IJBPAS, January, 2016, 5(1): 351-361

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

PHYTOPLANKTON DIVERSITY AND ITS RELATION TO PHYSICOCHEMICAL PARAMETERS IN HANNA RESERVOIR (IRAN)

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ABSTRACT

This study was located at Hanna reservoir (Southwest of Iran).Water samples were collected from April 2015 through March 2015 in three selected silts. Environmental parameters and chlorophyll a concentration were measured, as well as identification and abundance of phytoplankton communities were studied. According to this study, 27 species were identified at four seasons. Most abundance was related to the phyla Bcillariphyta (17species), Cyanophyta (4species),Crysophyra and Chlorophyta(3) species,Dinophyta(2 species) and Crysophyte(1 species) respectively. The results showed, the maximum rate of chlorophyll a concentration was measured in the warm and minimum of this, was measured in the cold months. According to this, minimum and maximum of the chlorophyll a concentration was observed in March (2.1 μg/L) and October (4.9 μg/L), respectively. The rate of chlorophyll a concentration shows an oligotrophic condition in the lake of karoon 4 dam (5). As the results, we have the positive significant correlate between the parameters include, COD,NO3,temperature, pH, turbidity, chlorophyll a and phytoplankton abundance($P< 0.01$).Whereas, there is not significantly positively correlated between DO and another parameters($P> 0.05$).The chlorophyll a concentration and phytoplankton community have a significant negative correlation with transparency (-$P< 0.01$).

Keywords: Phytoplankton, chlorophyll a, karoon4, identification, abundance

INTRODUCTION

About 45.000 enormous dams>15 m in elevation had been built until the end of 2000, in more than 150 Countries. While 160 to 320 new enormous dams are founded worldwide each year (34).Damming by Supplying water, bridling floods, irrigating yields, transport facilitation and obtaining easy electric energy, have many interests all over the world for thousands of years(32). However damming have a several environment impacts, including make the physical, chemical and geomorphologic changes. because of blocking a river and varying the natural dispensation and schedule of stream flow. Among other impacts

that enlace changes in primary producers of ecosystems, such as effects on river margin and littoral plant life and on down- stream ecosystems such as wetlands(30).

Algae are important for aquatic environments. They belong to highly diverse group of producer organisms with chlorophyll a and unicellular reproductive structures. They ranged from 4 to 13 with as many as 24 classes and about 26,000 species. The algae are one of the important biological indicators in aquatic ecosystems. While In most ecosystems they play a role as the primary producers in the food chain, on the other hand some species by secret the toxic substances hepatic toxins or neurotoxins etc., can be harmful to human, fishes and other vertebrates into the water bodies (1). Reproduction of harmful especially species organisms should be monitored. Analysis of the phytoplankton biology and ecology are advantageous for monitoring the physico-chemical and biological factors of the water environment. Some

groups of phytoplankton's particularly blue green algae can be inducement deoxygenating, when they bloom, may leading to fish death (31).

Algae widely occur in water ecosystems, such as fresh water, marineor brackish. However, they can also be found in almost every other environment on earth, such as some algae that grow in the snow of somemountains. In addition their function to provide the food source for heterotroph organisms .They also supply the oxygen necessary for the metabolism of the consumer organisms. Sometimes humans directly consume algae (10). but mainly these microorganisms are consumption by organisms such as zooplanktons. Algae are largely present in freshwater environments, such as lakes, reservoirs and rivers.

They are typically present in these places as micro-organisms. These organisms are visible only with the aid of a light microscope. Nevertheless their microscopic size, they have a major impact in the freshwater ecosystems, both in terms of fundamental ecology and in relevance to human (5).

Algal bloom can be cause of some important environmental impacts worldwide, and it will reason a several problems such as toxin production, redolence, trash and possibly unsafe drinking water(22).Commonly ,temporal and spatial occurrence of algal blooms is mainly controlled by several physical and chemical factors including temperature, nutrients, flowrate and rainfall (8 & 24). Nutrient access has often importance than other factors and has been a main qualifying factor to impress successions of phytoplankton species abundance (18).In general, proliferated N and P inputs instigate bloom of some algae species and increase phytoplankton biomass (33).Another factor that has a major affect in algal bloom is water temperature(11, 6 & 14).Also some hydrodynamics, include water flow and sedimentation ,frequently stimulate the trophic replication in aquatic ecosystems (12).Some when, rainfall

as an external factor plays an important role in algal community and species combination and their environments (18).

MATERIALS AND METHODS

The survey was conducted from April 2015 through March 2015 in Hanna Reservoir. The Hanna Dam was constructed and impounded in 1997 on Hanna River at meeting point of its two headwaters to meet the irrigation requirements of Hanna plain. Esteky(2010) has discussed more details about the plain, the dam, the reservoir, the watershed and sampling sites . During the investigation period, water samples from whole water column of the reservoir were taken by Rotner bottle sampler with monthly intervals, and adequate amount of them have taken to a laboratory for further analysis.Tree stations were chosen to assessment chlorophyll a. phytoplankton numbering and identification and physicochemical parameters. For evaluate phytoplankton the samples were fixed immediately with acidLugol's iodine solution. To preserving the samples with Lugol's solution, 0.7 mlLugol's solution was added to 100ml samples and store in dark and for measurement ofChlorophyll

A concentration, samples were preserved immediately by 4% formaldehyde and maintenance in cold and darkcondition (3).

Turbidity, Temperature, pH and Do were measured with multi meter and Transparency was determined by secchi disk. For measuring biological oxygen demand (BOD), chemical oxygen demand (COD),total dissolved solid (TDS), total suspended solid (TSS), ammonium, nitrate and phosphate, the water samples were preserved after sampling according to Standard Method(4).

Water temperature, oxygen content and pH – values were measured in situ at sunrise and sun set with mercury glass thermometer, portable oxygen and pH meters. The concentrations of NH4+, and NO2- and the magnitude values of COD and BOD were determined according to the standard methods developed by Iranian Environmental protection organization (1998). The concentrations of unionized ammonia were calculated from the relation between ionized and unionized ammonia at different pH and temperature (Boyd & Tucker 1998).

The early morning oxygen minima in headwaters, different parts of the reservoir and outflow fluctuated between 6 – 8.5, 5.2 – 9.1 and 4.9 – 8.7 mg/lit, respectively and the mean values of the reservoir varied from 5.4 to 8.3. All of the minima were measured in August, while most of the maxima were observed in May and June.

The concentrations of unionized free ammonia in the headwaters fluctuated between 1.0 and 85 mg/lit –1 NH3-N. Most of the measured values in spring and winter were higher than 50 mg/lit-1 NH3-N and in summer and autumn were lower than 22 mg/lit-1 NH3-N. From June to August, however, the upper and lower parts of the reservoir were characterized by rather high values of unionized ammonia, ranging between 61 – 263 mg/lit-1 NH3-N and in the other samples it was lower than 50. In outflow high values of 109 and 255 mg/lit-1 NH3-N were measured in August and September and other obtained values varied from 10 to 48 mg/lit-1 NH3-N. Through long period of June to September the mean averages of the reservoir varied between 68 and 213 and in rest of the samples they fluctuated from 9.0 to 31 mg/lit-1 NH3-N.

In the headwaters there was no measured nitrite concentration in winter and early spring, but in summer and autumn the observed values fluctuated from 870 to 3110 mg/lit-1 NO2-N. In different parts of the reservoir the nitrate concentration showed significant irregular monthly fluctuation, ranging from 0.0 to 2230 mg/lit-1 NO2-N.

RESULTS AND DISCUSSION

According to this study, 27 species were identified at four seasons. Most abundance was related to the phylaBcillariphyta (17species), Cyanophyta(4 species), Crysophyra and Chlorophyta(3) species, Dinophyta(2 species) and Crysophyte (1 species) respectively. Algal communities were shown the variation according to several seasons. Results were indicated that spring and winter by 19 species have been a most abundant between several seasons. While, the summer (17 species) and autumn

(11 species) were located in latter levels respectively.
In the spring, Synedraacus and Achnanthi diumminutissimum by 21 and 20 cells/mL, were most abundant in study areas, respectively. While, Cosmarium sp. (44cells/mL) And Cyclotella meneghiniana(42 cells/mL) were most abundant in summer at several seasons. Also in the autumn and winter lost eriumacerosum(21species) and Cymbellacesatii(20 species) were most abundant, respectively. On the other hand, in the
Spring Nitzschiapalea by 75-100% of algal taxa was most abundant among the other species. But some species in summer had this feature, include Achnanthi diumminutissimum, Cosmarium sp., and Peridinium cinctum. Also in the winter, Dinobryon sertularia and Dinobryon sertularia by 100% of phytoplankton taxa had the most abundant (Table1).
Analyses of physicochemical parameters were also performed in this study. Monitoring of study sites showed, the highest level of oxygen dissolve between different seasons was 9.37mg/L in March and the lowest of this factor was 8.13mg/L in May. Whereas the oxygen variation between seasons was not considerable. Amount of phosphate 0.1> mg/L was very low and it can be as a limiting parameter. The highest range of temperature 27°Cwas recorded in the august and lowest was recorded in the march by 11 Degrees Celsius.
The results showed, the maximum rate of chlorophyll a concentration was measured inthe warm and minimum of this, was measured in the cold months. According to this, the chlorophyll a concentration was decreased in the march to 2.1µg/L. It shows the lowest rate of photosynthetic activity. So this parameter was enhanced to 4.9 µg/L, in the October. Generally the rate of chlorophyll a shows an oligotrophic condition in the lake of karoon 4 reservoir (5) .
The environmental parameters are presented in figure 1, shows the differentiations between the stations.
As can be observed in figure 1, there are not significant differentiations between study sites.
The secchi disk visibility was used for transparency of the lake. According to the results this parameter was high between the study times (5.72-7.65 m), this represent, the oligotrophic condition in the lake (5) and it shows, as the water temperature increases, the transparency is reduced to 5.72 m .
The analysis of the environmental indexes include, Dominance, Diversity (measured by Shanon index),and Richness (measured

by Margalef Index) was done. Based on the results, maximum and minimum of the richness (Margalef Index) was observed in the winter and summer respectively.(Fig 2).

According to the analyses, maximum and minimum of the dominance index was seen in the autumn and spring respectively. Whereas, the maximum of diversity (Shanonindex) was apperceived in the spring and minimum in the autumn (figure 2).

The Pearson correlation coefficients between the parameters show the positive significant correlate between the parameters include, COD,NO3,temperature, pH, turbidity, chlorophyll a and phytoplankton abundance ($P< 0.01$) (27,17 & 19). Whereas, there is not significantly positively correlated between DO and another parameters (2). The DO just correlated significantly negatively with temperature. It is because of decrease the potential of oxygen maintenance by increase the temperature (2 &16). The chlorophyll a concentration and phytoplankton community have a significant negative correlation with transparency. Since by increase of the phytoplankton community and chlorophyll a concentration reduced the visibility on secchi disk, it same to obtained result from (34).

According to statistical analysis, NO3 has correlated significantly positively by chlorophyll a concentration that is unlike the same studies (34), it can be due to enhanced agricultural and aquaculture activities upstream the lake. the biological oxygen demand (BOD) shows the significant correlation with chlorophyll a concentration because of enhancement of the phytoplankton activity in the water body (17,19,13) .

Analysis of variance (ANOVA) was used to analyze the differences between environmental parameter, phytoplankton abundance and chlorophyll a concentration and seasons .The results show the significant deference between several seasons and parameters except temperature .

Analysis of variance (ANOVA) was used to analyze the differences between environmental parameter, phytoplankton abundance and chlorophyll a concentration and seasons .The results show the significant deference between several seasons and parameters except temperature.

According to the results there is no significant differentiation between parameters of stations. All parameters include physicochemical factors; phytoplankton abundance and chlorophyll a concentration have not significant difference in stations. It shows that some factors such as floods can be affected to this condition. The presence of the some Bcilariophyta species such as Achnanthi diumminu tissimum and cymbella sp., monitored to the oligo and mesotrophic condition (29). The Eulenophyta populations thrive under high nutrient levels and are, therefore, useful bio-indicators of such conditions (21). Absence of this phylum shows the non-eutrophic conditions. We observed some group of Cyanophyta but in cold condition of water (9). Some groups of Chlorophyta include Chlamydomonas and Chlorella usually occurs in eutrophic waters, in this study this species of phylum Chlorophyta were not found (20).Whereas, another species such as Cosmariumsp. And Coelastrum sp., that indicate the oligotrophic waters, were observed in the samples.

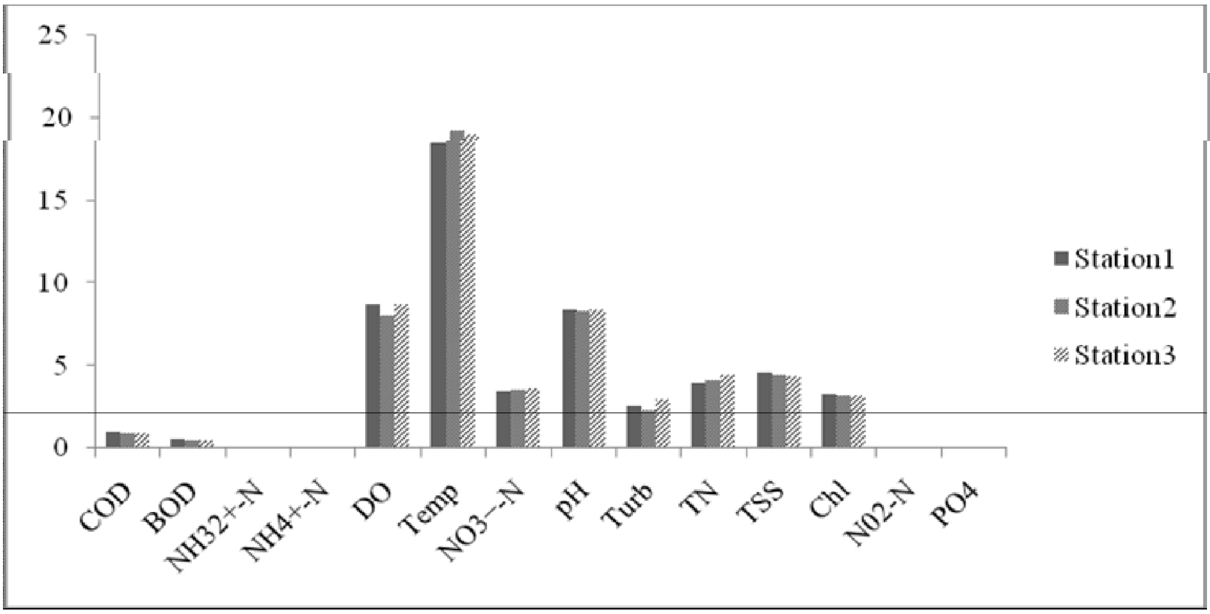

Fig 1: Environmental parameters. Chlorophyll a concentration in stations

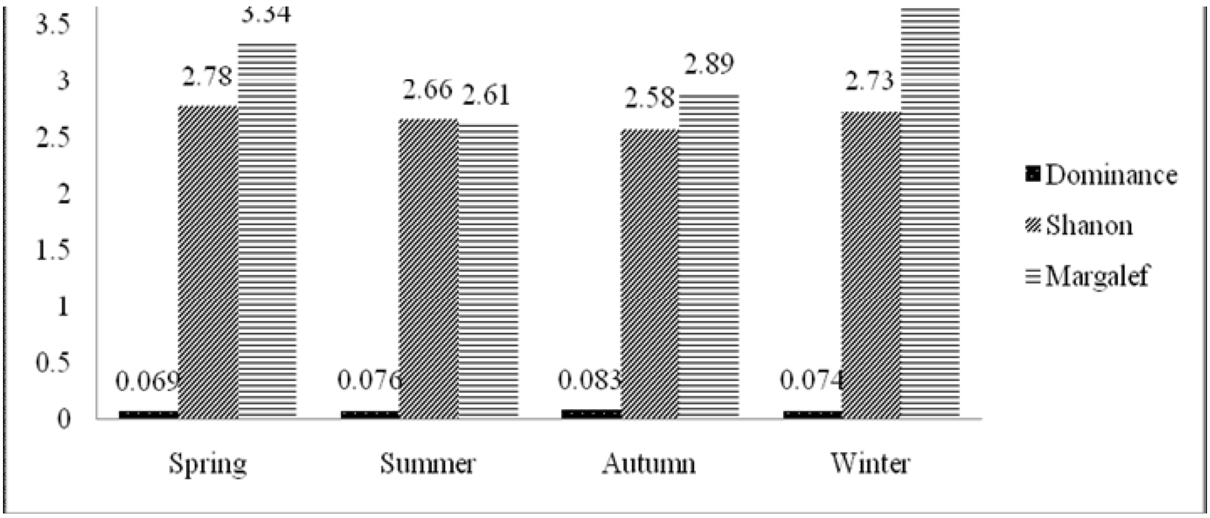

Fig 2: The change of environmental Indexes according to the seasons

List 1: List of phytoplankton species recorded from three stations according of seasons.

Spring Summer Autumn Winter

Bacillariophyta

AchnanthidiumminutissimumKützing ++ +++ +

CocconiesplacentulaHer. + +++ ++

CyclotellameneghinianaKützing+ +++ + +

CymbellaprostrataBerkeleyBrun ++ + +++

CymbellacesatiiRab. Grun. ++ ++++

FragilariacapucinaDesm+ +++ + +

GomphonematruncatumHer. ++ ++ ++

GomphonemaolivaceumLyngb. +++ +++

NaviculagracilisEhrenberg++ +++ +

NaviculatenelloidesMeist. ++ +++ +

NaviculalanceolataAgardh. Kutz. + +++ + +

NitzschiadraveillensisCoste&Ricard ++++

NitzschiafrustulumKutz. ++ ++ ++

NitzschiagraciliformisLange-Bert. +++ ++

NitzschiaacicularisW. Sm. ++ ++ ++

NitzschiapaleaKutz.&W.Sm. +++ ++

SynedraacusKützing ++ ++ + +

Chlorophyta

ClosteriumacerosumSchrank + ++ +++

Coelastrumsp ++ ++ +

Cosmariumsp. ++ +++

Chrysophyta

DinobryonsertulariaEhr. ++++

Cyanophyta

NostoccommuneVaucher ex. ++ +++

ScytonemaarenariumBerkeley ++++

SpirulinamajorKutz. +++ +++

GomphosphaeriaaponinaKützing++ ++ +

Dinophyta

PeridiniumcinctumMuell. ++ +++

CeratiumhirudinellaMuller++ +++

+ 25% of samples; ++25-50% of samples; +++ 50-75% of samples and ++++75-100% of samples.

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