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THE SITUATION OF MICROALGAE BLOOMER AROUND THE SHRIMP FARM COMPLEXES IN BUSHEHR PROVINCE IN PERSIAN GULF

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Abstract

The present work was performed with the aim to aware about the red tide condition before entering the algal bloomer in seawater supply canals of the Mond, Delvar and Heleh shrimp farm and hatchery complexes in Bushehr province, in Iranian part of Persian Gulf . Field investigation and sampling have been carried out in the southern of the supply canals of shrimp farm complexes, from April to December 2011. Microalgae Bloomer density, physico-chemical parameters such as pH, salinity and water temperature and also meteorological conditions were studied in this project.

Keywords – Microalgae Bloomer, Shrimp Farm, physico-chemical, Bushehr, Persian Gulf.

INTRODUCTION

Coastal ecosystems have impacted by environmental problems such as sea grasses losing, coral reef degradation, and loss of water quality due to urban and industrial effluents. These conditions face the marine and coastal zone with algal blooms phenomena. In recent years, the algal blooms causes many risks to human health and also brings negative effects on living resources and marine reserves, damage to marine ecosystems, and the deleterious effects on ecotourism [1].

Harmful species are belong to six groups including; diatoms, dinoflagellates, haptophytes, raphidophytes, cyanophytes, and pelagophytes [2]. The harmful species are classified in two types of causative organism: the toxin producers and the non-toxic high biomass bloomer. The high biomass bloomers are some species such as *Cochlodinium sp*, when the ecological condition is in their optimum growth range and in the presence of sufficient nutrients, undergoing rapid proliferation in a short time (usually within 1 to 3 weeks). Their density increased from several thousand cells per litter to tens of millions of cells. They usually damage the sea creature by physical methods (low oxygen levels and clogging the fish gill). Increase in the population explosion of algae and respiratory activity, leading to a severe reduction of dissolved oxygen in water [3]. Accumulation of mucus jelly-like mass mortality due to respiratory organs of aquatic algae and reduction of dissolved oxygen in the water caused severe losses in aquaculture in bloomed region.

The other category includes the phytoplankton often have low density (about 102-104 cell/lit), but because they produce toxins, causes harm to aquatics [1]. Toxic species are very dangerous, so that the consumption of contaminated fish with such toxic algae causing the death of humans within 2 to 24 hours. Most toxins that are produced by this group include Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP), Amnesic Shellfish Poisoning (ASP) and Neurologic Shellfish Poisoning (NSP). Species such as; *Alexandrium* ,*Gymnodinium cat*. and *Pyrodinium bah*. are PSP. *Dinophysis* and *Prorocentrum* are DSP. *Nitzschia* and *Psudonitzschia* are ASP [1 and 2].

About 4000 species of phytoplankton identified in the world, but only 80 species, most belong to the class of *Dinophyceae* are toxic and about 200 species are high biomass bloomer [4].

Outbreak of harmful algal bloom in autumn 2008 in Persian Gulf caused considerable damage to the marine ecosystem; serious concerns about the possible negative effects of this phenomenon on aquaculture activities led us to monitor the intake water of shrimp farm complexes in Bushehr province [5]. The aims of this project was aware about the presence of algal bloom species before entering in water intake of the hatcheries and farmed shrimp complexes in Bushehr province and to inform the shrimp farmer about the red tide condition.

EXPERIMENTAL

By concern to the distribution of shrimp farms and hatcheries complexes along the coastal of Bushehr province, three stations were selected in the southern of water intake canal of Mond, Delvar and Heleh (Fig. 1).

Monthly sampling has been carried out from April 2011 to November 2011. Identification and abundance of phytoplankton specially the bloomer species, the physic-chemical situation and their relationship with phytoplankton density and distribution, in the vicinity of shrimp complexes were the goals of this work.

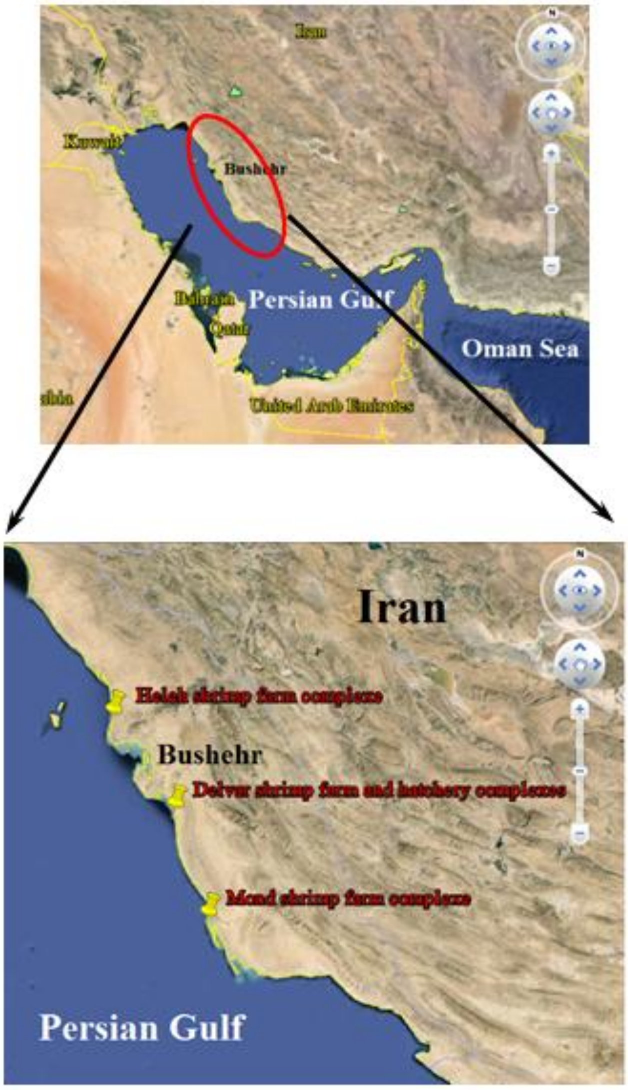

Fig. 1. The studied area and position of shrimp farm complexes in Bushehr province, Persian Gulf.

The phytoplanktons were sampled by Ruttner bottle of Hydro-Bios Model, and identified using an inverted microscope of Nikon, Model Eclipse Tis.

According to the objectives of the project, water samples were gathered monthly. Phytoplankton samples were fixed with Lugol's solution and transported to the National Shrimp Research Institute of Iran (NSRII) laboratories, located in Bushehr. Fixed specimens allowed be settling for two weeks and then identifying by using invert microscope. Phytoplankton sampling and laboratory methods have been done based on the references of [6-10].

Date and time of sampling, geographic coordinates include of latitude and longitude, depth, transparency, meteorological conditions, color of the water and weather situation was recorded and measured in each station,.

Water temperature and pH were recorded by the pH meter model WTW and salinity was recorded with an Atago S/Mill refractometer.

Recording and data processing and statistical analysis have been done by using EXCEL 2007 software.

RESULTS

The average of water temperature was 28.3 °C in the studied station. The minimum of water temperature was 19.0 °C in April and its maximum value reached to 34.2 °C in July at Delvar station.The average of salinity was 41.2 ppt. The highest of salinity value was 45.2 ppt in July at Delvar station and its minimum value was 38.2 ppt in July at Mond station. Due to mixing of low salinity water of Mond river with seawater, the salinity of water at Mond station has the lowest values in Bushehr coastal waters.

The average of pH was 8.46 in the studied waters. The highest level of pH was 8.88 which recorded in May at Mond station and the minimum level was 8.20 at Delvar station in September, and also was the same at Heleh in October. The identified phytoplankton were belong to three class of Bacillariophyceae (52.6%, 13,280 ± 7,226 cell/lit), Dinophyceae (37.7%, 6,302 ± 8,268 cell/lit) and Cyanophyceae (9.7%, 1,955 ± 806 cell/lit) (Fig. 2). The maximum density of total phytoplankton was 23,632 cell/lit and their temporal maximum density was 54,623 ± 22,569 cell/lit in August. The highest spatial density of phytoplanktons was 141,120 cell/lit at Delvar station in December.

Based on the reference list of IOC [11], Zingone [2] and Maso [1] the most abundant toxin producer and high biomass bloomer phytoplankton genus in the studied area were Alexandrium , Prorocentrum , Dinophysis , Ceratium , Gymnodinium which are belong to Dinophyceae class; Chaetoceros, Skeletonema, Thalassiothrix, Thalassionema, Psudonitzschia and Nitzschia which are belong to Bacillariophyceae class; and Oscillatoria which is belong to Cyanophyceae class. Alexandrium and Gymnodinium are producers of PSP toxin, while the Prorocentrum and Dinophysis are DSP toxin producer. Psudonitzschia and Nitzschia are producer of ASP toxin. Thalassiothrix, Thalassionema, Chaetoceros, Skeletonema, Ceratium and Oscillatoria are belongs to high biomass bloomer phytoplanktons.

Alexandrium, Chaetoceros and Thalassiothrix were the most abundant microalgae bloomer in the studied area with average density of 22,323, 7,018 and 5,713 cell/lit respectively (Fig. 3). The maximum value of spatial density of Chaetoceros is 22,385 cell/lit in September and for Thalassiothrix is 15,992 cell/lit in November (Fig. 4 and 5). The maximum density of Thalassiothrix was 138,240 cell/lit at Delvar station in depth layer in August, and for Chaetoceros was 33,220 cell/lit in September at Heleh station. Oscillatoria is the only identified high biomass bloomer phytoplanktons of Cyanophyceae class which its maximum of spatial density was 3,030 cell/lit at

Heleh station (Fig. 6). The maximum density of Alexandrium was 124,500 cell/lit at Mond station in August, and for Prorocentrum was 6,300 cell/lit in November also at Mond station (Fig. 7). The maximum values of temporal density of Alexandrium and Prorocentrum are 44,230 and 2,063 cell/lit respectively (TABLE I).

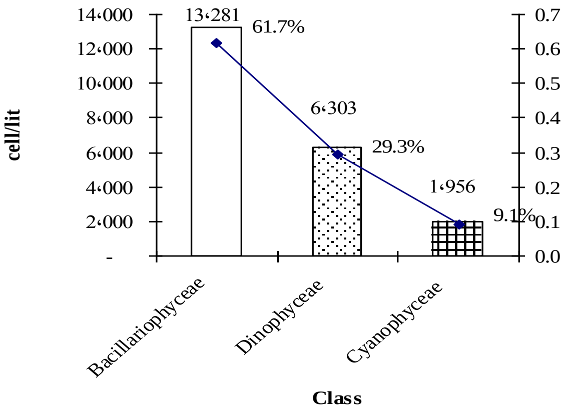

Fig. 2. Density and percentage of different classes of identified phytoplanktons, Bushehr province, 2011.

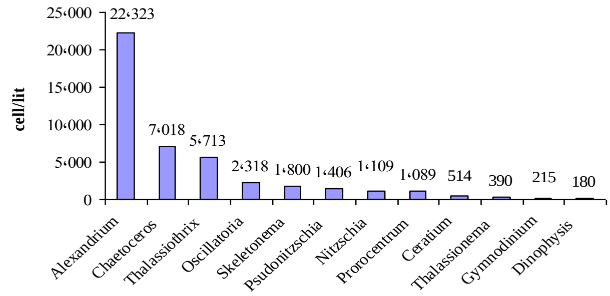

Fig. 3. Density of bloomer phytoplanktons in different months, Bushehr province, 2011.

TABLE I. Average of temporal density of bloomer phytoplanktons Bushehr province, 2011.

Genus	Mond	Delvar	Heleh
Chaetoceros	4,055	9,652	8,170
Nitzschia	1,421	1,500	706
Psudonitzschia	1,062	1,198	2,340
Skeletonema			1,800
Thalassionema	390		
Thalassiothrix	2,858	6,346	10,155
Alexandrium	44,230	300	475
Ceratium	679	243	558
Dinophysis	180		
Gymnodinium			215
Prorocentrum	2,063	750	610
Oscillatoria	1,872	940	3,030

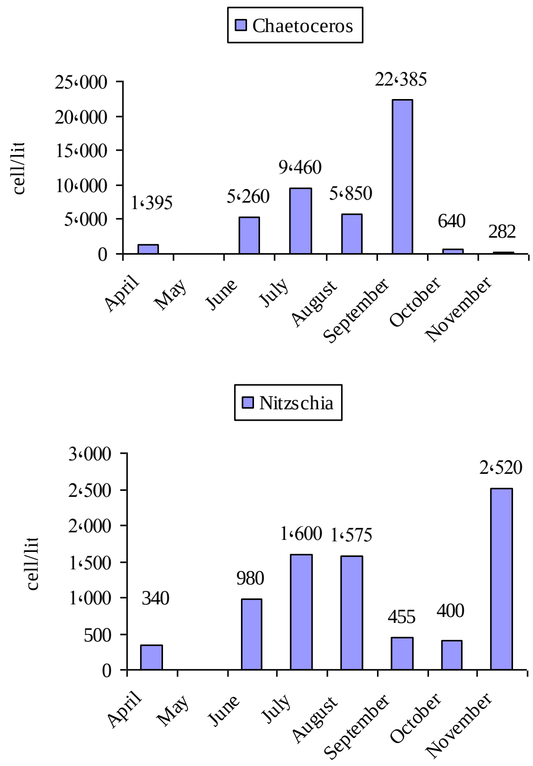

Fig. 4. Average of spatial density of Bacillariophyceae bloomer Genus in different months, Bushehr province, 2011.

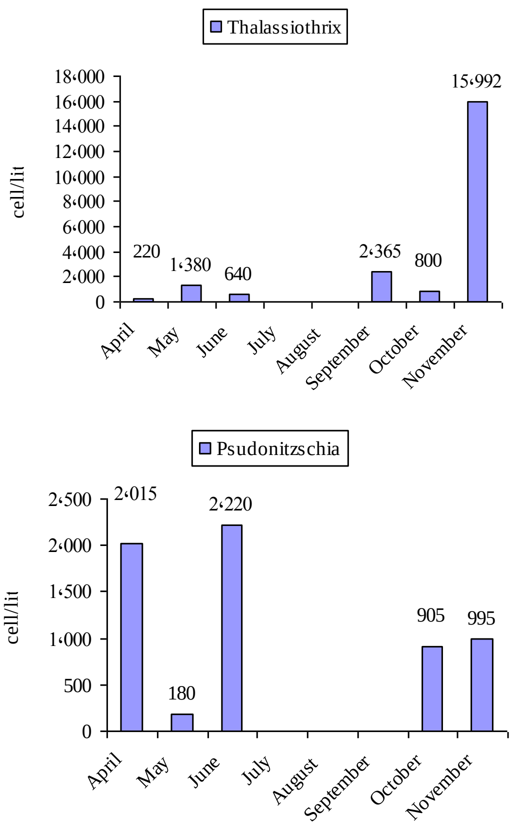

Fig. 5. Average of spatial density of Bacillariophyceae bloomer Genus in different months, Bushehr province, 2011.

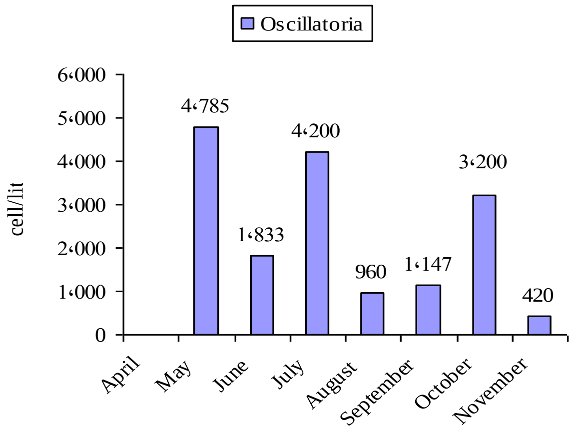

Fig. 6. Average of spatial density of Cyanophyceae bloomer genus in different months, Bushehr province, 2011.

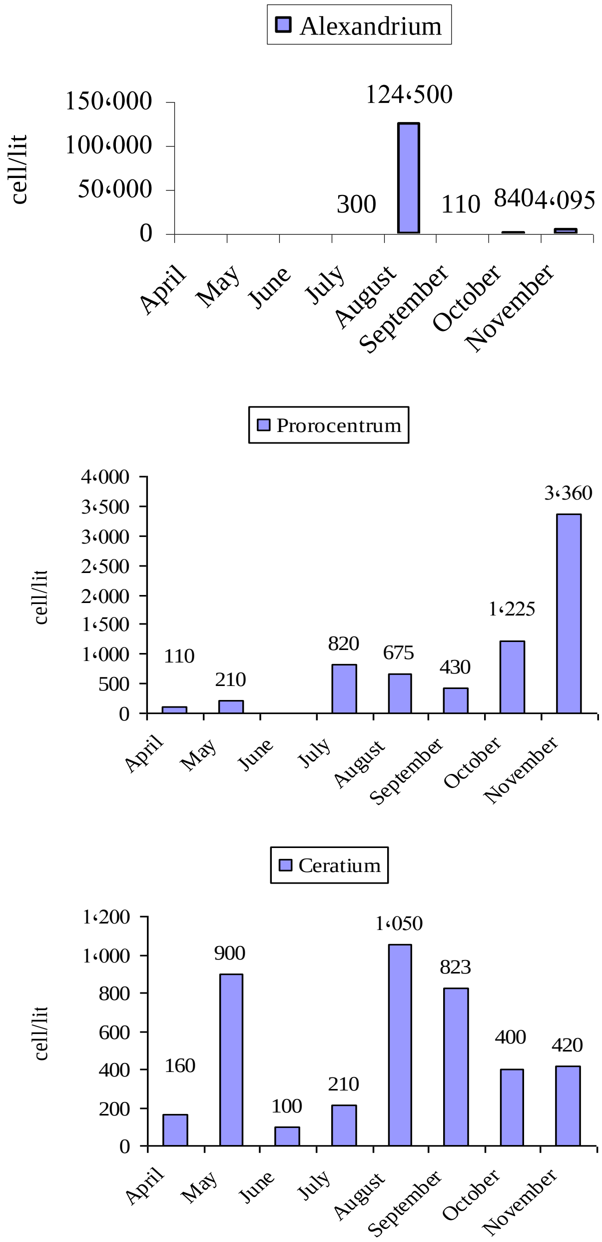

Fig. 7. Average of spatial density of Dinophyceae bloomer Genus in different months, Bushehr province, 2011.

DISCUSSION

The results show that the correlation coefficient between water temperature and phytoplankton density at different stations is -0.93. High negative correlation between these data implies that in the surveyed temperature range of this project, when the water temperature increases, the density of phytoplankton decreases.

The most important biological indicators such as growth, survival and community structure of aquatics are subjected by environmental conditions, especially to temperature water, salinity and nutrient values. The maximum growth rate of each species of phytoplankton are different and is depends on its optimum ecological condition especially to the temperature and salinity. Therefore, when the range of water temperature and salinity is in the optimum range, in the presence of sufficient nutrients, condition will be prepared for occurrence of phytoplankton bloom [12 and 13].

During the study, the salinity was increased up to 42 ppt in July and decreases to 39.7 ppt in September and again increased to 42.3 in November. This trend is consistent with the general trend of salinity variation in Persian Gulf which is depended to the entering current from Indian Ocean and Oman Sea to the Persian Gulf, and the seasonal variation of salinity [14]. The correlation coefficient between salinity and phytoplankton density at different stations was -0.99. High negative correlation between these data shows that in the surveyed area, by increasing the salinity, the density of phytoplankton decreases.

The highest density of *Prorocentrum* is in October and November which the average of water temperature at that time was closer to its optimum temperature range. Except for the sudden increase of *Alexandrium* density at Mond station in 2011 August, its highest overall density was October and November, which the water temperature was in its optimum range (Fig. 5). Our results are consistent with the findings of Sadaf Gul [15] and Anderson [16].

The results of this study indicate that due to high density of toxin producer phytoplankton genus such as *Alexandrium*, *Prorocentrum* and *Psudonitzschia*, in the vicinity of surveyed shrimp farm complexes, especially in August which is coincided with the shrimp culture season in Bushehr province and also for high biomass bloomer genus such as *Thalassiothrix* and *Chaetoceros* in Delvar shrimp farm in August, there is the risk of bloom outbreaks in Bushehr province shrimp farm complexes. This is consistent with the last high bloom of *Alexandrium* with density of 87 million cell/lit in Boyrate shrimp farm complex in August 2013.

REFERENCES

[1] M. Maso and E. Garces, "Harmful microalgae blooms (HAB); problematic and conditions that induce them", *Marine Pollution Bulletin*, Vol. 53, pp 620–630, 2006.

[2] A. Zingone and H. O. Enevoldsen, "The diversity of harmful algal blooms: a challenge for science and

management", *Ocean & Coastal Management*, Vol. 43, pp. 725-748, 2000.

[3] C. S. Kim et al, "Reactive oxygen species as causative agents in the ichthyo-toxicity of the red tide dinoflagellate Cochlodinium polykrikoides", *J. Plank. Res.*, Vol. 1, pp 2105-2115, 1999.

[4] A. Sournia, "Red tide and toxic marine phytoplankton of the world ocean: an inquiry into biodiversity", *Harmful marine algal blooms*, Paris: Lavoisier, Intercept Ltd, pp. 103-112, 1995.

[5] K. Aein Jamshid, F. Mohsenizadeh, A. Haghshenas and S. Omidi, "Interactive effects of industrial activities and marine environment in Pars Special Economic Energy Zone", *Second national conference on sustainable development perspective, and knowledge-based integrated of Pars Special Economic Energy Zone*, Mars 2010.

[6] D. E Andrew, " Standard Methods for Examination of Water & Wastewater", 21ed, Washington DC., 2005.

[7] G. E. Newell and R. C. Newell, " Marine Plankton (a practical guid)", Hatchinson of London, UK, 1977.

[8] A. Sorina, "Phytoplankton Manual, United Nations Educational", Scientific and Cultural Organization, 237, 1978.

[9] M. Hoppenrath, M. Elbrächter, and G. Drebes, "Marine Phytoplankton", Kleine Senckenberg-Reihe 49. E. Schweizerbart Science Publishers, Stuttgart Germany, 2009.

[10] MOOPAM, " Manual of Oceanographic Observation and Pollutant Analyses Methods", ROPME Publishing, 4th ed., 2010.

[11] Ø. Moestrup, R. Akselman, G. Cronberg, M. Elbraechter, S. Fraga, Y. Halim, G. Hansen, M. Hoppenrath, Larsen, J., N. Lundholm, L. N. Nguyen, A. Zingone, "2009 Ed IOC-UNESCO Taxonomic Reference List of Harmful Micro Algae" Available online at http://www.marinespecies.org/HAB. Accessed on 2013-07-26.

[12] P. Lehodey, "The pelagic ecosystem of the tropical Pacific Ocean: dynamic spatial modelling and biological consequences of ENSO", *Progress in Oceanography*, Vol. 49, pp 439–468, 2001.

[13] K. Brander, "Impacts of climate change on fisheries", *Journal of Marine Systems*, 79, pp. 389–402, 2010.

[14] J. Kampf and M. Sadrinasab, " The circulation of the Persian Gulf: a numerical study", *Ocean Sci.*, Vol 2,pp 27–41, 2006.

[15] Sadaf Gul and S. M. Saifullah, "The dinoflagellate genus prorocentrum (prorocentrales, prorocentraceae) from the north Arabian sea", *Pak. J. Bot.*, Vol. 43, No. 6, pp. 3061-3065, 2011.

[16] D.M. Anderson et al, "The globally distributed genus Alexandrium: Multifaceted roles in marine ecosystems and impacts on human health", *Harmful Algae*, Vol. 14, pp. 10–35, 2012.

[17] M. Noori Nejad and G. Delipour, "Oubreaks of *Alexandriumm* bloom in Boyrate shrimp farm complex, National Shrimp Research Institute of Iran unpublished report, August 2013.