton in the summer, Nodularia spumigena, of Cyanophytes, bloomed in 2005 (CEP, 2001).

Phytoplankton is often categorized into groups based on their primary role in biochemical material fluxes and/or in primary production. As well as in case of varying salinity, the diversity of temperature conditions of the Caspian increases its biodiversity. Undoubtedly that the mineral elements arriving with river runoffs serve as a basis for biological production. The areas of this study adjoining to river estuaries are always characterized by increased producing capacity due to organic matter brought by rivers. In southern Caspian Sea, many spesies of Bacillariophyta are photosynthetic, which lead to their initial categorization as plants. As a result, it was shown that the species of chaetognaths decreased rapidly with decrease temperature (Ganjian et al., 2009) then river and lakes are important part of the nature and their water quality should be maintained. The current findings indicate clearly that more algal species were recorded in the dry season than the rainy season. The representation of higher members of Cyanophyta consequent of several factors which include increased temperature, low N/P ratios and low vulnerability to grazing by zooplankton. The rainy season was the period with the highest Nitrate-Nitrogen concentration which is known to support the formation of blooms. Cyanobacteria exhibit in addition to the above adaptability to regulate buoyancy, as well as the regulation of pigment pools in response to both quantity and quality of light. Hence it could be said the presence of higher number of species of the Chlorophyta and Cyanophyta in the dry and rainy season, respectively is indicative of the water quality in the two seasons. An additional strategy to supplement nutrients in phytoplankton may involve luxury uptake of N- and P- compounds (Tahami et al., 2011 and Tahami et al., 2009).

Shannon-Weaver diversity index of phytoplankton was greater than 3 indicate that water is suitable for the growth of phytoplankton.

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. After increase M. leidyi, the maximum specific growth rate was increased and more them observed in spring and summer,during the period of active reproduction of adult animals (M. leidyi). Ecological significance includes playing a major role at the phytoplankton diversity, the base of the food chain as Bacillariophyta diversity decreased but remnant phyla increased (Ganjian et al., 2009) due to shnnon index show significant changes in the Caspian Sea waters before and after M.leidyi arrival (Roohi, 2008 and Tahami, 2012).

A numbers of reports (Salmanov, 1967 and Ganjian Khenari et al., 2010) shown that the bacillariophyta constitute the main phyla in the middle and the southern part of Caspian Sea. In spring and summer with increase air temperature, species of Cyanophyta increased.

REFERENCES

APHA (American Public Health Association). 2005. Standard Methods for the Examination of Water and Wastewater. 17th edition, APHA, AWWA, and WPCF, Washington D.C; USA. p. 150.

Ali SS. 1999. Fresh Water Fisheries Biology, 1st ed. Naseem Book Depot, Hyderabad.

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

Battish SK. 1992. Fresh water zooplanktons Of India, Oxford and IBH Publishing Co. Ltd. New Delhi.

Boyd CE and CS Tucker. 1998. Pond Aquaculture Water Quality Management, Kluwer Academic Publisher, London.

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.
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, L Legendre, and JC Therriault. 1986. Phytodistribution of phytoplankton.
Ganjian A, Makhlogh A and Tahami F. 2004. The Survey and quality distribution of phytoplankton in the southern of Caspian Sea, The 2nd congress on applied biology (International approach), Mashhad Free university, 850p.
Ganjian Khenari A, WO Wan Maznah Kh, Yahya Sh, Najafpour GhD Najafpour, Vahedi M, Roohi A and Fazli H. 2010. Seasonal Succession of Phytoplankton Community Structure in the Southern Part of Caspian Sea "American-Eurasian J. Agric. & Environ. Sci.,8(2): 146-155, 2010.
Ganjian KHA, WO Wan Maznah, Yahya KH, Najafpour SH, Najafpour DGH and Roohi A. 2009 The assessment of biological indices for classification of water quality in southern part of Caspian Sea, World Apply Science Journal, 7(9); PP 1097-1104, 2009.
Hsiao SIC. 1980. Quantitative composition, distribution, community structure and standing stock of sea ice microalgae in the Canadian Arctic. Arctic 33:768-793.
Hsiao SIC. 1988. Spatial and seasonal variations in primary production of sea ice microalgae and phytoplankton in Frobisher Bay, arctic Canada. Marine Ecology -Progress Series 44:275-285.
Hart D and Robinson D. 1990. Resources Limitation in stream community. Phosphorus enrichment effects on periphyton and grazers, J. Ecology, 71, 1992-1502.
Hutchinson GE. 1961. The paradox of the plankton. Am. Nat. 95: 137-145.Bulletin of Marine Science, 43:710-729.
Legendre LS, Demers C, Garside EM, Haugen DA, Phinney LP, Shapiro J, Therriault C and Yentsch CM. 1988..Circadian photosynthetic activity of natural marine phytoplankton isolated in a tank. Journal of Plankton Research 1O:I-6.
Newell GE. 1977. Marine plankton. Hutchinson Co. London, p. 320.
ROOHI A, Zulfigar Y, Kideys A, Aileen T, Eker – Develi E, Gangian A and Nasrollahzadeh H. 2008a. Environmental changes due to a new alein comb jelly, Mnemiopsis leidyi in the Southern Caspian Sea. International conference on environmental research and technology (ICERT 08), 28-30 MAY 2008, Penang, Malaysia.
Sournia A. 1974. Circadian periodicities in natural populations of marine phytoplankton. Marine Biology 12:325-389.
Salmanov MA. 1987. The Role of Microflora and Phytoplankton in the Production Processes of the Caspian. Moscow, Nauka, 1-214.
Salmanov MA. 1987. The Role of Microflora and Phytoplankton in the Production Processes of the Caspian. Moscow, Nauka, 1-214.
Sorina A. 1978. Phytoplanktone Manual Unesco, Paris.340 p.
STRATHMANN RR. 1967. Estimating the organic content of phytoplankton from cell volume or plasma volume. LimnoL Oceanogr., 12,411-418.
Shannon CE and Weaner W. 1949. The mathematical theory of communication. University of Illinois Press, Urbana, pp:117.
Tahami FS, Mazlan Bin AG, Negarestan H and Lotfi Bin WM. 2009. Identify of phytoplanktons in Caspian Sea waters.Conference Aquaculture 2009, Kuala Lumpur, Malaysia.
Tahami FS, Mazlan Bin AG, Negarestan H and Lotfi Bin WM. 2011.Abundance and Biomass of Phytoplanktons in Different Seasons in Southern Caspian Sea Before and After Mnemiopsis leidyi. International Congress on Applied Biology . Mashhad, IRAN.
Tahami FS, Mazlan AG, Negarestan H, Lotfi WWM STUDY ON PYTOPLANKTON POPULATION IN SOUTHERN CASPIAN SEA BEFORE AND AFTER MNEMIOPSIS LEIDYI. JMBA Journal, 2012 (In publishing).
Tahami FS, Mazlan AG, Negarestan H, Najafpour SH, Lotfi WWM and Najafpour GD Phytoplankton Combination in the Southern Part of Caspian Sea. World Applied Sciences Journal 16 (1): 99-105, 2012.
Tahami FS. 2012. Changes in phytoplankton community structure during the Mnemiopsis leidyi invasion of the Southern Caspian Sea (IRAN). Thesis for the degree of Ph.D of Marine Science.
Vandevelde T, L Legendre JC, Therriault S Demers and A Bah. 1987. Sub-surface Chlorophyll maximum and hydrodynamics of the water column. Journal of Marine Research 45:377-396.
Vollenweider AR. 1974. A manual on methods for measuring primary production in aquatic environmental. Blackwell Scientific Publication Oxford, London ,UK. p. 423.
Zonn IS. 2000. Three centuries at Caspian (The Synchronism of Major Historical Events of XVIII–20 cc.). 1-72.