PHYCO-ECOLOGICAL STUDY ON TWO MAJOR PARKS WATER BODY IN ERBIL PROVINCE (NORTH IRAQ)

RABAR MOHAMMED HUSSEIN

Master Thesis

Biology Department

Supervised: Assoc. Prof. Dr. Mustafa KOYUN

June 2016

T. C.

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This Master Thesis on 06.20.2016 by the following jury members unanimously / ~~by majority vote~~ has been accepted.

Prof. Dr. Bülent ŞEN
Chairman of Jury

Assoc. Prof. Dr. Mustafa KOYUN **Assist. Prof. Dr. Mehmet Ulupınar**

(Supervisor) **Member**

The above results has been Approved by

Assoc. Prof. Dr. İbrahim Yasin ERDOĞAN

Director of the Institute

PREFACE

To begin with, I thank (Allah) for his blessing who made me able to complete and perform this study with success.I would like to thank my supervisor, Assoc. Prof. Dr. Mustafa KOYUN for his patience and guidance throughout this long project.

My gratitude and appreciation are dedicated to the presidency of Bingol University, the deanery of College of Agriculture and to the head of Environmental pollution Department for their necessary facilities during the work.

Deepest gratitude to Dr. Abdulla H. A. BILBAS for his encouragement and scientific advices throughout the period of this work. I am also grateful to Dr. Cüneyt N. SOLAK for his valuable remarks. Special thanks to Mrs. Nurgül ŞEN for her comments and corrections. I express my thanks also to Dr. Abdulkadir SÜRÜCÜ, Dr. Wand ALI, Dr. Sulaiman GAFAR, and Miss. Tuba ELHAZAR.

Last but not least, I express my sincere gratitude to my family for their support, cheerfulness, patience, and encouragement. Finally, I thank all those who assisted me in doing my work.

Dedication:

I dedicate this work to my parents and my sisters**.**

Rabar Mohammed

Bingöl 2016

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LIST OF SYMBOLS

SYMBOL	: DESCRIPTION
^{o}C	: Degree Celsius
Cells/l	: Cells per litter
M	: Meter
$Mg.l^{-1}$	: Milligram per liter
µm	: Micrometer
µS/mc	: Microsimens per centimeter
%	: Part per thousand

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ABSTRACT

The study was conducted in eight stations within Sami Abdulrahman Park and Shanadar Park, Erbil, Kurdistan region (North Iraq), the stations were distributed as a follows; four stations were selected in Sami Abdulrahman Park and four stations were selected in Shandar Park. Water samples were collected in polyethylene bottles and algal samples were collected in sterile vial of 50 ml. The study was focused on the epipelic and phytoplankton composition during the study period. Generally, results revealed that air temperature has a wide range of fluctuation; it was ranged from 17-21 ºC. Water temperature in all stations was ranged from 11-16 ºC, whereas it was never falling below 11 ºC. The results of water sample analysis showed the following records; Electrical conductivity ranged from 295-1370 $\mu S.cm^{-1}$; turbidity ranged from 7-11 NTU;Total alkalinity, acidity and hardness were range from 196-390, 19.21-15.62, 165 to 220 mg $CaCO_3$ l^{-1}, Calcium ion were ranged between55-96, magnesium ion were ranged 25-30.13. Results of inorganic constituent analyses total dissolved solid were between 329-666, value of hydrogen ion concentration were noted from 7.97-8.25. Lower value of dissolved oxygen 2.61 and higher value 4.45.On the other hand, results of biological oxygen demand were ranged between14.64-17.41. In point view of algal flora, a total of 34 algal species was identified belong to 13 genera, 11 families, and 4 divisions were identified. The dominant division was Cyanophyta shared by 15 species (44%), followed by Chlorophyta with 10 species (29%), Euglenophyta with 6 species (18%), Bacillariophyta with 3 species (9%). The genus and species were identified (*Chlamydomonas reinhardtii*, *Chloroccocum infusionum*, *Chlorococcum humicola*, *Chroococcus micrococcus* (Kuetz) Rabenh., *Chroococcus montanus*, *Chroococcus turgidus*, *Cladophora kutzing*, var. *nordstedtiana* Brand, *Cosmarium bioculatum* Berb., *Cosmarium leave* Rabenh, *Cymbella cistula*, *Cymbella minuta*, *Euglena acusvarrigida* Huebner, *Euglena deses* Her., *Euglena geniculate*, *Euglena gracilis*, *Euglena spirogyra* Ehrenberg, *Euglena texta*, *Gloeotrichia* sp., *Lyngbya aesturii* after Komarck 1956, *Lyngbya limneticalemm*, *Oscillatoria acutissima* Kufferath, *Oscillatoria anagustissima* West G.S.W., *Oscillatoria chlorina* Kutz. (After Fremy), *Oscillatoria irrique* (Hhr) Gomont, *Oscillatoria limosa* (Ag) Gomont, *Oscillatoria minnesotensis* Tilden, *Phormidium lucidum* Kutzing, *Phormidium standleyi* Drouet, *Phormidium willei* after Komarek, *Spirogyra maneramae* Rand, *Spirogyra porticalis*,*Spirogyra pseudoreticulate* Krieger, *Synedra ulna*.

Key Words: Kurdistan (North Iraq), Erbil, Sami Abdulrahman Park, Shanadar Park, Algae.

ERBİL (KUZEY IRAK)'DE İKİ BÜYÜK PARKTA BULUNAN GÖLLERDE PHYCO - EKOLOJİK ÇALIŞMA

ÖZET

Bu çalışma Kuzey Irak Kürdistan bölgesi, Erbil'de Sami Abdulrahman Park ve Shanadar Parkta gerçekleşmiştir. Dört istasyon Sami Abdulrahman Parkından, diğer dört istasyon ise Shanadar Parkından seçilmiştir. Su örnekleri polietilen şişelerde, alg örnekleri ise 50 ml'lik steril şişeler içinde toplanmıştır. Çalışmada epipelik ve fitoplankton kompozisyonu üzerinde durulmuştur. Sonuçlar genellikle hava sıcaklığındaki dalgalanmalardan dolayı geniş bir yelpaze ortaya koymuştur; hava sıcaklığı 17-21 ^{0}C arasında değişirken su sıcaklığın tüm istasyonlarda 11-16 derece arasında olup hiçbir zaman 11 derecenin altına düşmediği görülmüştür. Su örneklerinin analiz sonuçları sırasıyla su şekilde; Elektriksel iletkenlik 295-1370 mS.cm arasında, bulanıklık ise 7-11 NTU arasında kaydedilmiştir. Toplam alkalinite, asitide ve sertlik sırasıyla 196-390, 19,21-15,62 220 mg $CaCO_3$ l için 165 idi. Kalsiyum iyonu 55-96 arasında, magnezyum iyonu 25-30,13 arasında değişme göstermiştir. Toplam katı çözünmüş inorganik bileşen analiz sonuçları 329 -666 arasında bulunmuştur. Hidrojen iyon konsantrasyonu (pH) 7,97 -8,25 olarak kaydedilmiştir. Çözünmüş oksijenin en düşük değeri 2,61 ve en yüksek değeri ise 4 –4,5 olmuştur. Diğer yandan, biyolojik oksijen ihtiyacı 14,64 -17,41 sonuçları arasında değişmiştir. Çalışılan alg florası için 4 bölüm,11 familya ve 34 tür tespit edilmiştir. Sırasıyla bulunma oranları *Cyanophyta* (mavi-yeşil algler)'ya ait 15 tür (%44), *Chloraphyta* (yeşil algler)'ya ait 10 tür (%29), *Euglenophyta* (kamçılı algler)'ya ait 6 tür (%18), *Bacilloroiophyta* (diatomalar)'ya ait 3 tür (%9) cins ve türler tespit edilmiştir. Bu türler sırasıyla (*Chlamydomonas reinhardtii*, *Chloroccocum infusionum*, *Chlorococcum humicola*, *Chroococcus micrococcus* (Kuetz) Rabenh, *Chroococcus montanus*, *Chroococcus turgidus*, *Cladophora kutzing*, var. *nordstedtiana* Brand, *Cosmarium bioculatum* Berb., *Cosmarium leave* Rabenh, *Cymbella cistula*, *Cymbella minuta*, *Euglena acusvarrigida* Huebner, *Euglena deses* Her., *Euglena geniculate*, *Euglena gracilis*, *Euglena spirogyra* Ehrenberg, *Euglena texta*, *Gloeotrichia* sp., *Lyngbya aesturii* after Komarck, *Lyngbya limneticalemm*, *Oscillatoria acutissima* Kufferath, *Oscillatoria anagustissma* West G.S.W., *Oscillatoria chlorina* Kutz. (After Fremy), *Oscillatoria irrique* (Hhr.) Gomont, *Oscillatoria limosa* (Ag.) Gomont, *Oscillatoria minnesotensis* Tilden, *Phormidium lucidum* Kutzing, *Phormidium standleyi* Drouet, *Phormidium willei* after Komarek, *Spirogyra maneramae* Rand, *Spirogyra porticalis*, *Spirogyra pseudoreticulate* Krieger, *Synedra ulna* olmaktadır.

Anahtar kelimeler: Kürdistan (Kuzey Irak), Sami Abdulrahman Park, Shanadar Park, Alg.

1. INTRODUCTION

Fresh-water habitats may be divided into two important categories; standing water or lentic and running water or lotic. Lentic ecosystems contain all forms inland waters such as lakes, ponds, swaps and their intergrades in which the motion of the water is not that of a constant flow in a definite direction. Lotic environment includes all forms of inland waters such as springs, brooks, creeks and rivers in which water moves constantly in a definite orientation. All land areas, with a few minor exceptions, have fresh water habitats (William and Richard 1968)

Fresh water is a very valuable resource, and getting more valuable every day. Each day, our limit water supplies have to be shared by a larger population. Humans need at least about fifty liters of water a day to stay healthy (e.g. for drinking, cooking, sanitation, washing). With increasing populations and increasing technological growth, the ecosystems we depend on are under greater stress. The Earth's supply of accessible fresh waters is especially at risk. One third of people in the developing world do not have access to safe drinking water (Desonie 2008).

A lake is an area may be defined as a large body of water (usually freshwater),exactly surrounded by land and with no immediately access to the sea. A lake may also be separated, not part of the ocean and bigger than ponds. In many positions these isolated lakes are saline due to evaporation or groundwater inputs. Relying on its origin, a lake may located anywhere within a river basin. A head water has no single river input but is maintained by inflow from many small tributary streams, by direct surface rainfall and by groundwater inflow. Such lakes almost positively have a single river output. Further downstream in river basins, lakes have a main input and one major output, with the water balance from input to output varying as function of additional sources of water (Caldecott 2008). Although lakes contain fifty percent of all the water on the Earth’s surface, they hold forty nine point one percent of the liquid surfaces freshwater. Many organisms depend on fresh water for survival, and humans frequently depend on lakes for a great

many goods and service such as drinking water, waste removal, fisheries, agricultural irrigation, industrial activity, and recreation. For these reasons lakes are important ecosystem (Hairston and Fussmann 2002).

Good water quality in lakes is essential for maintaining recreation and fisheries and for the provision of municipal drinking water. These uses are clearly in conflict with the degradation of water induced by agricultural use and by industrial and municipal waste disposal practices. The management of lake water quality is usually directed to the resolution of these conflicts. Nowhere in the world has lake management been a totally successful activity. However, much progress has been made particularly with respect to controllable point source discharges of waste. The more pervasive impacts of diffuse sources of pollution within the watershed, and from the atmosphere, are less manageable and are still the subject of intensive investigations in many parts of the world (Caldecott 2008).

A pond is a body of standing water, either natural or man-made formed by fracture and extract rocks. The ponds closed basins receive their water from the ground and seepage waters. They may arise naturally in flood plains as part of a river, or they may be somewhat isolated depressions (examples include vernal pools and prairie potholes). Usually they contain shallow water with marsh and aquatic plants and animals. The type of life in a pond is generally determined by a combination of factors including water level (particularly depth and duration of downfall) and nutrient levels, but other factors may also be important, including presence or absence of shading by tress, presence or absence of streams, effects of grazing animals and salinity (Rasoul 2013).

There are almost as many definitions for ecosystem one of them the definition of Christopherson (1997) seems quite workable, but so are quite a few others. Ecosystem definition: An ecosystem is a natural system consisting of all plants, animals and microorganisms (biotic factors) in an area functioning together with all the non-living physical (abiotic) factors of the environment (Christopherson1997).

Roy Clap ham was invented the term ecosystem in 1930, to indicate the physical and biological components of an environment considered in relation to each other as a unit. British ecologist Arthur Tensely later refined the term, describing it as the interactive system established between biocoenosis (a group of living creatures) and their biotope

(the environment in which they live). Central to the ecosystem concept does the idea that living organisms are continually engaged in a set of relationships with every other element constitute the environment in which they exist. Ecosystems can be bounded and discussed with tremendous variety of scope, and describe any situation where there is relationship between organisms and their environment (Vreugdenhil et al. 2003)

Pollution is an earnest and growing problem of the aquatic environment. Increasing numbers and amounts of industrial, agricultural and commercial chemicals discharged into the aquatic environment have led to various deleterious effects on aquatic organisms. Aquatic organisms, including fish, accumulate pollutants directly from contaminated water and indirectly from contaminated water and indirectly via the food chain (Firooz and Shahzrad 2014).

Algae phycologically, diverse group of simple (mainly unicellular to colonial) organisms that have chlorophyll-a as their main photosynthetic pigment and lack a sterile covering of cells around reproductive cells. Carry out oxygenic photosynthesis; they include eukaryotes and prokaryotes (Edward and David 2010).

Algae most commonly occur in fresh water, marine, or brackish. However, they can also be found in almost every other environment in earth, from the algae growing in the snow of some American mountains to algae living in lichen associations on bare rocks, to unicellular algae in desert soils, to algae living in hot springs in most habitats they function as the primary producers in the food chain, producing organic material from sun light, carbon dioxide, and water. Besides forming the basic food source for these food chains, they also form the oxygen necessary for the metabolism of the consumer organisms. In such cases humans rarely directly consume the algae as such, but harvest organisms higher up in the food chain (i.e., fish, crustaceans and shellfish) some algae, particularly the reds and browns, are harvested and eaten as a vegetable, or the mucilages are extracted from the thallus for use as gelling and thick ending agents (Robert2008).

Environmental assessments of water bodies that have been used algae for a century also now used in countries around the world. This review synthesizes recent advances in the field around a framework for management that can guide design of assessments, environmental assessment, applications of phycology in assessments, and refinements of those applications to better support management decisions. Algae are critical types of

aquatic ecosystems that power food webs and biogeochemical cycling. Algae are also important sources of problems that threaten many ecosystems goods and services when toxic taxa are high and abundances of nuisance. Thus, algae can be used to indicate ecosystem goods and services, which complement how algal indicators are also used to assess levels of contaminants and habitat alterations (Stevenson 2014).

Parks are part of the urban infrastructure for physical activity, for families and communities to gather and socialize, or for a simple respite. Research reveals that people who exercise outdoors in green-space derive greater mental health advantages (Kaplan and Kaplan 1989). Providing activities for all ages, abilities and income levels is important for the physical and mental well-being of the general people (Friedman et al. 2013). Also Parks are the places that people go to get healthy and stay fit and bringing money for the local economy supply vegetative buffers to development, produce habitat for wildlife, and provide a place for children and families to connect with nature and recreate outdoors together etc.

The aims of the study are to

1. Quality of water in Sami Abdurrahman Park and Shanadar Park.
2. Identification algal flora in Sami Abdurrahman and Shanadar Water.
3. Connection between water properties and occurrence of algae.
4. Create a comprehensive baseline data for Sami Abdurrahman and Shanadar Water bodies.
5. Evaluate the health of Sami Abdurrahman and Shanadar using the most important physico-chemical properties of water pollution indicators.
6. Study the quantitative and qualitative phytoplankton of park.

1.1. Literature Reviews

1.1.1. Phyco- Ecological Studies in Kurdistan Region are for Example

Phyco-ecological studies in Kurdistan region was done in different inland water systems including lakes, rivers, ponds and springs during the Iraqi Kurdistan.

Al- Hamid (1976) worked about the phytoplankton abundance in Dokan Reservoir, he specified different types of algae 4 taxa were belonging to Cyanophyta, 17 taxa to Chlorophyta, and 2 taxa to Pyrrophyta.

Maulod and Hinton (1978) the paper was published by ecological study on Sarchinar spring in Sulaimaniyah province, they worked were proceed by two parts ecologically results pH was generally 7.3, temperature 17.7^{0}C, turbidity was low and the water was very hard caused by Calcium and Magnesium cations, then Carbon dioxide between 7 to 32 mg l^{-1}, Sulfide between 0.4 to 6.4 mgl^{-1}. The second part of Maulod and Hintons (1978) work was identification algal flora the studies were proceeded by thirteen sites of springs and ponds of Sulaimaniyah during the summer season and they showed 87 species of Cyanophyta and Chlorophyta.

In 37 springs water within Sulaimaniyah province a comprehensive study of algal ecology and seasonal variations of physical and chemical properties of water by Ibrahim (1981). The highest mean temperature was reached 29.5^{0}C in Khumal spring and the lowest in Balkian spring which was recorded 12.18^{0}C, conductivity ranged from 226-2050 $\mu S.cm^{-1}$, alkalinity of the studied springs were intermediate and ranged between 148-352 $mgCaCO_3$ l^{-1}. Phosphate ranged from 0.28 to 12.7µg at.P-PO4 l^{-1}, low nitrite concentrations characterized all springs with an overall mean of 0.12µg at.N-NO_2 l^{-1}, and nitrate was between 16.1 and 275µg at.N-NO3 l^{-1}. Also He identified different algal taxa in all springs they are; Chlorophyta represented by 37 taxa, 9 taxa belong to Chrysophyta, 130 taxa to Cyanophyta, while Rhodophyta represented only by 4 genera totally 180 algal taxa he was identified.

Conducted an ecological and phycological study in seven thermal springs within Nineveh province was made by Al-Nimma and Maulood (1992), Water Temperature ranged between 18 and 40^{0}C. whereas water pH fell to 6.9 with high Conductivity value ranged from 950 to 3900 $\mu S.cm^{-1}$, and Acidity ranged from 60 to 217 mg $CaCO_3$ l^{-1}, They also identified 33 species of algal taxa, five species were have to be new additions to the Iraqi algal flora, the algal population of these thermal springs composed of 66% blue-green algae, whereas diatoms made up 27%, and only 3 taxa of the green algae were identified in this area.

Al-Barzingy (1995) identified 198 taxa in different water systems including springs, streams, karezes, lake and small ponds within Erbil province. Mainly they were belonging to Cyanophyta and Chlorophyta.

Comprehensive phycolimnological study on algal abundance, with their distribution and periodicities along the Rawanduze River path in different habitats including springs, streams, rivers and one pond within Erbil province was made by Aziz 1997 water temperature ranged between 2.5 to 23.5^{0}C, Air temperature ranged from 4 to 38^{0}C, pH was ranged 7.01, conductivity value of 128 to1075 μS.cm^{-1} total hardness was between 80 and 538 mg$CaCO_3$ l^{-1}, total alkalinity value was between 96 and 532 mgCaCO3 l^{-1}. He identified a total of 1016 taxa, including 483 species of Bacillariophyceae, 238 species of 229 species of Chlorophyceae, 66 species of Cyanophyceae.

Ganjo (1997) performed an extend limnological study in Rawanduze River with their tributaries including 27 sites covered by (springs, streams, rivers and one pond), he analyzed 35 physico-chemical variables, also he revealed that the pH of all studied stations lies in the alkaline side exception in one case, Conductivity was ranged from 150 to 650 μS.cm^{-1}, Dissolved oxygen was high with mean of 5.6 mg. l^{-1}, BOD_5 ranged from 1 to 5.4 mg l^{-1} and alkalinity was between 53 and 375 mg $CaCO_3$ l^{-1}. on the other hand he identified fifty two genera were belong to the Classes; Cyanophyceae 12 genera, Chlorophyceae 18 genera Euglinophyceae 3 genera, Xanthophycaea 2 genera, Bacillarophyceae 13 genera Chrysophyceae 1 genera Dinophyceae 2 genera.

Toma (2000) made the limnology of Dokan Lake. He found that Dokan Lake was characterized as a turbid and as warm monomeric during the studied period. He concluded that the secchi-disc reading was 5.07m with high dissolved oxygen (5.5-10.6 mg l^{-1}), He made the following results pH ranged from 6.95 to 8.88, alkalinity ranged from 100-176 mg$CaCO_3$ l^{-1}, EC ranged from 214-380 μS.cm^{-1},Na ranged from 3.1 to 6.6 mg/l and K ranged from 1.0–2.8 mg/l the total hardness was dominated by calcium and ranged hard to hard water. He identified 61 taxa from the phytoplankton and most of them diatom.

Aziz and Ganjo (2002) studied on nutrient status and algal flora then recorded 210 algal taxa including 109 diatoms and 101 non diatoms in streams, springs and small pond in the highest mountain (Halgurd) area in Iraq at an altitude of 2800-3728m.a.s.l. in summer, the

results showed that the water temperature never exceeded 4.7^{0}C and air temperature was around 15˚C in July dissolved oxygen ranged between 4.1-5.4 mg l^{-1}, total hardness, alkalinity and electrical conductivity ranged between 93 and 122mg$CaCO_3$ l^{-1}, 117 and 136 mg$CaCO_3$ l^{-1} and 156 and 198 μS.cm^{-1} respectively, the pH was slightly alkaline, nitrate, phosphate and silicate were ranged from 12.7 to 21.2μg at.N-NO_3 l^{-1}, 0.12 to 0.65μg at P-PO_4 l^{-1}, and 45.6 to 67.6μg at Si-SiO_2 l^{-1} respectively, thus the studied waters were in eutrophic conditions.

Bilbas (2004) studied phycolimnological study on some springs within Erbil province. He made a phycolimnological of 20 springs with their seasonal and spatial variation he stated that all the springs stenothermal with fluctuation of 1 ^{0}C around the mean annual temperature exclude one case, air and water temperature ranged from 10 to 22.5 ^{0}C and-1 to 39 ^{0}C, pH were ranged from 6.4 - 8.6, electrical conductivity and total dissolved solid were ranged from 150-3120 μS.cm^{-1} and 70-1560 mg/l, turbidity ranged value between 0.34 and 120 NTU while alkalinity, acidity and hardness were ranged from 100-2180 mg $CaCO_3$ 1^{-1}, 0.27-330 mg $CaCO_3 1^{-1}$, and 30-710 mg $CaCO_3 1^{-1}$, he also investigated that all springs were classified moderately hard to the very hard water and calcium concentration dominated over magnesium in the studied springs, moreover caloricity and sulfate were ranged from 3.99-126.7 mgl^{-1} and 37-440 mgl^{-1}, then dissolved oxygen and biological oxygen demand for five days were ranged from 0 to 12.0 and 0 to13.0 mgl^{-1}, also he identified a total of 233 taxa belong to 65 genera and 5 division , 10 taxa of them were new records for Iraqi algal flora, 120 species of Bacillarophyceae and Xanthophyceae, 55 species of Cyanophyceae, 53 taxa of Chlorophyceae, 3 species of Euglinophyaceae and species of Rhodophyta.

Bapeer (2004) performed Ecological study on the distribution of algae in different aquatic habitats within Erbil province. The investigation started from the beginning to May 2001 till the middle of April 2003 in which 158 water samples, which belongs to 57 sites and 22 parameters including the physical, chemical and biological properties in the different season of the year, he collected samples from a different water resources in the area were; spring, well, karezes, stream, pond and water impoundment. The highest degree that the water temperature reached was 31.^{0}C, the pH value never dropped below 7. The electrical conductivity of the waters characterized with high values, which reached 1809 μS.cm^{-1} in the pond. Almost all water samples considered as non-polluted waters which indicate

from their low values of BOD which only in the some cases high and reached 8.0 $mg1^{-1}$ and also the non-pollution of the water samples indicated from the high values of dissolved oxygen of their water samples which reached 11.38 $mg1^{-1}$, the water sample characterized to very hard waters which might be due the geological formation of the area and reached 472.26 $mgCaCO_3$ 1^{-1} and calcium hardness which reached 108.04 $mg1^{-1}$, magnesium values were lower and reached 89.52 $mg1^{-1}$ generally dominance of Magnesium than Calcium. Biologically he studied on algae include the count of the main species of the diatom; Chlorophyta and Cyanophyta and non-diatom algae the highest numbers he identified Synedra.

A phycolimnological study of Derbendikhan Lake was carried out seasonally by Toma (2011). The lowest and highest range of physicochemical properties was as follows; 13-34^{0}C and 12-30^{0}C for air and water temperature. Electrical conductivity and total dissolved solids varied from 435- 485µs cm^{-1} and 278-310 mg l^{-1} respectively. pH was always on alkaline side of neutrality. Alkalinity ranged from 200 to 240 $mgCaCO_3$ l^{-1}. Hardness ranged between 210-280 $mgCaCO_3$ l^{-1}. Phycologically, a total of 30 algal taxa were recorded.

Aziz (2009) conducted a study on algal assemblage as biological indicators for fresh water quality assessment; he showed that the algal community associated with fresh water, eutrophic, alkalinity, fresh and hard water conditions.

Fattah (2010) performed phycolimnological study on Khabour River, He showed that water temperature ranged from 5 to 20 (Halgurd) ^{0}C, pH ranged from 7.41 to 8.48 while specific electrical conductivity ranged between 336.9-856.75µs cm^{-1} alkalinity value ranged from 152.5-282.5 mg $CaCO_3$ l^{-1}, he also noted that water of the river classified as hard to very hard also he identified a total of 130 algal species belong to the 4 division.

Rasoul (2013) studied of algal communities and some environmental parameters in six ponds within Guer area near greater Zap River in Erbil province. This study focused on the spatio-temporal variation of epipelic and phytoplankton composition as affected by some physical and chemical parameters, the results of the chemical and physical parameters are; air temperature 19-42 ^{0}C, water temperature 15-35 ^{0}C, pH (6.37-8.31), EC 956-5667µS cm^{-1}, TDS 627-3683 $mg.l^{-1}$, turbidity 1.90-35NTU, alkalinity 102-410 $mgCaCO_3$ 1^{-1}, acidity 20.01-25.75 mg $CaCO_3 1^{-1}$, total hardness 100-722 $mg.l^{-1}$. In point

views of algal flora, a total of 292 algal species belong to 85 genera, 43 families, and 8 divisions were identified. Among them 32 species and 2 genera were new records to Iraqi algal flora (27 species belong to non-diatom and the rest to diatom). The dominant division was Bacillarophyta shared 133 species (45.54%). Followed by Cyanophyta with 67 species (23.44%), Chlorophyta with 62 species (21.03%), Euglinophyta with 23 species (7.876%), Dinophyta with 4 species (1.769%) and each of Cryptophyta, Chrysophyta, and Xanthophyta with species (0.249%).

Bilbas (2014) made the ecological health assessment of Dukan Lake from Sulaymaniya Kurdistan region Iraq. He worked on twenty sites were selected within Dukan lake watershed and water samples again from twenty locations. Generally, results revealed that air temperature has a wide range of fluctuation; it was ranged from 3.5-42.5^{0}C. Water temperature in river and stream sites was ranged from 5.5 - 36 ^{0}C, whereas it was never fallen below 10^{0}C even at 60 meters. Thermally, Dukan Lake was stratified during spring and summer months and circulated during autumn and winter months. The lake was classified as subtropical warm monomictic lake. The results of water sample analysis showed the following records: EC ranged from153-398µs cm^{-1}; water transparency ranged from 0.50-7.0 m, turbidity ranged from 0.5- 5 NTU, total alkalinity, acidity and hardness were range from 100-390 mg $CaCO_3$ 1^{-1}, 0–22 mg $CaCO_3$ 1^{-1} and 100-332 mg $CaCO_3$ 1^{-1}. Results of inorganic non-metallic properties in Dukan Lake basin showed the following records; pH ranged from 7.10-8.80, Cl^{-1} ranged from 2.98 - 46.67 mg l^{-1};ammonia, nitrite and nitrate were ranged from 2.75-20.35µg N-NH_3 l^{-1}, 5.46-15.34µg N-NO_2 l-1 and 39.11-88µg N-NO_3 l^{-1}, $(PO_4)_3$ranged from 0.49-25.5µg P-PO_4 l^{-1}, Celica- ranged from 23.76-111. Phycologically he identified 93 algal species dominated by diatom species. The quality of Dukan Lake water was rated as fair with WQI of 73.78 and 75.1 % calculated during turnover and stratified months. The geoaccumulation index Igeo revealed that Dukan Lake sediment was suffered from cadmium and lead metal pollution.

1.1.2. Global Phycolimnological Study

Rao (1971) performed an ecological effect of three fresh water ponds on phytoplankton (Volvocales and Chlorococales) in Hyderabad-India. The result showed that the Volvocales preferred eutrophic waters having high salt content; their periodicity was possibly dependent upon the concentration of nitrates and phosphates. Chlorococcous

were present in both calcium rich and calcium poor ponds but the species composition was totally different from the each other.

Sabater (1990) conduct the phytoplankton composition in the Ter River, Spain. The results was given pH ranged between 7.6-8.2, dissolved oxygen ranged from 4.7 to 9.6 $mg.l^{-1}$ respectively, phytoplankton's cell varied from 9 to 92 x 10^6 cells l^{-1}. Chlorophyceae were dominating taxonomic group in the river.

Khan et al. (1990) reported plankton organisms on Bachhra reservoir from 1982 to 1987. They performed that plankton population ranged from 70 u/l in 1986 to 4762 u/l in 1984. They were worked on Chlorophyceae algae. The important flora recorded by them were *Microcytisaeroginosa, Ahanocapsa* sp., *Anabaena* sp., *Merismopaedia* sp., *Myxophyceae* sp. *Spediastrium* sp., *Eudorinia* sp., *Pandrina* sp., *Oedogonium* sp.,*Spirogyra* sp., *Ulothrix* sp. *Melosira* sp. *Synedra* sp.

Limnological study on Kapti Lake made by Ahmad and Saha (1992) studied some chemical and physical parameters of this lake. The results were noted the air temperature was always found higher than water temperature. Vertical variation in temperature (0.8-4.7 ºC) was noted in all months. Dissolved oxygen 6.4-9.1 mg/l content showed favorable condition for aquatic lives.

Physicochemical properties and phytoplankton community structure with dynamics of Salado River by Farrell (1993). The results were given that water temperature varied from (10-30^0C) and the pH ranged between 7.7 to9.6dissolved oxygen ranged between (5.6-13.5) $mg.l^{-1}$). The conductivity was low in summer, while have a highest suspended solid.

Razzaque et al. (1995) studied on plankton population of Halti bell at Notorein Bangladesh, the results show as temporal abundance they measured of total phytoplankton and found to vary between 11.7-4.6 to 4.6 to 47.7 - 34.6 cells/ml. they also identify a total of 87 phytoplankton genera among them the most abundant genera were; *Spirogyra, chlorella, Anabaena, Cymbella, Scenedesmus,Ulothrix, Aphanocapsa, Euglina, Cosmarium, Fragillaria, Melosiria, Nostoc, Rivularia, Protococcus, Zygnema* etc.

Tafas and Amilli (1997) made the physical and chemical status of Trichonis Lake in Greece. Correlation between Lake Nutrient and phytoplankton biomass, Trichones is carbonate type, low electrical conductivity, nitrogen and phosphorus consecration he was worked on and weak correlation was found between plankton community feature (species abundance, biomass and chlorophyll a) and light penetration. Tryfon and Govni (1997) the phytoplankton of Lake Mikri Prespa was studied in monthly interval, they focused on species composition, consisting of a great number of Cyanophyta and a small number of Chrysophyta and eutrophic character of lake.

Ghosh and Pandit (1997) studied on the plankton, periphyton, bottom biota and macro vegetation on wet lands of their different zones (fresh water, low saline, high saline) they results shown as are water temperature, pH, alkalinity and phosphate ranged from 20 to 35 ^{0}C, 7.00 to 7.80, 72.00 to 196.00 mg/L and 0.16 to 0.56 mg/L in fresh water.

Phytoplankton as a bio-indicator of health conditions of Atezca Lake in a mountainous zone of North–eastern Mexico by Diaz-Pardo, et al. (1998).The results were reached that the lake was a monomictic system with a winter circulation period, and stratification in spring and summer. A high concentration of nitrates and phosphates occurred at the beginning of the stratification period and decreased toward late stratification. During the overturn period these nutrients increased. These dynamics affected the phytoplankton assemblage because Bacillariophyceans and Chlorophyceans were dominant in early stratification, Dinophyceans and Cyanophyceans in late stratification.

The epipelic and epilithic algae of Dağbaş Lake Rize, Turkey were made by Sahin (2001). the algal flora was identified consist of 103, 31, 15, and 4 species, belonging to Bacillariaphyta, Chlorophyta, Cyanophyta, and Euglenophyta, then 83 taxa were recorded from the epipelic algae and epilithic algae were at least 43 species.

Sohrabipouret etal. (2004) reported on marine algae from Lengeh province of Iran. they worked on three station at Lengeh area geography this province located from the south of Iran and north of Farsi an Gulf, during the period of the study they identified and collected hundred nineteen species of algae, they consist twenty nine Chlorophyceae on the another hand three of them were new recorded, thirty one species of Phaeophyceaeand four of them were new recorded, last group is Rhodophyceae represented by fifty nine species also two of them were new recorded.

Perez et al. (2009) performed the composition of phytoplankton in the Ebro River estuary Spain. The results that he showed us water pH ranged between 7.86 and 8.55 and electrical conductivity between 928-9071µs cm^{-1}.Also he identified 304 algal taxa belong to the classes; Bacillariophyceae, Chlorophycaea, Cyanobacteria, Cryptophyceae, Chrysophycaeae, Dinophyceae, Dictyochophyceae etc.

Mustafa et al. (2009) studied on fresh water algae from Karachi, Pakistan. They worked on three towns of Karachi city during the period of the study they identified 214algal species belong 68 genera of 33 families, 15 orders, 10 classes and 6 phylum were collected variables from the water of fresh. The composition of the algae were divided by 6 phyla; Cyanophycota was represented by eighty two species also the percentage of this phyla 38.32%, the second type is Volvophycota by seventy eight species as well as 36.45%, represent by four species of Euglenophycota on the other hand percentage is 1.87, Chrysophycota was showed by two species and 0.93%, another phyla is Bacillarophycota displayed as thirty eight species and 17.76% of the algal composition, the last phyla is Chlorophycota also they identified ten species of this group and 4.67%.

Ozbay (2011) performed a study on the composition and abundance of phytoplankton in relation to physical and chemical variables in the Kars River, Turkey. The results noted that the temperature ranged between 9.6 to 21 ^{0}C, pH ranged from 5.9 to 7, dissolved oxygen between 4$mg.l^{-1}$ respectively. Also identified 66 taxa of phytoplankton were dominated group was Cyanophyta, expect in June when it was overcome by Bacillariophyta.

2. MATERIALS AND METHODS

2.1. Methods of the Field Work and Sampling

2.1.1. Water samples

Water samples from 8 different studied stations were collected from January 2016 to April 2016. Surface water samples were taken for physical, chemical and biological analysis using polyethylene bucket which had been washed twice with water sample and transferred to a 5 liter polyethylene bottles which was rinsed twice with water sample before filling it.

Winkler's and Amber bottles for dissolved oxygen (DO) and biochemical oxygen demand for five days (BOD_5) respectively were placed under the surface of water and filled it to eliminate water bubbles, the bottles then stoppered under water surface, all reagents ($MnSO_4$, Alkali iodide aside and concentration $H2SO_4$) were added to the Winkler's bottle in the field except the titration (APHA 2012).

2.1.2. Algal Sampling

Eight samples of the algae were collected using spatula and forceps at each eight sites directly transferred to a small vials, water from the area was add to the vials and on return to laboratory, compound microscope (Model E100) was used for algal identification.

2.2. Physical and Aggregate Analyses

2.2.1. Altitude

The altitude was recorded for each station by a portable Global Positioning system (GPS) model (Garmin e-Figure) accurate up to 2m and was able to connect with 12 satellites to determine the actual point of stations.

2.2.2. Temperature

Temperatures impress physical, chemical and biochemical processes in a water body (Pradhanang 2012). In the field air and water temperature were measured by a precision glass mercury thermometer (0–50^{0}C) graduated up to 0.1^{0}C intervals. For surface water, the measurements were taken after the liquid column in the thermometer stops moving, while for subsurface water column, the temperature measurements were taken at each depth (10, 20, 30, 40, 50 and 60m) through a thermometer attached originally with a depth sampler Van Dorn as described by Bartram and Ballance (1996).

2.2.3. Electrical Conductivity

It was measured in the field using a portable conductivity meter model (HI 9811, HANNA instruments 2000) calibrated with (0.01M) standard potassium chloride solution before each sampling; the results were expressed in $\mu S.cm^{-1}$ as described by (APHA 2012).

2.2.4. Turbidity

It was measured by Nephelometric method using HACH turbid meter model (2100 A, U.S.A), calibrated before each sampling by using of manufacture standard solutions of 0.61, 1, 10, 100, and 1000 NTU, and the results were expressed as NTU (APHA 2012).

2.2.5. Total Alkalinity

Alkalinity determined in the laboratory by Titration method using standard sulfuric acid titrant (0.1 N) as described by APHA (2012), the results were expressed in mg $CaCO_3\ l^{-1}$ using the formula bellow:

Alkalinity as mg $CaCO_3\ l^{-1}$ = A x N x 50000/ml of sample.

Where; A= ml of standard acid used.

N= normality of standard acid.

2.2.6. Total Acidity

It was determined by Titration method using standard sodium hydroxide titrant (0.1 N) as

described by APHA (2012), the results were expressed in mg $CaCO_3$ l^{-1} using the following formula:

Acidity as mg $CaCO_3$ l^{-1} = A x B x 50000/ml of sample.

Where A= ml of standard NaOH titrant used.

B= normality of standard NaOH.

2.2.7. Total Hardness

It was determined by EDTA Titrimetric method as described by APHA (2012), using Eriochrome Black T as indicator and buffer solution of pH 10, the results were expressed in mg $CaCO_3$ l^{-1} using the formula bellow:

Hardness as mg $CaCO_3$ l^{-1} = A x B x 1000/ml of sample.

Where A= ml titration for sample.

B= mg $CaCO_3$ equivalent to 1ml EDTA titrant.

2.2.8. Calcium Ion Ca^{2+}

It was determined by EDTA Titrimetric Method as described by APHA (2012) using murex ide as indicator and NaOH. The results were expressed in mg Ca^{2+} l^{-1}, the following equation was used:

mg Ca^{2+} l^{-1}= A x B x 400.8 / ml of sample.

Where A= ml titrant for sample.

B= mg $CaCO_3$ equivalent to 1ml EDTA titrant at the calcium

Indicator end point.

2.2.9. Magnesium Ion Mg^{2+}

Calculated by subtraction of EDTA volume used for calcium titration from EDTA volume used for total hardness as described by APHA (2012). The results were expressed in mg Mg^{2+} l^{-1}, the following equation was used:

Mg Mg^{2+} l^{-1}= [total hardness (as mg $CaCO_3$ l^{-1}) – calcium hardness (as mg $CaCO_3$ l^{-1})] x 0.243

2.3. Inorganic Constituent Analyses

2.3.1. Hydrogen Ion Concentration (pH)

It was measured directly in the field by Electrometric method using a portable pH-meter model (HI 9811, HANNA instruments 2000) accurate up to 0.01 pH unit with a range of 0 to 14. The instrument was calibrated before each sampling using buffer solutions of (pH= 4, 7 and 9) as described by APHA (2012). The measurements of subsurface water samples were obtained after water collected at each depth in a container. The pH of water is the negative logarithm of the hydrogen ion activity (WHO1996 Bapeer 2004).

2.3.3. Total Dissolved Solid

It was measured directly in the field by using a portable T.D.S meter model (H1 9811, HANAH instruments 2000) the results were expressed in $mg.l^{-1}$. Total dissolved solids (TDS) arethe amount of mineral and salt impurities in the water, displays the concentration of dissolved minerals. In the case of total dissolved solids (TDS), there was a considerable amount of dissolved ions in all the sampling locations (Pradhanang 2012). On the other hands total dissolved solids (TDS) is the used to qualify the inorganic salts and small amounts of organic matter present in solution in water. The origin constituents are usually Calcium (Ca), Magnesium (Mg), Sodium (Na), and potassium cations (K) and carbonate (CO_3), hydrogen carbonate(HCO_3), chloride (Cl^-), sulfate (SO_4), and nitrate anions(NO_3) (WHO 2008).

2.3.4. Dissolved Oxygen (DO)

Dissolved oxygen was determined by aside modification method of the classical Winkler procedure (1888) using manganese sulfate solution, alkali-iodide-aside reagent, sulfuric acid and sodium thiosulfate as titrant as described by APHA (2012). The results were expressed in mg DO l^{-1}. For titration of 200 ml sample, 1ml of sodium thiosulfate titrant =1mg DO l^{-1}.

2.4. Organic Constituent Analyses

2.4.1. Biochemical Oxygen Demand for 5-days (BOD_5)

Biochemical Oxygen Demand for 5-days (BOD_5) was done after five-day incubation according to APHA (2012), using the following equation for undiluted samples:

BOD_5 as mg l^{-1}=DO before incubation–DO after incubation.

In case of low concentrations of dissolved oxygen, the dilution method by distilled water was conducted and the BOD_5 was calculated by formula of:

BOD_5as mg l^{-1}=DO_1–DO_2/ P

Where DO_1 = Initial dissolved oxygen in the diluted sample.

DO_2 =Dissolved oxygen after 5- days incubation.

P= Dilution factor

2.5. Biological Analysis

2.5.1. Phytoplankton Analysis

Count of phytoplankton was determined using Membrane Filtration Method using a measured volume of well-mixed water sample into a funnel equipped with a membrane filter of 25 mm diameter and 0.45 µm pore size. The volume of water sample which had been filtered depended on the phytoplankton quantity, suspended solids and sediments in the water sample (APHA 2012).The Phytoplankton was counted by Compound Microscope (Olympus PM-b, Japan), the number of phytoplankton cells per liter calculated according to the following formula:

Total no. of phytoplankton (cell l^{-1})=(D x area of filter)/(area of 30 fields x liter of sample filtered).

Where; D= Total counts of 30 fields.

2.5.2. Identification of Algae

The algal samples with different sources of collection habitat were examined by binocular microscope under low and high power the algal samples were fresh photo were taken when even it need with microscope camera model (Olympus PM-b, Japan)Non-diatom algal forms were identified the genera and taxa depending on the following references: Wolle (1884), West (1904), Smith (1950), Desikachary (1959), Prescott (1968 and1975), Lind and Brook, (1980), Bold and Whyne (1985).

2.6. Computer software and programs

The following programs were used

1- Figure Info Professional. Version 9.0. Released 2007. Figure Info Corp: used for drawing the Figure of the studied area.
2- Statistical Product and Service Solutions (IBM SPSS Statistics for Windows). Version 17. Released 2011. IBM Corp.
3- Microsoft Word Office Professional Plus 2010. Version 14.0.6129. Microsoft Corp.
4- Microsoft Excel Office Professional Plus 2010. Version 14.0.6129. Microsoft Corp.
5- End Note Software. Version X6.0.1. Released 2012. Thomson Reuters Corp. Used for writing the references.

3. DESCRIPTION OF THE STUDY AREA

Generally, Iraqi territory lies in the border between two major geostructural parts; Arabian unit of African platform and Asian branches of Alpine geosyncline. The largest part of Iraqi Kurdistan Region is belonging to the second unit. The northern region of Iraq includes three important governments;

Erbil, Duhok, Sulaimaniah with the population approximately by more than four million peoples. The Kurdistan region of Iraq is located approximately between the SN latitude $34^0 30'$ and $37^0 20'$; and the WE longitude $42^0 20'$ and $46^0 20$ its borders Iran to the east, Turkey to the North, Syria to the west and the rest of Iraq to the south (Bilbas 2014).

3.1. Area and Geology of Erbil City

Erbil is a capital of Kurdistan region it is situated almost at the center of the region. Erbil covers about 18170 square kilometers. It is bounded by greater Zap River to the North-West and by lesser Zap River to the South-East. Boundaries extended from longitude 43 15 E to 45 14E and from latitude 35 27 N to 37 24 N. the province may be distinguished into two distinct regions with regard geology and topography one is the low folds regions of valleys and plains. The second region is the high folds and nape zone of high mountains and narrow valleys. Geological formations range in age from Jurassic to recent. It includes limestone, shale, sand, stone and conglomerates. Cretaceous formation occur extensively in the high folds and nape zone whereas younger sediments and recent alluvial deposits predominate the low fold region, in the high folds zone north-east of Pirmam Chia there is predominate of cretaceous limestone (Bapper 2004).

3.2. Climate and Hydrology

In Kurdistan region all types of precipitation occur (rain, snow and snowflake). In general snowing is the characteristic of mountain region. Its range very annually: some time snowing may occur in foothill regions. While snow flake is mostly occur in spring season due to cold current of air. The annual rainfall varies with season and region. The higher altitude parts of the area have colder winters and receive more precipitation than the area of lower elevations .in Kurdistan region precipitation increased from south, southwest to northeast with annual range 300 mm to110 mm (Fatah 2010).

The mean of annual temperature in Kurdistan region varies sharply with elevation and season (between summer and winter), it over (40^0C) in summer and fall below zero in winter. The factors (rainfall and humidity) play important role on the climate all together with temperature Relative humidity varies from (50-75%) in winter while fall down below (30%) from May to October which indicating hot and dry summer months (Guest 1966, Fatah 2010).

The climate of the Erbil area is similar to that of other parts of Iraqi Kurdistan region and other northern part of Iraq which is semi-arid and characterized by a hot dry summer and moderately rainy cold winter. The higher altitude parts of the area have colder winters and receive more precipitation that the areas of lower elevation. Compared to other regions of Iraq the studied area coldest wettest climate of the country with a relative humidity in winter and low humidity in the summer the winds direction is mainly north westerly (Haddad et al. 1974).

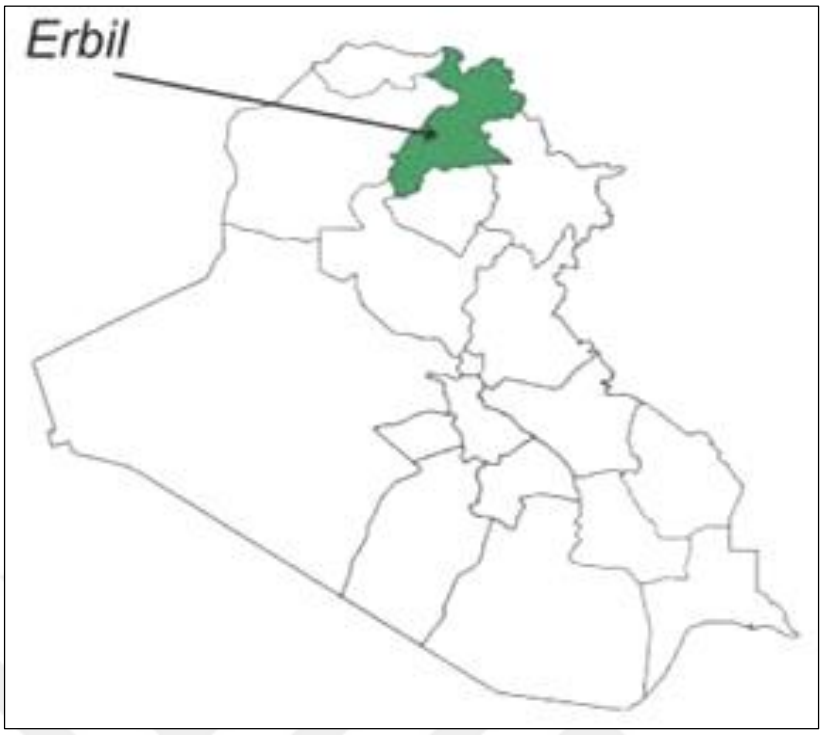

Figure 1. Location of studied area (Erbil)

3.3. Sami Abdurrahman Park

The largest park in Kurdistan Region, situated at the West side of Erbil city, neighbored by the Sixty Meter Street from East, and exactly opposite the buildings of Kurdistan's Parliament and Council of Ministers of the Region Near it from South passes the main road between Erbil and Mosul cities. The latitude of Sami Abdurrahman Park is 36.11'32.19, and the longitude is 43.59'44.90. In the past (prior to 1991), it was a military point embracing a large number of military units. The military presence in the city's western suburb at that time had distorted the natural construction development of Erbil city for seven decades, ever since the foundation of the Iraqi State. The Kurdistan Regional Government reserved a parcel of 800 thousand sq m. of the lands that used to be a series of military camps during Dictatorial era, and decided to transform it into a spacious public garden after the mid-nineties of last century. Sami Abdurrahman Park is contains the Erbil International Fair Ground, Zaytun Public Library, theaters, a number of statues and monuments, a summer movie theater, and two artificial lakes.

Sami Abdurrahman Park is a green area in Erbil, Kurdistan, northern Iraq we worked this park from January to April of 2016 also we had a three stations during the study period. this park contain a two big lakes both of them were names station one and station two then station three located from the central of the park, also station four near the monument of 1-Shubat (personal information).

Figure 2. Location of studied area (Sami Abdurrahman)

Figure 3. Station 1. Lake one

Figure 4. Station 2, Lake two

Figure 5. Station 3, central of the park

Figure 6. Station 4, near the Monument of 1 Shubat

3.4. Shanadar Park

We worked on Shanadar Park in Hewlêr located between Zanyari locality and Minara Park (Figure 3), this park is consist of three sections:section one 40.000 m^2, section two 18.000 m^2 and section three 12.000 m^2 total of the area Park is 70.000 m^2, introduced in 2008 is spot of water and two fountain: one of them on a hilltop Shanadar and other in South of park (Personal information from the Mangier Park Kawes Ahmad Sleman) The Park in the past was the train station connecting Hewlêr to Kirkuk. Now the park includes nearly 6000 trees of different types.

The importance of the Park of the presence of Shanadar gallery represents a cultural center held its Art and literary activities and visitations hundreds of people at these events also to that found in Shanadar two include large library by of hundreds of books (Personal information from Engineer Park Aram Omer Mhammed).Our study includes have three stations for collecting algae and water sampling station:one, near gallery of Shanadar (Plate 5) and stations two in this park near fountain (Plate 6), the third near Alsawaf-Mosque (Plate7) finally near the small pond near the door of aqua park its name station 8 (Plat8)

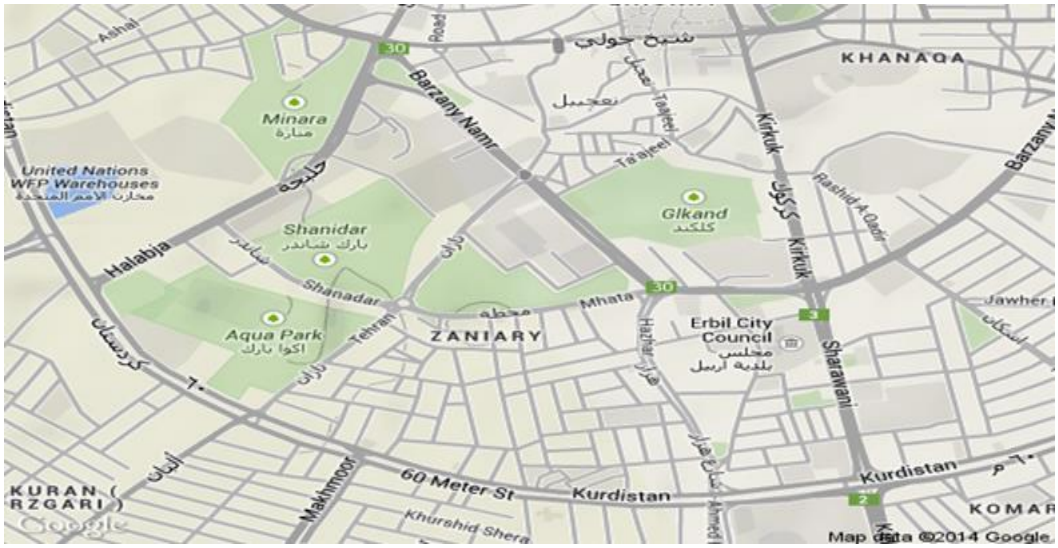

Figure 7. Location of studied area (Shanadar)

Figure 8. Station 5, near gallery of Shanadar

Figure 9. Station 6, near fountain

Figure 10. Station 7, near Alsawaf-Mosque

Figure 11. Station 8, near the door of Aqua Park

4. RESULTS

The research contains the explanation of knowing quality of water in Sami Abdurrahman Park and Shanadar Park, identification algal flora in both park, relationship between water properties and occurrence of algae. Quality of water in Sami Abdurrahman Park and Shanadar Park. Create a comprehensive baseline data for Sami Abdurrahman and Shanadar Park. Evaluate the health of Sami Abdurrahman and Shanadar using the most important physico-chemical properties of water pollution indicators. Study the quantitative and qualitative Phytoplankton of park. From Table (1) we can see the results of chemical and physical aggregates, organic constitute analysis and in organic constitute analysis the air temperature results showed variation with respect to the season, the air temperature ranged was between 17-21^{0}C. On the other hand, we can see the results of water temperature the ranged was between 11-16^{0}C. The highest value of electrical conductivity was noted 1370 µS.cm^{-1} and the lowest value was 295µS.cm^{-1}. Turbidity ranged was between 7-11 NTU. Then we can see the maximum value of alkalinity was noted 390 mg$CaCO_3$ l^{-1} and the minimum value 196 mg $CaCO_3$ l^{-1}. The acidity ranged between 19.21-15.62mg$CaCO_3$ l^{-1}.The results of total hardness between 165 to 220 mg $CaCO_3$ l^{-1}. We can say that calcium ion more than magnesium ion of both parks. Total dissolved sold were between 329-666value of hydrogen ion concentration were noted from 7.97-8.25. Lower value of dissolved oxygen 2.61 and higher value 4.45 the results of biological oxygen demand were ranged between 14.64 to17.41.

Biological analysis identification of algae flagellated forms of algae and some Cyanophyta were identified before algal fixation as soon as possible because of their loss of taxonomic characters. Non-diatom algal forms were identified using the some references and books.

Identified (34) genus and species of algae, but some of algae (*Euglena* sp., *Osillatoria* sp. *Chlamydomonas* sp.) which found in water park have important role in pollution.

Table 1. The results of chemical-physical aggregates, organic constitute analysis and in organic constitute analysis of the water sample

Parameters	St1	St2	St3	St4	St5	St6	St7	St8
Air temp.	21	20	18	17	19	19	20	18
Water temp.	14.7	15.1	15.1	12	13.1	16	14	11
EC	295	316	1370	392	396	361	397	371
Turbidity	8.5	8.7	11	9	7	7.6	7.9	8.3
Alkalinity	317	362	390	376	267	196	243	271
Acidity	17.76	18.13	19.21	18.24	16.34	15.62	16.12	16.54
Total hardness	207	176	216	220	200	172	212	165
Calcium ion	94	67	92	96	80	68	90	55
Magnesium ion	29.88	26.48	30.13	30.13	29	25	30	26.73
pH	8.02	8.14	8.25	8.17	8	7.95	8.1	8.07
TDS	425	437	666	532	329	354	342	333
DO	3.52	3.68	4.45	3.91	2.61	3.27	3.17	2.89
BOD_5	14.64	15.73	16.29	15.88	17.41	16.20	16.45	15.47

Table 2. The statically analysis of chemical - physical aggregates, organic constitute analysis and in organic constitute analysis of the water sample

Parameters	Maximum	Minimum	Mean	Range	Std.deviation	variance	Sum
Air temp.	21	17	19.00	4	1.309	1.714	152
Water temp.	16	11	13.87	5	1.71	2.92	111
EC	1370	295	487.25	1075	358.67	128647	3898
Turbidity	11	7	8.5	4	1.19	1.4	68
Alkalinity	390	196	302.75	194	69.6	4849	2422
Acidity	19.21	15.62	17.24	3.59	1.26	1.58	137.96
Total hardness	220	165	196	55	21.7	472	1568
Calcium ion	96	55	80.25	41	15	233	642
Magnesium ion	30.13	25	28.41	5.13	2	4	227.35
pH	8.25	7.95	8.0	0.30	0.0982	0.010	64.70
TDS	666	329	427.25	337	119	14177	3418
DO	4.45	2.61	3.43	1.84	.585	.343	27.50
BOD_5	17.41	14.64	16.00	2.77	.80	.647	128.07

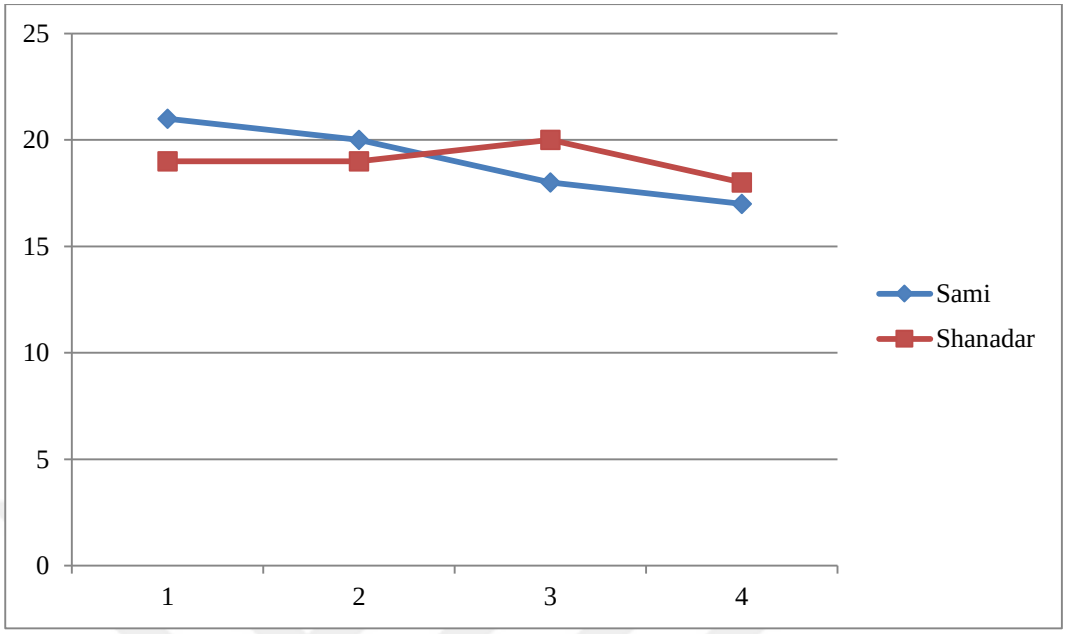

Figure 12. Mean with minimum and maximum air temperature at 8 stations in Sami Abdurrahman with Shanadar Park and its tributaries during the studied period

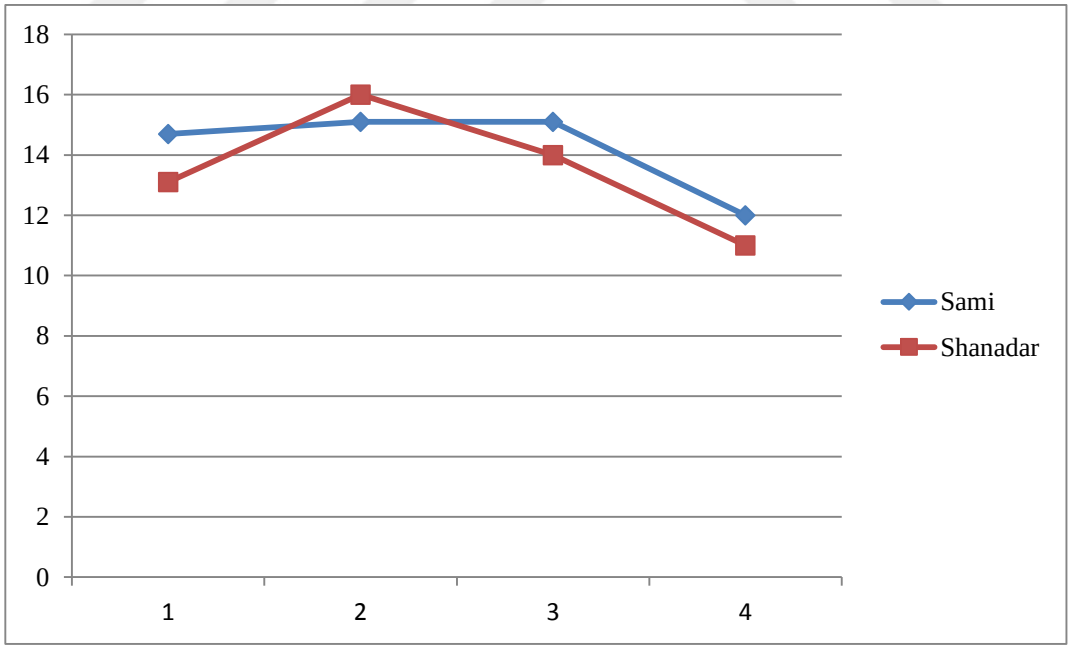

Figure 13. Mean with minimum and maximum water temperature at 8 stations in Sami Abdurrahman with Shanadar Park and its tributaries during the studied period

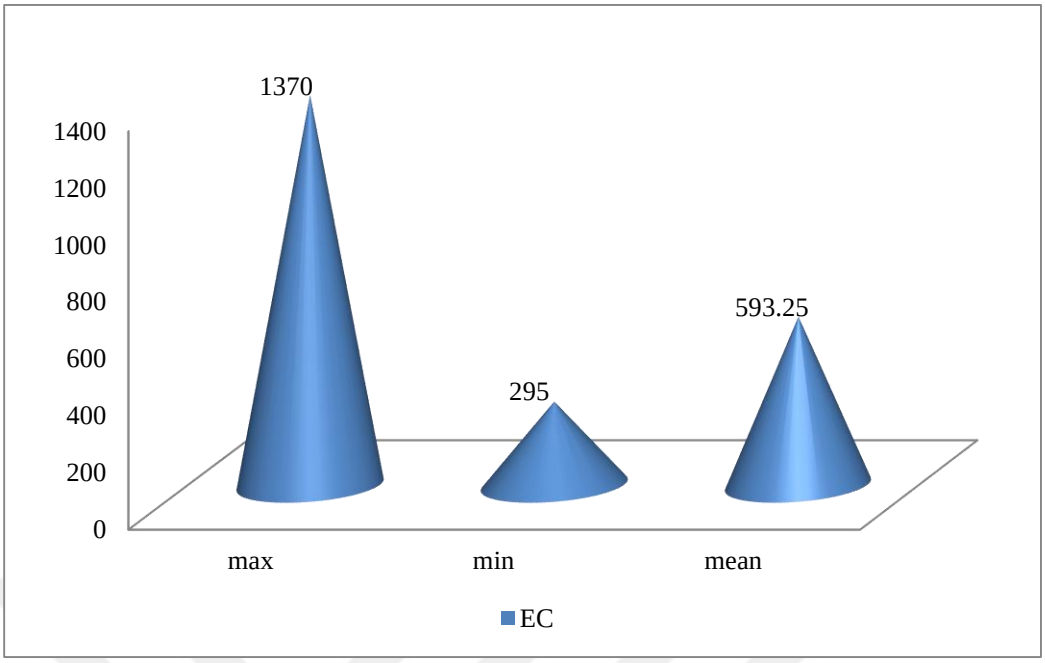

Figure 14. Mean with minimum and maximum electrical conductivity (EC) at 4 stations in Sami Abdurrahman and its tributaries during the studied period

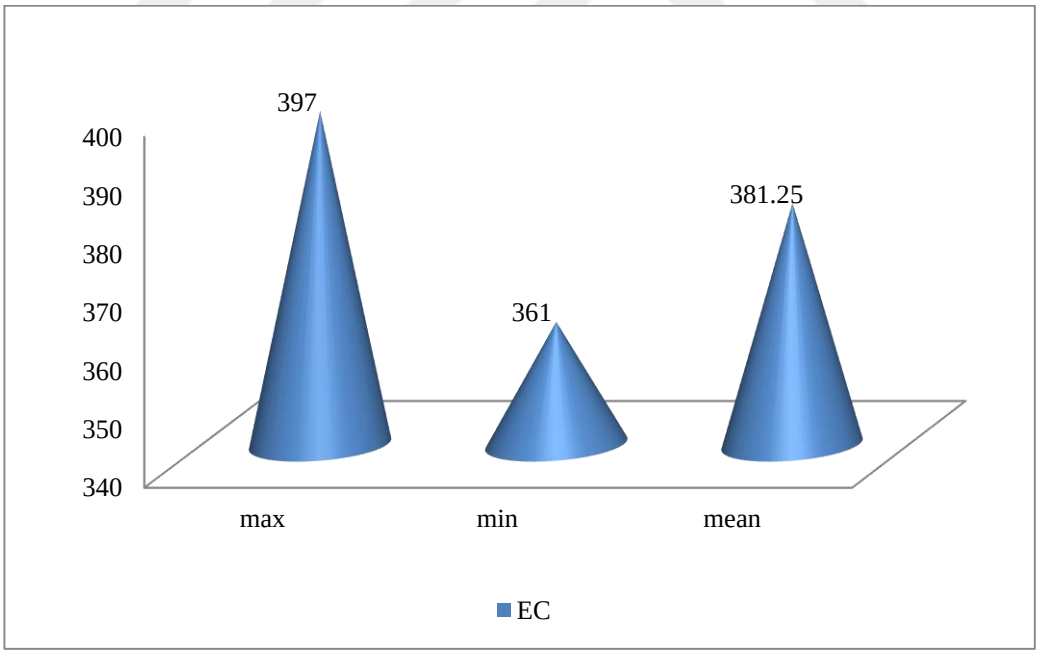

Figure 15. Mean with minimum and maximum electrical conductivity (EC) at4 stations in Shanadar Park and its tributaries during the studied period

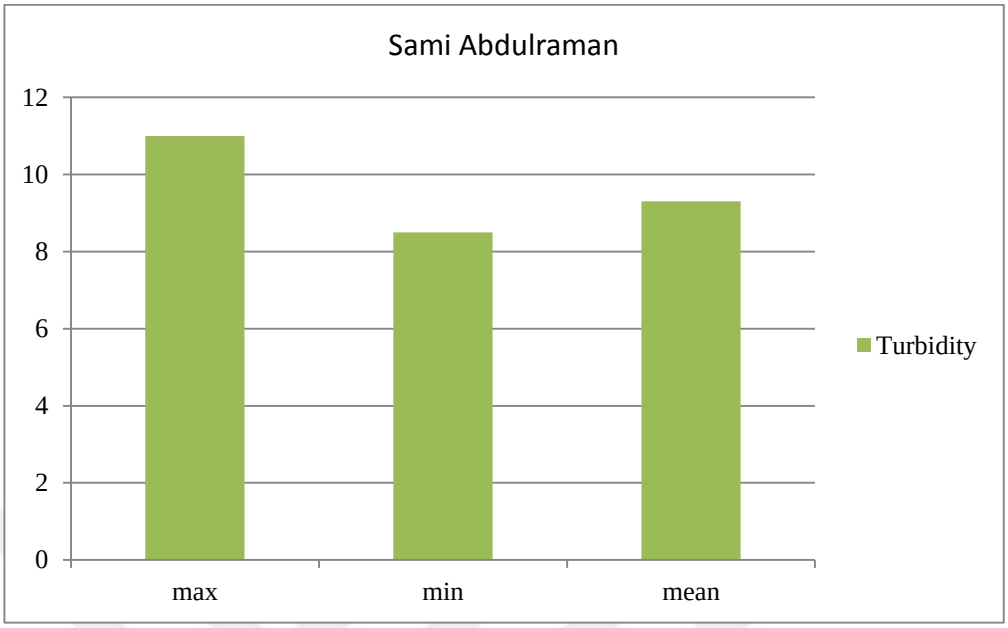

Figure 16. Mean with minimum and maximum turbidity at 4 stations in Sami Abdurrahman and its tributaries during the studied period

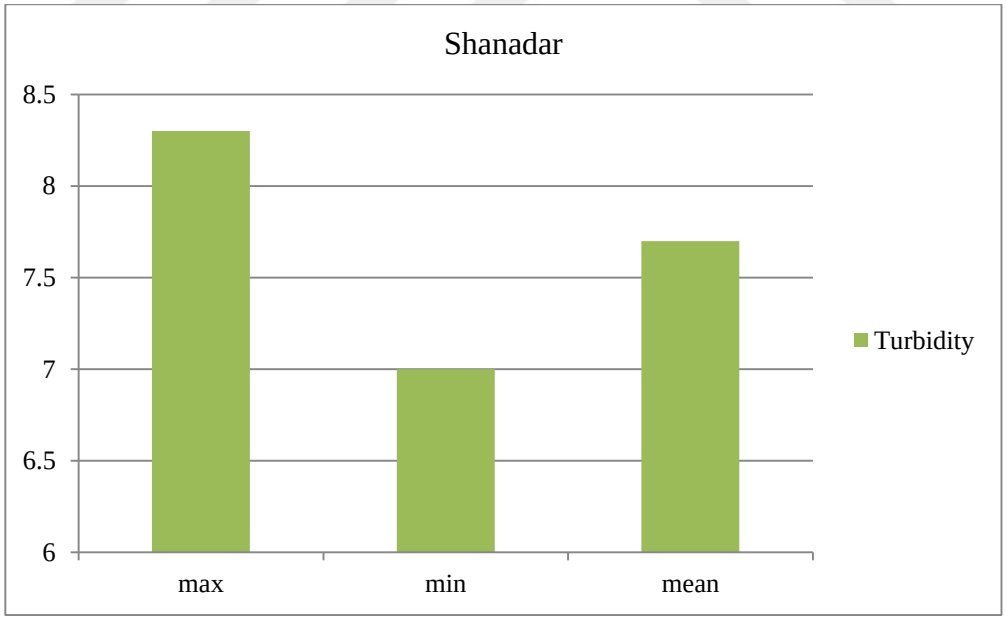

Figure 17. Mean with minimum and maximum turbidity at 4 stations in Shanadar Park and its tributaries during the studied period

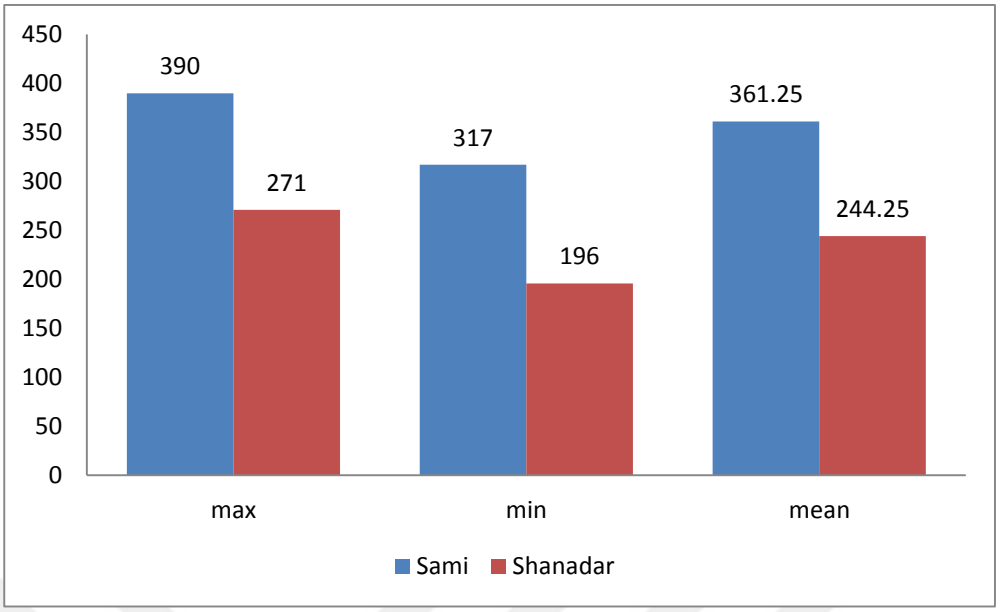

Figure 18. Mean with minimum and maximum alkalinity at 8 stations in Sami Abdurrahman with Shanadar Park and its tributaries during the studied period

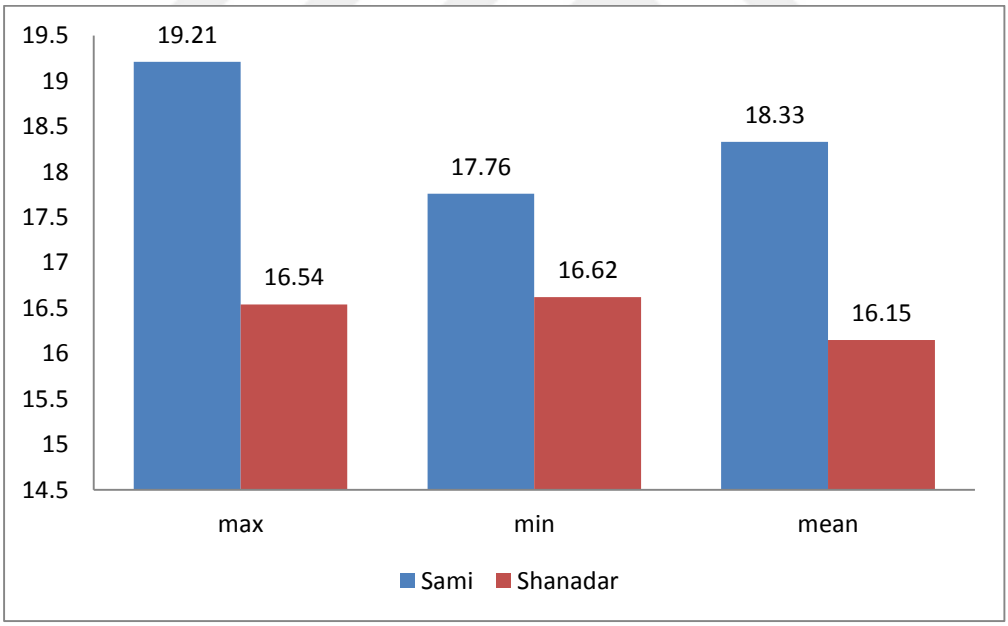

Figure 19. Mean with minimum and maximum acidity at 8 stations in Sami Abdurrahman with Shanadar Park and its tributaries during the studied period

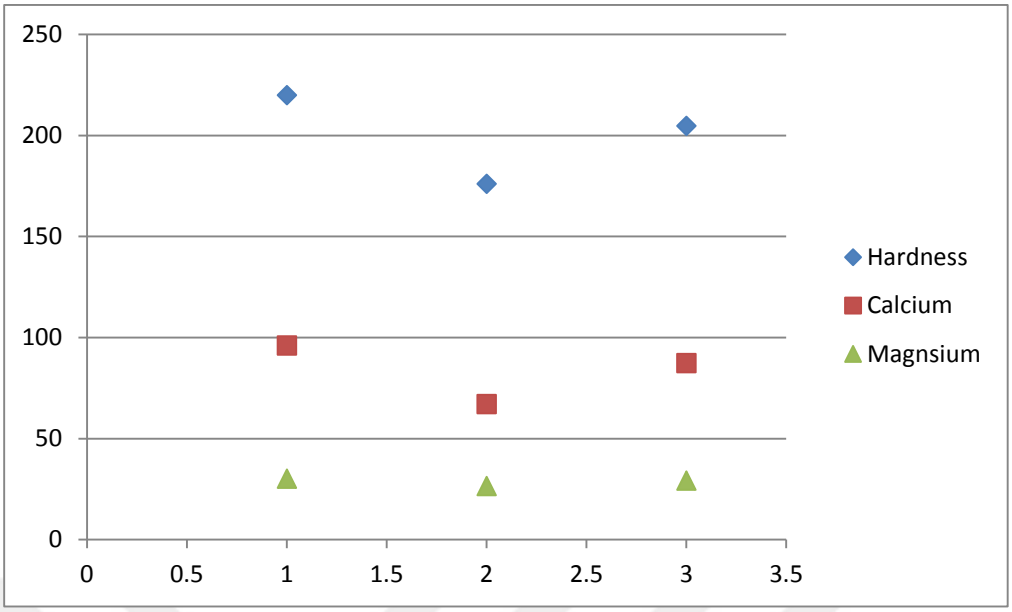

Figure 20. Mean with minimum and maximum of total hardness, calcium, magnesium at 4 stations in Sami Abdurrahman and its tributaries during the studied period

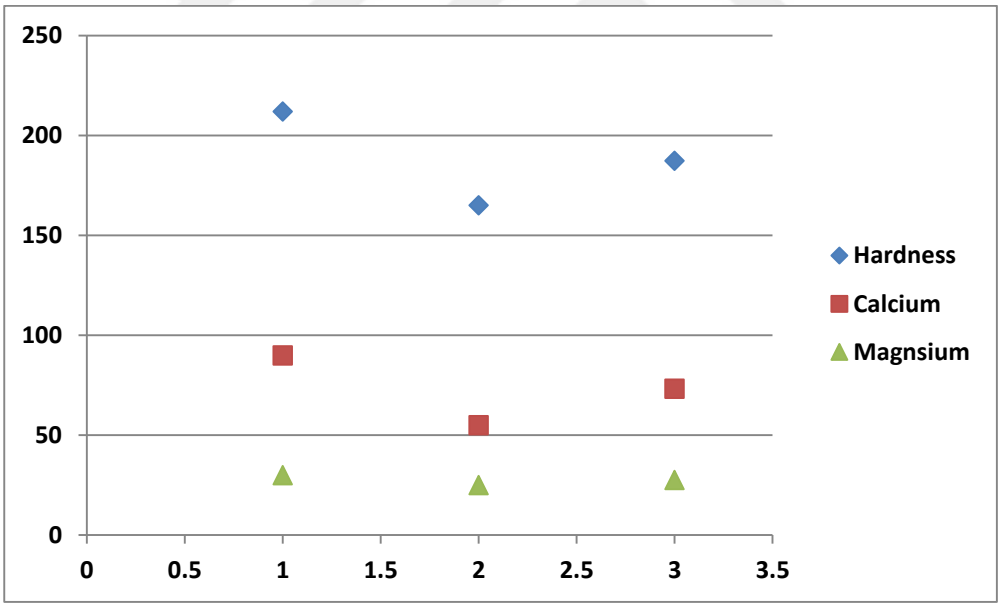

Figure 21. Mean with minimum and maximum of total hardness, calcium, magnesium at 4 stations in Shanadar Park and its tributaries during the studied period

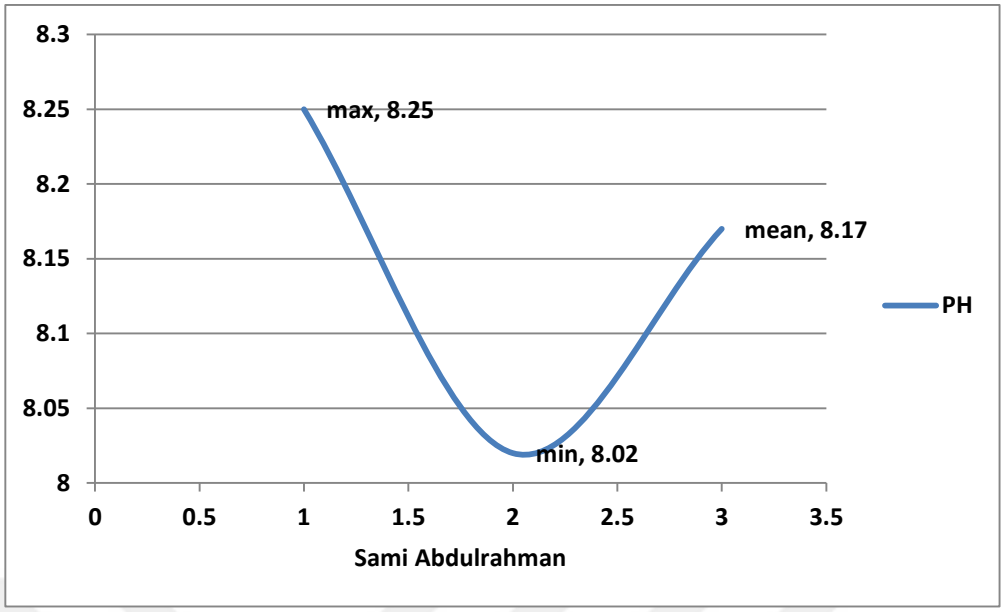

Figure 22. Mean with minimum and maximum pH at 4 stations in Sami Abdurrahman Park and its tributaries during the studied period

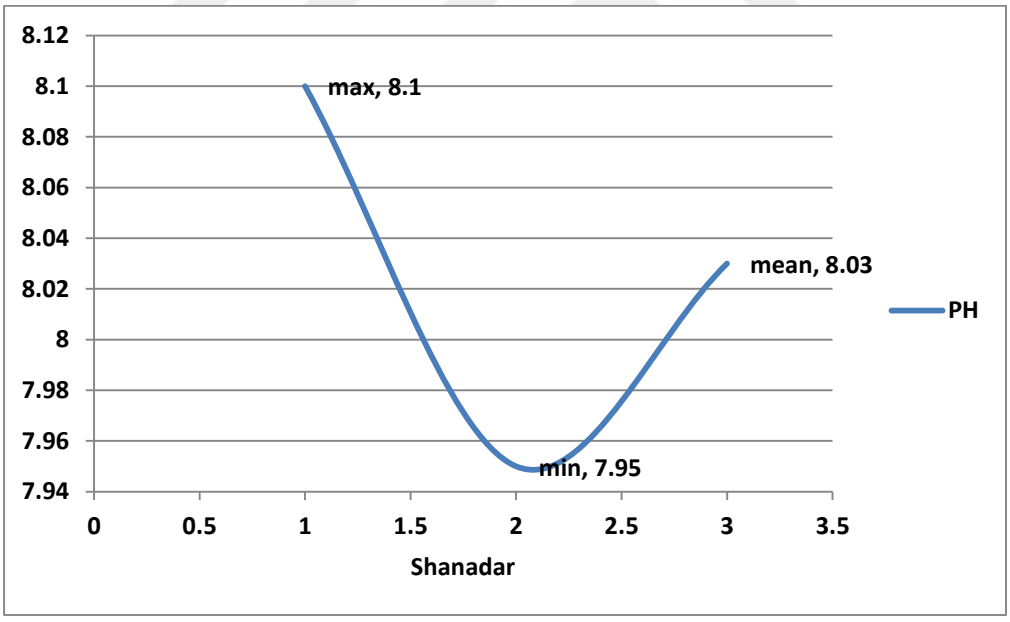

Figure 23. Mean with minimum and maximum pH at 4 stations in Shanadar Park and its tributaries during the studied period

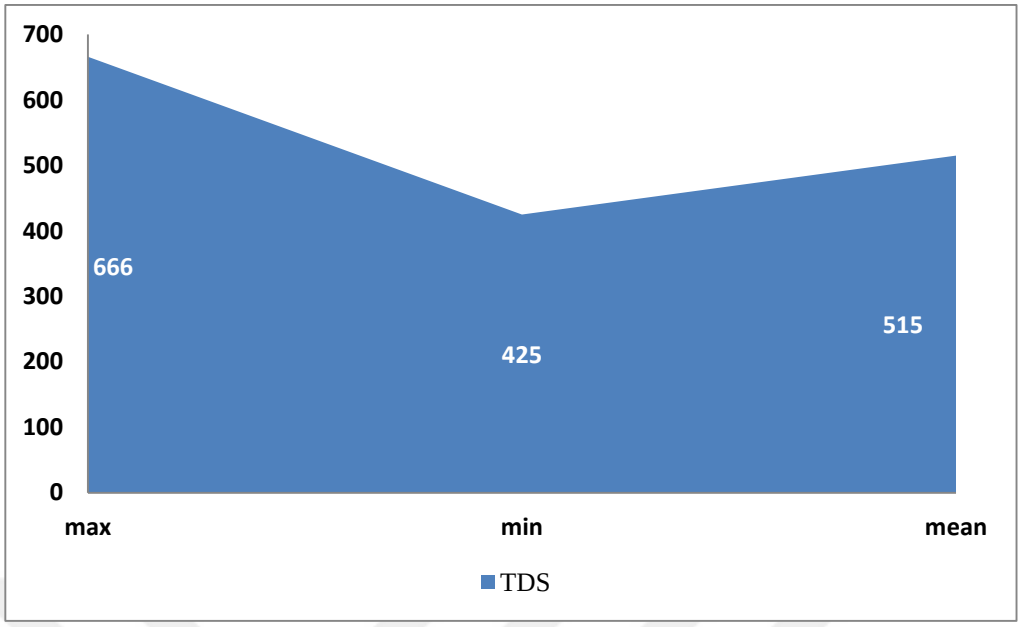

Figure 24. Mean with minimum and maximum total dissolved solid (TDS) at 4 stations in Sami Abdurrahman park and its tributaries during the studied period

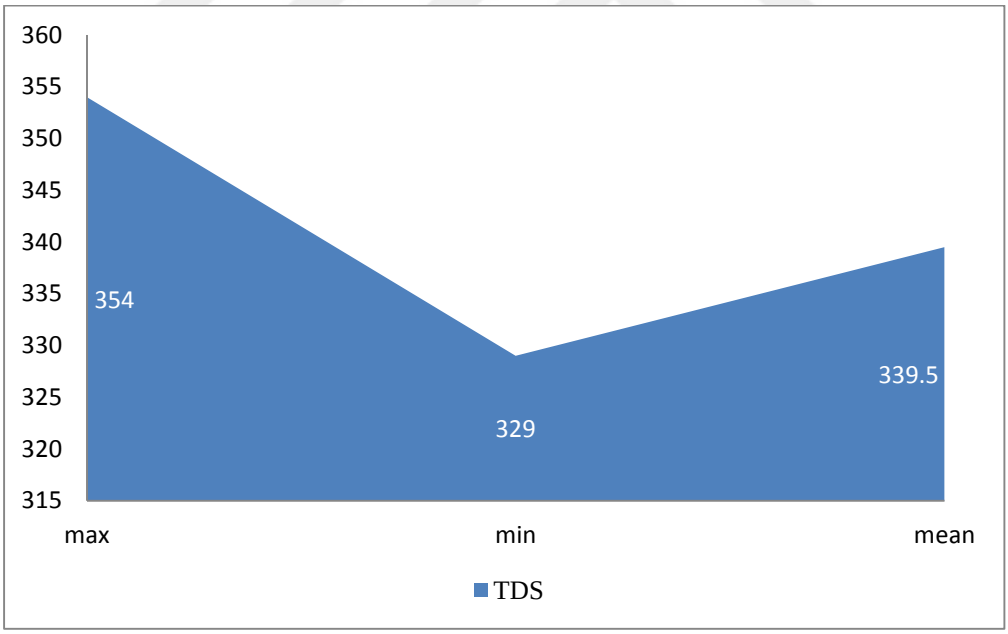

Figure 25. Mean with minimum and maximum total dissolved solid (TDS) at 4 stations in Shanadar park and its tributaries during the studied period

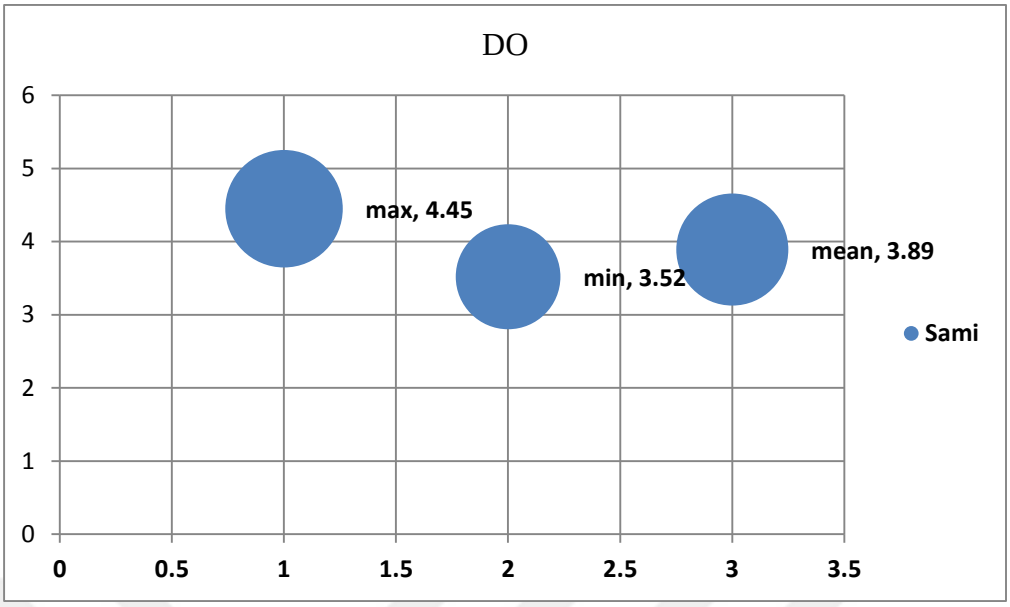

Figure 26. Mean with minimum and maximum dissolved oxygen at 4 stations in Sami Abdurrahman Park and its tributaries during the studied period

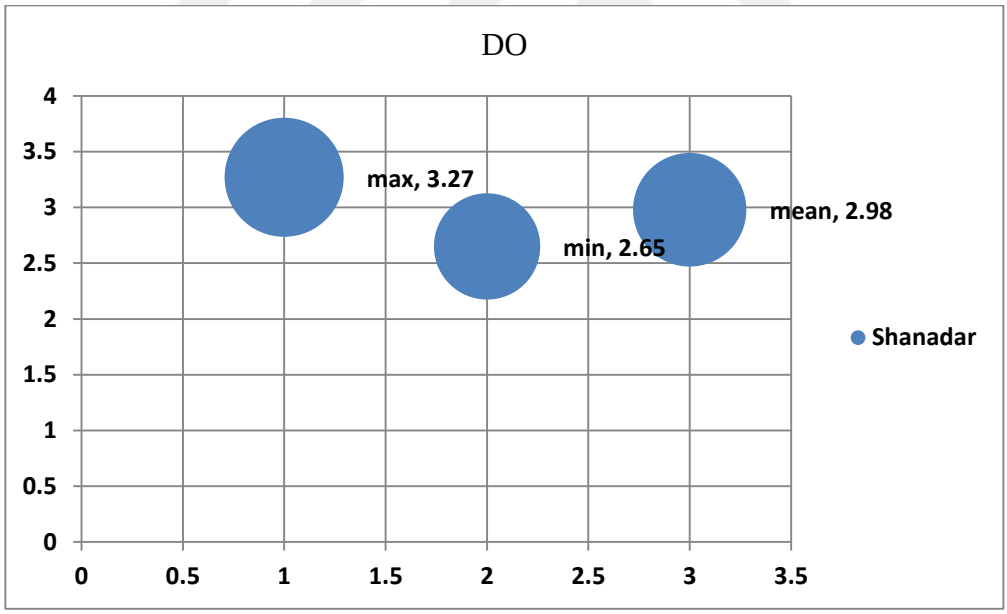

Figure 27. Mean with minimum and maximum pH at 4 stations in Shanadar Park and its tributaries during the studied period

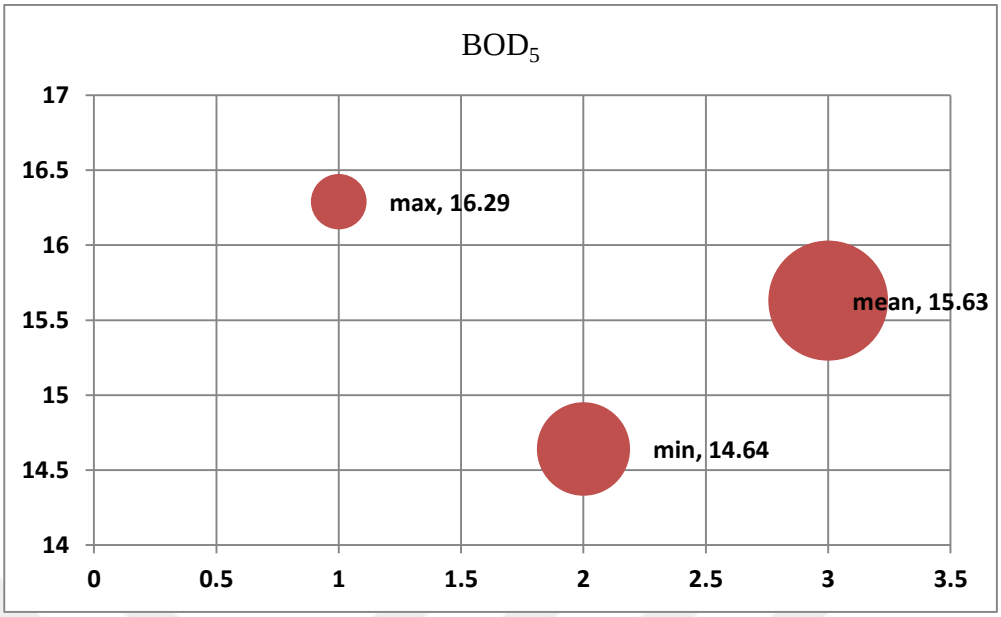

Figure 28. Mean with minimum and maximum biological oxygen demand at 4 stations in Sami Abdurrahman Park and its tributaries during the studied period

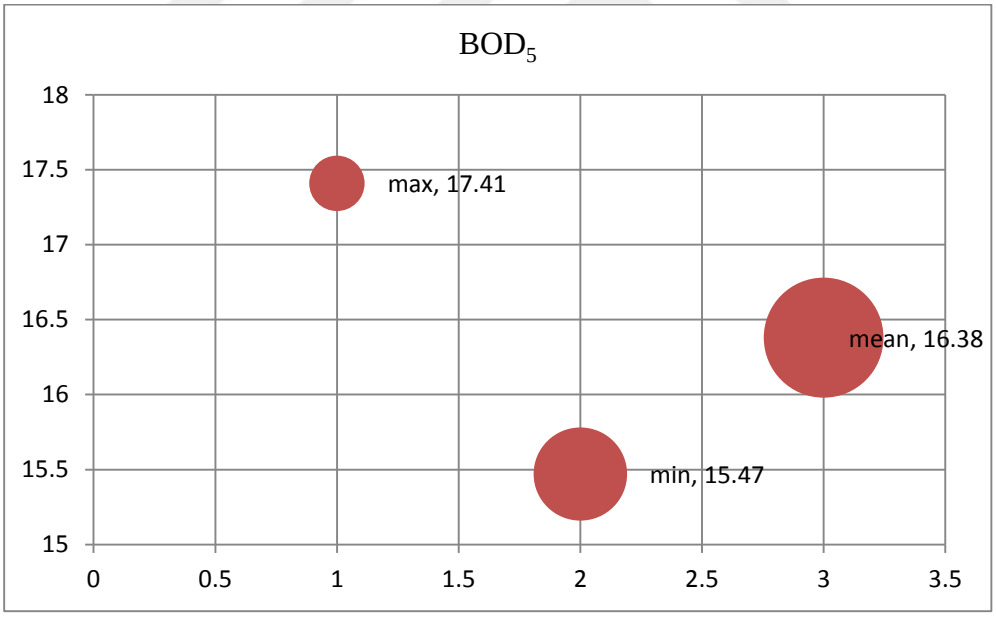

Figure 29. Mean with minimum and maximum biological oxygen demand at 4 stations in Shanadar Park and its tributaries during the studied period

Table 3. The biological results of the 8 sample from the Sami Abdurrahman Park and Shanadar Park during the study period.

Genus and species	St1	St2	St3	St4	St5	St6	St7	St8
Chlamydomonas reinhardtii P.A. Dang.					+			
Chloroccocum infusionum (Schrank) Meneghini 1842		+				+		+
Chlorococcum humicola (Nägeli) Rabenhorst 1868			+				+	
Chroococcus micrococcus (Kuetz) Rabenh.	+							
Chroococcus montanus Hansgirg 1893		+		+				+
Chroococcus turgidus (Kützing) Nägeli 1849			+			+	+	
Cladophora Kutzing1843							+	
Cladophora profunda var. *nordstedtiana* Brand	+		+		+	+		+
Cosmarium bioculatum Berb.		+		+				
Cosmarium leave Rabenh	+				+			
Cymbella cistula (Ehrenberg) O. Kirchner 1878		+				+		+
Cymbella minuta Rabenhorst, L. 1862			+		+	+		
Euglena acusvarrigida Huebner				+			+	
Euglena deses Her.			+					+
Euglena geniculate Dujardin 1841		+				+		
Euglena gracilis Klebs 1883				+			+	+
Euglena spirogyra Ehrenberg			+					
Euglena texta (Dujardin) Hübner 1886				+				
Gloeotrichia sp.					+		+	
Lyngbya aesturii after Komarck1956						+		+
Lyngbya limneticalemm		+					+	
Oscillatoria accutissima Kufferath	+				+			
Oscillatoria anagustissma West G.S.W			+					+
Oscillatoria chlorina (Fremy) Kuetz.		+						
Oscillatoria irrique (Hhr.) Gomont						+	+	
Oscillatoria limosa (Ag.) Gomont.		+			+			
Oscillatoria minnesotensis Tilden	+							
Phormidium lucidum Kutzing						+		+
Phormidium standleyi Drouet			+				+	
Phormidium willei after Komarek	+				+			
Spirogyra maneramae Rand, 1938						+		
Spirogyra porticalis (O.F.Müller) Dumortier 1822					+		+	
Spirogyra pseudoreticulate Krieger 1944							+	+
Synedra ulna (Nitzsch) Ehrenberg 1832	+						+	
Total	7	8	8	5	9	8	12	10

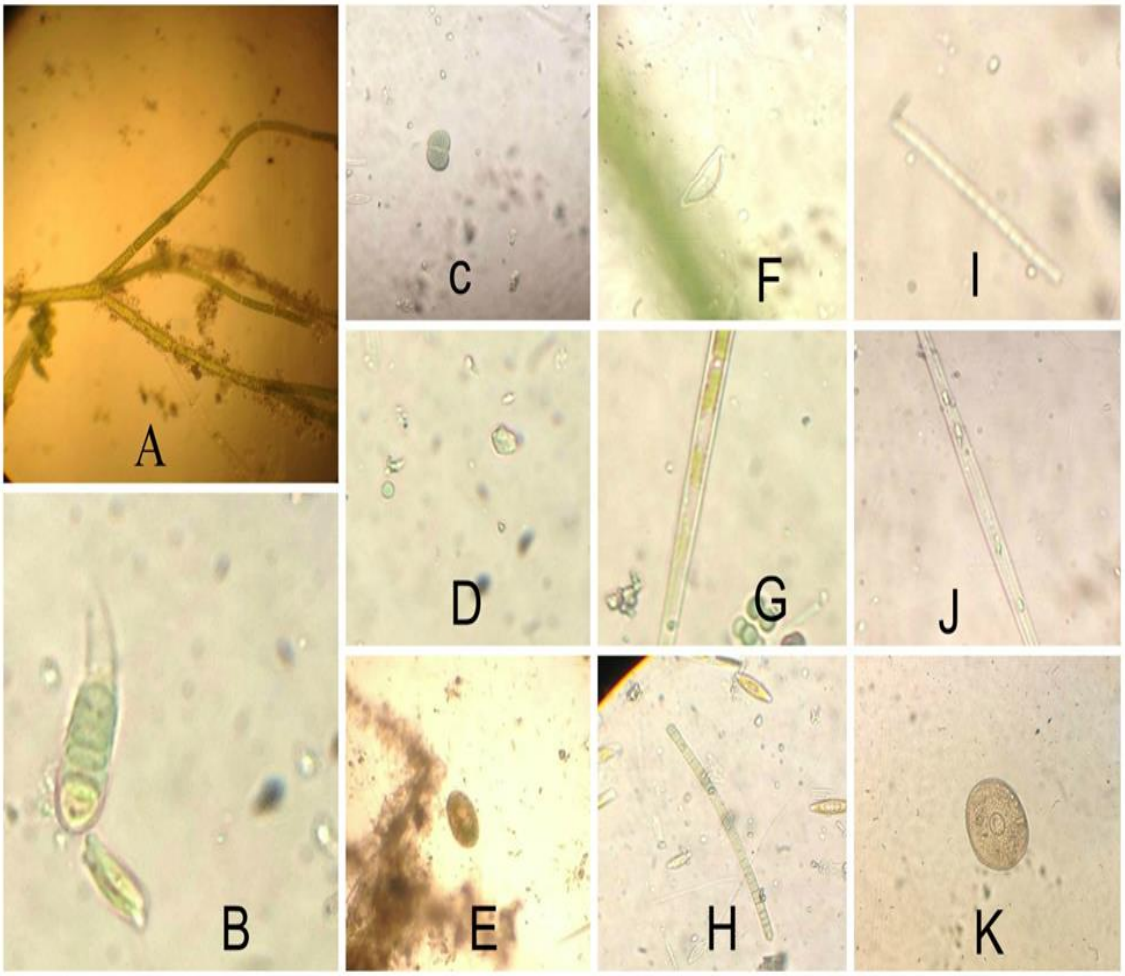

Figure 30. Identification of some algae during the study period of Sami- Abdurrahman Park and Shanadar Park.

A= Cladophora sp. B= Gloeotrichia sp. C= Chroococcus sp. D= Chlamydomonas sp. E=Euglena sp. F=Cymbella sp. G=Lyngbya sp. H= Osillatoria sp. I=Phormidium sp. J=Synedra sp. K=Chloroccocum sp.

Table 4. The total number of algal species with their percentage (%) from the total recorded during the study period.

Genera	No. of species	Percentage %
Chlamydomonas	One	2.94
Chloroccocum	Two	5.88
Chroococcus	Three	8.82
Cladophora	Two	5.88
Cosmarium	Two	5.88
Cymbella	Two	5.88
Euglena	Six	17.64
Gloeotrichia	One	2.94
Lyngbya	Two	5.88
Oscillatoria	Six	17.64
Phormidium	Three	8.82
Spirogyra	Three	8.82
Synedra	One	2.94
Total	Thirty four	100%

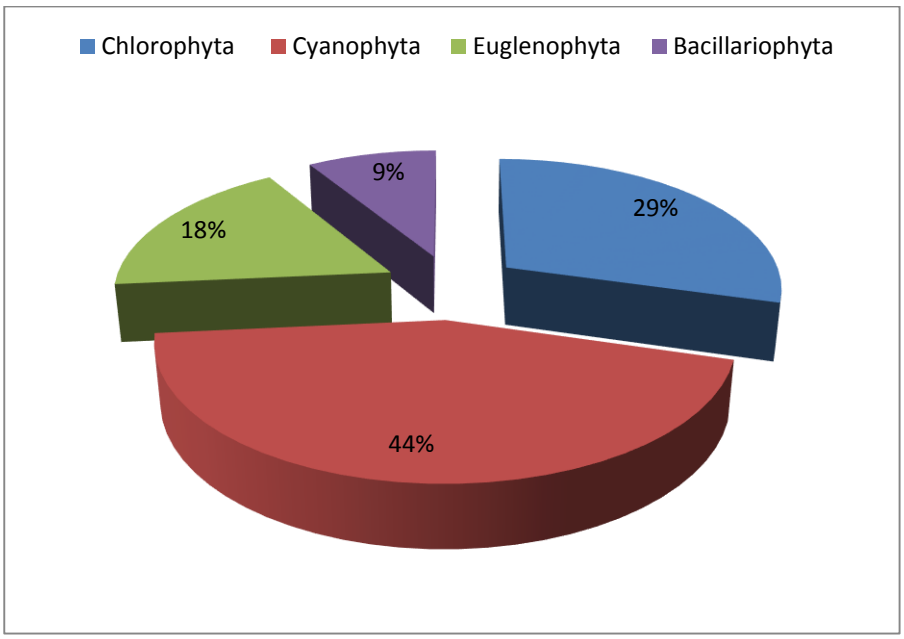

Figure 31. The algal composition during the study period in both parks Sami Abdurrahman and Shanadar.

Table 5. Recorded algal species with habitats during the study period

Lists of Taxa	Habitat / Phyto	Habitat / epi
Domain: Eukaryota		
Kingdom: Plantae		
Division: Chlorophyta		
Class: Chlorophyceae		
Order: Chlamydomonadales		
Family: Chlamydomonadaceae		
Chlamydomonas reinhardtii		
Order: Chlorococcales		
Family: Chlorococcaceae		
Chloroccocum infusionum	+	
Chloroccocum humicola	+	
Division: Chlorophyta		
Class: Zygnematophyceae		
Order: Zygnematales		
Family: Zygnemataceae		
Spirogyra maneramae Rand, 1938	+	
Spirogyra porticalis	+	+
Spirogyra pseudoreticulate Krieger 1944		+
Order: Desmidiales		
Family: Desmidiaceae		
Cosmarium bioculatum Berb.		+
Cosmarium leave Rabenh	+	
Order: Chladophorales		
Family: Cladophoraceae		
Cladophora kutzing	+	
Cladophora profunda var. *nordstedtiana* Brand	+	
Domain: Eukaryota		
Kingdom Protozoa		
Division :Euglenophyta		
Class: Euglenophyceae		
Order: Euglenales		
Family: Euglenaceae		
Euglena acusvarrigida Huebner	+	+
Euglena deses Her	+	+
Euglena geniculate		+
Euglena gracilis		+
Euglena spirogyra Ehrenberg	+	+
Euglena texta		+
Domain: Prokaryota		
Kingdom: Eubacteria		
Division: Cyanobacteria		
Class:Cyanophyceae		
Order: Chroococcales		
Family: Chroococcaceae		

Chroococcus micrococcus (Kuetz) Rabenh.		
Chroococcus montanus.	+	
Chroococcus turgidus.	+	
Order: Oscillatoriales		
Family: Oscillatoriaceae		
Oscillatoria accutissima Kufferath	+	+
Oscillatoria anagustissma west G.S.W	+	
Oscillatoria chlorina (Fremy) kuetz.		+
Oscillatoria irrique (Hhr) Gomont	+	
Oscillatoria limosa (Ag.) Gomont.	+	
Oscillatoria minnesotensis Tilden	+	
Lyngbya aesturii after Komarck 1956		+
Lyngbya limneticalemm	+	
Gloeotrichia sp.	+	
Family: Phormidiaceae		
Sub phylum: Formidioidea		
Phormidium lucidum Kutzing		+
Phormidium standleyi Drouet		+
Phormidium willei after Komarek	+	
Domain: Eukaryota		
Kingdom: Chromista		
Phylum: Bacillariophyta		
Subphylum: Bacillariophytina		
Class: Bacillariophyceae		
Subclass: Bacillariophycidae		
Order: Cymbellales		
Family: Cymbellaceae		
Cymbella cistula	+	
Cymbella minuta	+	
Subclass: Fragilariophycidae		
Order: Fragilariales		
Family: Fragilariaceae		
Synedra ulna	+	

5. DISCUSSION

5.1. Physical and Aggregate Properties

5.1.1. Air Temperature

In the present study, the air temperature results ranged from 17-21 ^{0}C in Sami Abdurrahman Park and Shanadar Park with Erbil province. On the other hand, the overall mean of air temperature for the studied stations was 19^{0}C calculated during the period of the study.Air temperature results indicate that the area is characterized by winter season. Guest (1966) stated that the area characterized by cold and snowy winters and warm dry summers. While it exceeds the minimum and maximum air temperature reported by Bilbas (2004), he found a fluctuation ranged from 10-22.5ºC in Erbil province.

5.1.2. Water Temperature

Water temperature records for eight stations in both parks Sami Abdurrahman and Shanadar were ranged 11-16 ºC. On the other hand, the overall mean of water temperature for the studied stations was 13.87 ºC calculated during the period of the study. Pradhanang (2012)Surface water temperature has great influence on aquatic environment; Temperature is known to influence the pH and alkalinity as well.

5.1.3. Electrical Conductivity – EC

Conductivity is the capability of a solution to conduct an electric current. It is not only attached on the concentration of dissociated salts and dissolved gases (Pelkie et al, 1992). But also on colloidal suspension, it is expressed as microsiemen per centimeter (µS/cm). It was ranged from 295-1370µS/cm. Generally, electrical conductivity values were higher in Sami Abdurrahman than Shanadar Park. On the other hand, the overall mean of electrical conductivity for the studied stations was 487.25µS/cm calculated during the

period of the study. Conductivity in water is normally controlled by the geology of the area through which the water flows. The conductivity of the most fresh water ranges from 10 to 1000 (μS/cm) but exceed 1,000 (μS/cm) especially in polluted water (WHO 1996).5.1.4. Turbidity (NTU)

Turbidity is measured by quantifying the degree of light traveling through a water column is scattered by the inorganic particles and suspended organic (including algae), the scattered of light increases with a greater suspended load (Bilbas2014).

The turbidity values (NTU) recorded on Sami Abdurrahman and Shanadar Park ranged from 7-11 NTU. High levels of turbidity were observed in Sami Abdurrahman Park at station three near monument of 1- Shubat, whereas low values were recorded in station five near gallery of Shanadar in Shanadar Park.

5.1.5. Total Alkalinity (mg CaCO3 l-1)

Alkalinity of water is acid-neutralizing ability. It is the sum of all the treatable bases. The measured value may vary significantly with the end-point pH used. Alkalinity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known. Alkalinity is significant in many uses and treatments of natural waters and wastewaters. Because the alkalinity of many surface waters is primarily a function of carbonate, bicarbonate, and hydroxide content, it is taken as an indication of the concentration of these constituents. The measured values also may include contributions from borates, phosphates, silicates, or other bases if these are present. Alkalinity in excess of alkaline earth metal concentrations is significant in determining the suitability of water for irrigation. Alkalinity measurements are used in the interpretation and control of water and wastewater treatment processes (AHPA 2012). It was ranged between 196- 390 mg $CaCO_3$ l^{-1} during the study period. On the other hand, total alkalinity concentrations were decreased at Shanadar Park stations compared to Sami Abdurrahman Park stations.

5.1.6. Total Acidity (mg $CaCO_3$ l^{-1})

Acidity is the name given to quantitative ability to react with a strong base to a determined pH. The scaled value may vary significantly with the end-point pH used in the

designation. Acidity is a scale of an aggregate property of water and can be explicated in terms of specific substances only when the chemicals composition of the sample is kwon Strong mineral acids, weak acids such as carbonic (H_2CO_3) and acetic (CH_3COOH), and hydrolyzing salts such as iron and aluminum sulfates may contribute to the measured acidity according to the method if determination (AHPA 2012).Regarding the both park water body tributaries, total acidity levels were ranged from 15.62- 19.21mg CaCO3 l^{-1}.

5.1.7. Total Hardness (mg $CaCO_3$ l^{-1})

The hardness of water is defined in terms of its content of calcium and magnesium ions. Hardness in water is caused by the presence of a variety of certain dissolved polyvalent metallic ions in solution in water - predominantly calcium and magnesium, although other ions for example, aluminum, barium, iron, manganese, strontium, and zinc, also contribute. The source of the metallic ions are typically sedimentary rocks, and the most common are limestone ($CaCO_3$) and dolomite Ca, $Mg(CO_3)_2$, the determination of water hardness is a useful test that provides a measure of quality of water for households and industrial uses (Roxas and Salgados, 2014). The total harness concentrations in Sami Abdurrahman Park and Shanadar Park showed higher levels and lowest levels were noted 165- 220 mg $CaCO_3$ l^{-1}. On the other hand compared with standard total hardness scales the water of both parks were hard and very hard waters according to the 8 stations during the study period.

5.1.8. Calcium Ion Ca^{2+}

The average abundance of Calcium Ca^{2+}in the earth's crust is 4.9%; in soils it is 0.07 to 1.7% and in surface water it is about 15 mg/l. The most common forms of calcium are calcium carbonate (calcite) and calcium magnesium carbonate (dolomite). Hardness is based on the concentration of calcium and magnesium salts, and often is used as a measure of potable water quality. Calcium is necessary in plant and animal nutrition and is an essential component of bones, shells, and plant structures. The presence of calcium in water supplies results from passage over deposits of limestone, dolomite, gypsum, and gypsiferous shale (APHA 2012, Bilbas 2014). In the present study, the concentration of

calcium Ca^{2+} ion ranged from 55 to 96 mgl^{-1}, during the study period in Sami Abdurrahman Park and Shanadar Park.

5.1.9. Magnesium Ion Mg^{2+}

The average abundance of Mg^{2+}in the earth's crust is 2.1%; in soils it is 0.03 to 0.84% and in surface waters it is 4 mg l^{-1}. Magnesium is an essential element in chlorophyll (APHA 2012, Bilbas 2014). In the present study, Magnesium ion concentration ranged from 25 to 30.13 mg l^{-1} in both parks and its tributaries. The overall mean of Magnesium ion for the studied stations were 28.41mg l^{-1} calculated during the period of the study.

5.2. Inorganic Constituent Properties

5.2.1. Hydrogen Ion Concentration – pH

pH is a numeric scale used to specify the acidity or basicity (alkalinity) of an aqueous solution Bates (1973).pH of natural water bodies varies around 7, generally more than 7 (alkaline) due to presence of carbonate. pH increases during day time due to photosynthesis whereas decreases at night time due to respiration activity but it also depends upon many factors like air, temperature, disposal of industrial waste (APHA, 2012). The results of hydrogen ion concentration–pH revealed that the pH values between 8-8.8 during the period of the study. The overall mean of hydrogen ion concentration–pH for the studied stations was 8.3 calculated in 8 stations during the study period.

5.2.2. Total Dissolved Solid

TDS meaning for total dissolved solids, and represents the total concentration of dissolved substances in water. TDS is a measure of combined content of inorganic salts, as well as a small amount of organic matter. That can be found Common inorganic salts in water include calcium, magnesium, potassium and sodium, which are all cations, and carbonates, nitrates, bicarbonates, chlorides and sulfates, which are all anions. Cations are positively charged ions and anions are negatively charged ions (Health Canada 2007). A high concentration of dissolved solids is usually not a health hazard. In fact, many people buy mineral water, which has naturally elevated levels of dissolved solids. Environmental

Protection Agency (EPA)in United States, which is responsible for drinking water rules in the United States, includes TDS as a secondary standard, meaning that it is a voluntary guideline in the United States. While the United States set legal standards for many damaging substances, TDS, along with other contaminants that cause aesthetic, cosmetic and technical effects, has only a guideline (EPA 1992). The results of total dissolved solid ranged was noted between 329- 666 on the other hand this results compared to the environmental protection agency for standards the results in both park were good and fair.

5.2.3. Dissolved Oxygen

The amount of dissolved oxygen (DO) concentration in water points to the degree of organic pollution. Oxygen content is essential to all forms of aquatic life. The higher water temperature, the lower the solubility of oxygen gas in water vice versa (Pradhan 1998). Dissolved oxygen fluctuated from 2.61-4.45 mg l^{-1} during the period of the study. The overall mean of Magnesium ion for the studied stations were 3.43 mg 1^{-1} of 8 sits in Sami Abdurrahman and Shanadar Park.

5.3. Organic Constituent Properties

6.3.1. Biochemical Oxygen Demand for Five Days –BOD_5

Biological Oxygen Demand for five days (BOD_5) defined as the amount of oxygen required by bacteria while stabilizing decomposable organic matter under aerobic conditions within 5 days (Sawyer and McCarty 1978). Biochemical oxygen demand results in Sami Abdurrahman Park and Shanadar Park tributaries ranged 14.64- 17.41 mg l-1.The overall mean of Dissolved oxygen for the studied stations were 3.43 mg 1^{-1} during the period of the study.

5.4. Biological Analyses

5.4.1. Algal Species Composition

The study of the phytoplankton in both parks Sami Abdurrahman and Shanadar Park the algal samples were fresh photo were taken when even it need with microscope camera

model (Olympus PM-b, Japan)Non-diatom algal forms were identified the genera and taxa depending on the following references;Wolle (1884), West (1904), Smith (1950), Desikachary (1959), Prescott (1968 and 1975), Lind and Brook, (1980), Bold and Whyne (1985),. with tributaries revealed that we identified 34 algal taxa: (*Chlamydomonas reinhardtii*, *Chloroccocum infusionum*, *Chlorococcum humicola*, *Chroococcus micrococcus* (Kuetz) Rabenh, *Chroococcus montanus*, *Chroococcus turgidus*, *Cladophora kutzing*, *Cladophora profunda* var. *nordstedtiana* Brand, *Cosmarium bioculatum* Berb., *Cosmarium leave* Rabenh, *Cymbella cistula*, *Cymbella minuta*, *Euglena acusvarrigida* Huebner, *Euglena deses* Her., *Euglena geniculate*, *Euglena gracilis*, *Euglena spirogyra* Ehrenberg, *Euglena texta*, *Gloeotrichia* sp., *Lyngbya aesturii* after Komarck1956, *Lyngbya limneticalemm*, *Oscillatoria accutissima* Kufferath, *Oscillatoria anagustissma* West G.S.W, *Oscillatoria chlorina* (Fremy) Kuetz, *Oscillatoria irrique* (Hhr.) *Gomont, Oscillatoria limosa* (Ag.) Gomont., *Oscillatoria minnesotensis* Tilden, *Phormidium lucidum* Kutzing, *Phormidium standleyi* Drouet, *Phormidium willei* after Komarek, *Spirogyra maneramae* Rand, 1938, *Spirogyra porticalis*, *Spirogyra pseudoreticulate* Krieger 1944, *Synedra ulna* on the other hand, they are divided by 4 Division of (Chlorophyta, Cyanophyta, Euglenophyta, Bacillariphyta).

5.4.2. Algal Properties

During the period of the study area we identified 34 algal taxa they are divided by four divisions;

5.4.2.1. Cyanophyta

The member of the Cyanophyta is commonly known as Blue green algae, the names Cyanobacteria because of characteristics similarities with bacteria. The cell is prokaryotic and algae should be eukaryotic (Allaby M. ed. 1992). Cyanobacteria can be found in almost every fresh water, terrestrial and some are marine also some of them on rock, in plant body, on salty water and in symbiotic association for example lichens (Stewart and Falconer 2008). Economic aspects of the Cyanophyta theses algae, together with other algae, are ingested by fish. Those blue green algae that live and die in the soil serve ultimately to enrich the organic component of the soil and thus to increase soil fertility, on the other hand, peculiar taste of reservoir water may by some times ascribed to the

contamination of the water with these algal organisms (William and Richard 1968). We identified 15 algal taxa belong two order and Cyanophyceae class, The composition of the Cyanophyta 44% during the period of the study in both park Sami Abdurrahman and Shanadar.

5.4.2.2. Chlorophyta

The members of Chlorophyta are commonly known as green algae. Majority of the members are fresh water, marine, lake, most soils and walls, Have chlorophylls "*a"*and"*b"*, and form starch with the chloroplast, usually in association with a pyrenoid. The Chlorophyta thus differ from the rest of the eukaryotic algae in forming the storage product in the chloroplast instead of in the cytoplasm. No chloroplast endoplasmic reticulum occurs around the chloroplast, cell wall is mainly composed of cellulose, another important feature of this group is the occurrence of motile stages in the life cycle flagella are mostly of isokontae type, the organization of the thallus varies widely it ranges from unicellular,multicellular colonial (Robert 2008). Economic importance of green algae constitutes the ultimate source of food for both fresh water and marine animal life. They serve to keep the water saturated with oxygen, which in turn plays so important a part in respiration of aquatic animal life (William and Richard 1968). We identified 10 algal taxa belong Chlorophyceae class, The composition of Chlorophyta 29% during the period of the study in both park Sami Abdurrahman and Shanadar.

5.4.2.3. Euglenophyta

Members of the division Eulgenophyta are called Euglenoids. They are fresh water habitats; puddles, ditches, ponds, streams, lakes, and rivers, particularly waters contaminated by animal pollution or decaying organic matter, Euglenoids are characterized by chlorophylls "a" and "b", one membrane of chloroplast endoplasmic reticulum, a mesokaryotic nucleus, flagella with fibrillar hairs in one row, no sexual reproduction, and Paramylon or Chrysolaminarin as the storage roduct in the cytoplasm (Robert 2008). We identified 6 algal taxa belong Euglenales order and Euglenophyceae class , the composition of Euglenophyta 18% during the period of the study area in both parks Sami Abdurrahman and Shanadar.

5.4.2.4. Bacillariophyta

The members are commonly known as a diatom. It is a group of algae and is among the most common types of phytoplankton. Organisms are unicellular, the thallus mostly occurs singly or cells may be united in colonies then the diatom cell is known as frustule (Grethe et al 1990). Diatoms are perhaps the most important photosynthetic mechanisms in the floating plankton of the sea and thus contribute in very great measure to the pelagic pasture on which feeds marine life, large and small similarly the diatoms in the neritic plankton sustain the breeding of fish in the shallower waters along the cost, the vitamin A that occurs in cod liver oil and when diatoms die, their siliceous valves sink to the bottom of the body of water in which they are contained, here over long periods of time these siliceous skeletons of the diatoms accumulate to form extensive deposits of diatomaceous earth, in Lompoc Valley California and in some lakes of Florida there occur great quantities of diatomaceous earth, the use of which in industry seems to be ever increasing, diatomaceous earth is regularly used as an absorbent for nitroglycerin in the preparation of certain types of dynamitic, it has long been used for its abrasive quality in certain dentifrices and also in the manufacture of many metal polishes, it's also employed in the filtration of oil, and in many sugar refineries it is utilized in the filtering of the sugar syrup, diatomaceous earth has been found to be more resistant to very high temperatures than asbestos and consequently finds wide in the insulation of boilers and blast furnaces (William and Richard,1968) we identified 3 algal taxa belong two orders and Bacillariphayceae class during the period of study, the composition of Bacillariophyta 9% in both parks Sami Abdurrahman and Shanadar.

Conclusions

During the studied period in Sami Abdurrahman Park, Shanadar Park and its tributaries, the following conclusions were noted;

1-Thermally, water temperature never fall below 11 °C and it was circulated during the period of the study.

2-There is a marked generally increase in the values electrical conductivity (EC) and total dissolved solid (TDS) in Sami Abdurrahman Park more than Shanadar Park.

3-In all investigated ponds calcium ion concentration dominated over magnesium ion concentration.

4-Phycologically, a total of 34 algal taxa were identified, but some of algae genera recognized as their ability to tolerate and resist pollution (*Euglena* sp., *Osillatoria* sp. *Chlamydomonas* sp.) which found in water parks have important role in pollution.

5- Classification of water hardness to the present of cation amount in water we can say the degree of hardness between hard and very hard water in both parks during the period of the study.

6- Typical BOD_5 Value for water quality on Sami Abdurrahman and Shanadar Park were poor or pollute poor oxygen with high levels of organic materials and organisms.

7- The water of both parks rich with nutrient and heavy metals because a Cladophora life in these properties of water in spite of that it was found Cladophora especially have the ability to accumulate radioactive material.

Recommendation

More studies and researches are required for;

1- Determination heavy metals in waters, aquatic plants sediments.

2- Studies of food web and food chain of such ponds.

3- Studied of the biological propertied of water on the other hand with chemical and physical.

4- Studies of physical and chemical properties of the soil, and looking for the chloride concentration in studied ponds.

5- Phycologically, a total of 34algal taxa we identified, but some of algae (*Euglena* sp., *Osillatoria* sp. *Chlamydomonas* sp.) which found in water parks have important role in pollution.

6- Identification of algae and their distribution as affected by environmental condition of such ecosystem in the area.

7-More studies are still requiring in both Parks especially the toxicity of aquatic organisms.

REFERENCES

Ahamed, KK., Saha, SB., "Limnlogical studies on Kapti Lake", Final report, Fisheries Research Institute, Riverine Substation, Rangamati, p.36, 1992.

Al-Barzingy, YOM., "Phycological study within Erbil province", M. Sc. Thesis, univ. of Salahaddin-Erbil, Iraq, 1995.

Al-hamid, MI., "Limnological investigation of Dokan Reservoir (Iraq)", Bulletin of the Natural History Research Centre, 7: 91-109, 1976.

Allaby, M., (ed.). "The concise Oxford dictionary of botany", Oxford Univ. Press, New York, 1992.

APHA, "Standard methods for the examination of water and wastewater", (Eugene W. R., Rodger BB., Andrew DE., Lenore SC. Ed. 22th. ed.): American Public Health Association, American Water Works Association, Water Environment Federation, 2012.

Aziz, FH., "A Phycological study with particular reference to Rawanduz River path within Erbil province", Iraq. Ph. D. Thesis. Univ. of Salahaddin, Iraq, 1997.

Aziz, FH., Ganjo, DJA., "Nutrient status and algal flora in the Halgurd (Haasarost) mountain area within Erbil province", Iraq. Zanko Sci J. of DuhokUniv., 5: 1-12, 2002.

Aziz, FH., "Algal assemblages as biological indicators for fresh water quality assessment", Zanco J. of pure and applied Sci. Salahaddin Sci. J. of Duhokuniv, 12:15-20, 2009.

Bapeer, UHK., "Ecological study on the distribution of algae in different aquatic habitats within Erbil province", Iraq. Ph.D. Thesis. Univ. of Salahaddin, Erbil , 2004.

Bartram, J., Balance, R., "Water quality monitoring: a practical guide to the design and implementation of freshwater quality studies and monitoring programmers", United Nations Environment Programmer and the World Health Organization UNEP/WHO: Taylor & Francis, 1996.

Bates, RG., "Determination of pH: theory and practice", New York. 1973.

Bilbas, AHA., "Phycolimnological study on some springs within Erbil province", M.Sc. Thesis. Univ. of Salahaddin, Erbil, 2004.

Bilbas, AHA., "Ecosystem Health Assessment of Dukan Lake, Sulaimani, Kurdistan Region of Iraq",Ph. Dr. Thesis.Univ.of Salahaddin, Erbil, 2014.

Bold, H., Wynne, M.," Introduction to the algae: structure and reproduction", (2nd. ed.): Princeton, New Jersey: Prentice Hall, 1985.

Caldecott, J., "Water: Life in Every Drop", London, UK: Virgin Digital Books Publisher, 2008.

Christopherson, R., "Geosystems: an Introduction to physical geography (in English)", 3rd. Upper Saddle River, NJ, USA. p. 5, 1997.

Desikachary, T., "Cyanophyta", Indian council of agricultural research, monographs on algae. New Delhi, India, 1959.

Desonie, D., "Freshwater Systems and Pollution", New York, USA: Chelsea House, 2008.

Diaz-pardo, E., Vazquez, G., López-López, E., "The phytoplankton community as a bioindicator of health conditions of Atezca Lake, Mexico", Aquatic Ecosystem Health and Management, 3:257-266, 1998.

Edward, GB., David, CS., "Freshwater algae: identification and use as bioindicators" John Wiley & Sons, Ltd., p. 245, 2010.

EPA (Environmental Protection Agency), "Guidelines for exposure assessment", U.S. Washington, DC, 1992.

Farrel, I., "Phytoplankton ecology and limnology of the Salado River (Buenos Aires, Argentina)", Kluwer academic, Belgium, Hydrobiologia, 271: 169-178, 1993.

Fattah, AO, "Phyco-Limnological study on Khabour River", M. Sc. Thesis Univ. of Sulaimanyah, Iraq, 2010.

Firooz, F., Shahzrad, A., "Histopathological evaluation of environmental gill disease (EGD) in the cultured rainbow trout, *Oncorhynchus mykiss*", Pelagia Research Library, European Journal of Experimental Biology, 4: 390-39, 2014.

Friedman, D., Dannenberg, A., Frumkin, H., "Design and public health: working hand-in hand for better built", Environments Arcade Summer, 2013.

Ganjo, DA., "A limnological study on Rawanduz River path within Erbil province", Iraq. Ph. D. Thesis Univ. of Salahaddin, Erbil, 1997.

Ghosh, AK., Pandit, PK., "Ecology and bio-diversity of different wetlands with their production potentially", In. K.K. Vass and M Sinah (eds.) changes prospective of inland fisher's proceedings of the national of the national Seminar. March 16-17, 1997, IFSI, Barrackpore, India, p. 221-227, 1997.

Grethe, RH., Erik, ES., Karen, AS., Karl, T., Carmelo R.,"Identifying Marine Diatoms and Dinoflagellates", Academic Press, p. 7–225.1996.

Guest, E., "Flora of Iraq, Ministry of Agriculture" Baghdad, V. 1, 1966.

Haddad, RH., Smoor, PB., Basho, DY., Sarbaro, SK., AL-Azawi, AL., AL Damerchi, MS., "Groundwater resources of Arbil area", Iarnr Tech. Bull. No. 70. Bagdad, 1974.

Hariston, GN., Fussmann, G., "Lake Ecosystems", New York, USA, P: 1, 2002.

Health Canada Services "Guidelines for Canadian Drinking Water Quality: Chemical and Physical Parameters", 2007.

Ibrahim, AMK., "A study on the algal ecology of springs in Sulaimaniyah province", M.Sc. Thesis. Univ. of Sulaimaniyah, Iraq, 1981.

Kaplan, R., Kaplan, S., "The Experience of Nature: A psychological perspective", Cambridge: Cambridge University Press, 1989.

Khan, MAKP., Srivastava, DN., Singh RK., Tyagi RK., Dwivedi SN., Mehrotra KP., "Significance of ecological parameters in fisheries management of a newly impounder reservoir–Bachhra Reservorir, In; Jhingran", A.G.V.K. Unnithun and A. Ghosh (eds) contributing to the fishers of Inland water open system in India, 1990.

Lind, EM., Brook, AJ., "A key to the commoner desmids of the English Lake District: Freshwater Biological Association", 1980.

Maulood, B., Hinton, G., "An ecological study on SerchinarWater, chemical and physical aspects", Zanco Sci. Jour. Univ. of Sulaimaniya, Iraq.4: 93-11, 1978.

Mustafa, S., Aliya, R., Zarina, A., "Survey of fresh water algae from Karachi, Pakistan" Pak. J. Bot., 41: 861-870, 2009.

Ozbay, H., "Composition and abundance of phytoplankton in relation to physical and chemical variables in the Kars River, Turkey" J. of Environment and Water, 80: 85-92, 2011.

Pelkie, JE., Concannon, JP., Manley, BD., Poling, EB., "Product Distributions in the CO_2, NH_3, H_2O system from liquid conductivity measurements", Ind. Eng. Chem. Res, 31, P: 2209-2215, 1992.

Perez, MC., Maidana, NI., Comas A., "Phytoplankton composition of the Ebro River estuary, Spain", Acta Bot. Coat., 68: 11-27, 2009.

Pradhan, B., "Water quality assessment of the Bagmati River and its tributaries Kathmandu Valley, Nepal", Ph.D. Dissertation, Vienna: Institute of Water Provision, 1998.

Pradhanang, S., "Water quality status of Karra River, hetauda, Nepal", Tri-Chandra Campus, Tribhuvan University, Nepal, p: 11, 2012.

Prescott, GW., "Algae of the western Great Lakes area", W.C Brown Company, 1968.

Prescott, GW., "How to know the Fresh- water algae", W.C Brown Company, 1975.

Rao, VS., "An Ecological study of three fresh water ponds of Hyderabad, India", Hydrobiologia, 38:213-223, 1971.

Rasoul, HB., "Study of algae communities and some environmental parameters in six ponds within guar area" Thesis. M.Sc. Univ. of Salahaddin, Erbil, 2013.

Razzaque, A., Hossain, M., Islam, A., Hossain, M.,Ehshan, M., "Study on phytoplankton population of Haltibeel at Notore, Bangladesh", Bangladesh J. Aquacult., 17:19-23, 1995.

Robert, EL., "Phycology fourth edition", Cambridge University Press, New York, 2008.

Roxas, MD., Salgados, BJ., "Quantitative determination of total hardness in drinking water, by complex metric edta titration", Diliman, Quezon City 1101, Philippines, 2014.

Sabater, S., "Phytoplankton composition in amedium-sized Mediterranean River: the Ter (Spain)", Limnetics, 6: 47-56, 1990.

Sahin, B., "Epipelic and Epilithic Algae of Dagbasi Lake (Rize,Turkey)", Turk J. Bot., 25: 187-194, 2011.

Sawyer, C., McCarty, P, "Chemistry for environmental engineers (3^{rd}ed)", McGraw Hill Book Company, New York, p: 532, 1978.

Smith, G.M, "The Freshwater algae of United States", McGraw, Hill Book Com. London, U.K., 1950.

Sohrabipour, J., Nejadsatari, T., Assadi, M., Rebei, R., "The marine algae of the Southern coast of Iran, Persian Gulf, Lengeh, area Iran", Tehran. J. Bot., 10:83-93, 2004.

Stevenson, J., "Ecological assessments with algae: a review and synthesis", Journal of Phycology published by Wiley Periodicals, Inc. on behalf of Phycological Society of America. J. Phyco., 50: 437-461, 2014.

Stewart, I., Falconer, IR., "Cyanobacteria and cyanobacterial toxins", Academic Press, P 271–296, 2008.

Tafas, T., Amilli, AE., "Limnological survey of the warm monomictic Lake Trichonis (central western Greece)", Kluwer academic, Belgium.Hydrobiologia, 344: 141-153, 1997.

Toma, J., "Limnological study of Dokan Lake", Kurdistan region of Iraq. Thesis. M.Sc. Univ. of Salahaddin, Erbil, 2000.

Toma, J., "Physical and chemical properties and algal composition of Derbendikhan Lake, Sulaimania, Iraq", Current World Environment, 6: 17-27, 2011.

Tryfon, E., Giovani, N., "Plankticcyanophytes and their ecology in the shallow Lake Mikri Prespa, Greece", Nordic Journal of Botany, 17, p: 439–448, 1997.

Vreugdenhil, D., Terborgh, J., Cleef, AM., Sinitsyn, M., Boere, GD., Archaga, VL., Prins, HHT., "Comprehensive Protected Areas System Composition and Monitoring", WICE, USA, Shepherdstown, P: 106, 2003.

West, GS., "A treatise on the British freshwater algae", Cambridge, Univ. press: University Press.1904.

WHO, "Guidelines for drinking- water quality", (3rded. Vol. 1, recommendations): World Health Organization, 2008.

WHO, "Guidelines for Drinking-Water Quality", Health Criteria and Other Supporting Information (2nd Ed. Vol. 2): World Health Organization, Geneva, 1996.

William, T., Richard, J., "General Biology", East-West Press, New Delhi, p. 835, 1968.

Wolle, F., "Desmids of the United States and list of American Pedi strums, with eleven hundred illustrations on fifty-three colored plates", xiv + 154 pp. 53 PIs. Bethlehem, Pennsylvania, 1884.

CURRICULUM VITAE

I was born in Erbil on the 17th of December 1991 but I am from Kirkuk, Primary and secondary school in Erbil. In 2010 I began undergraduate education at Salahaddin University College of education department of biology and graduated in 2014. In 2014 I registered for one year at Cyprus International University institute of graduate studies and research, environmental sciences department to continue my masters studying in 2015 I registered at Bingol University, institute of Biology department, the graduate program.